DAU xAPI Content Module Analysis

Version 1.0

Contributors: Rob Chadwick, Tom Creighton, Jason Haag, Jonathan Potrack

20 August 2019

DAU Content Module Analysis

1. Overview

1.1. Introduction

The ADL Initiative's Total Learning Architecture (TLA) Sandbox project identified the need for technical consulting, hosting, and implementation support from USALearning. This support included a task for Experience API (xAPI) consulting and conversion of SCORM content. The ADL Initiative identified Defense Acquisition University's (DAU's) FPD420 Reviewer Training Course as the best candidate for this task.

The FPD420 Reviewer Training Course xAPI content module was authored in the Composica course authoring tool. It's DAU's tool of choice for HTML5 responsive design and was used to create a vast majority of DAU's SCORM courses. DAU requested support from ADL to evaluate Composica's current level of xAPI support upon authoring and exporting a course. Previous DAU testing and evaluation of xAPI support from Composica minimally revealed that the exported content could simply send data (xAPI statements) to a Learning Record Store (LRS). No prior in-depth analysis was conducted on whether the xAPI implementation worked correctly or produced useful xAPI statements.

1.2. Scope

DAU leadership is currently interested in exploring what enhancements could be made to their Composica-based xAPI exports to better support data-driven learning and performance analytics. DAU leadership is also interested in understanding what other considerations or requirements should be further investigated in converting SCORM content to xAPI. The scope of this report is to provide configuration & launch instructions and recommendations for improving the quality of the xAPI implementation based on the results of analyzing the xAPI statements for the FPD420 Reviewer Training Course. The report will also provide some general considerations for converting SCORM content to xAPI for future DAU research efforts.

2.   Tasks

2.1 DAU xAPI Content Module Software Updates

The FPD420 Reviewer Training Course was exported from Composica and provided to USALearning for analysis. The course was examined and tested in order to understand how it should be configured to work with any xAPI conformant LRS. The purpose of this task was to identify and document instructions for any current xAPI configuration and launch requirements, as well as provide improvements or software updates so that DAU could enable these capabilities for future xAPI authoring and export efforts.

2.1.1 Configuration

The FPD420 Reviewer Training Course requires xAPI configuration details via a launch mechanism in order to report xAPI data to the LRS. This includes the following:

- **endpoint** - The endpoint URL to the LRS's xAPI (e.g. https://lrs.adlnet.gov/xAPI/)
- **auth** - The value of the authorization header used for access to the xAPI endpoint (e.g. Basic dG9tOjEyMzQ=)
- **actor** - The JSON representation of the actor that is currently taking the course (e.g. {"mbox": "mailto: tom@example.com"})
- **activity_id** - The URI of the activity representing this course (e.g. http://xapi.composica.com/activity/course/3dd6134f-e922-45b4-a741-3a461aa480d7)
- [optional] **activity_platform** - The platform on which the course was run (e.g. 'Moodle')
- [optional] **registration** - A UUID that can be used to represent a unique registration ID on statements related to that session/registration (e.g. 760e3480-ba55-4991-94b0-01820dbd23a2)
- [optional] **grouping** - The URI of an activity that is considered a parent or encompasses the current activity (e.g. http://xapi.composica.com/activity/course/)

When the course is provided with these values, the xAPI statements will contain the initialized values and the course has the location and authorization information required to track interactions with the course to an LRS.

2.1.2 Instrumentation & Usage

Rustici Launch
The xAPI tracking for the FPD420 Reviewer Training Course was instrumented using the Rustici TinCan wrapper. It automatically supports the Rustici Launch mechanism - obtaining the configuration information from the URL search query parameters. As such, the course can be launched and activated by any system, LRS, LCMS, LMS, that uses this process.

The FPD420 Reviewer Training Course also follows the Rustici Launch packaging guidelines. When unzipped/extracted, the course includes a tincan.xml file at the root of the package. Similar in purpose of the imsmanifest.xml found in SCORM packages, this file contains information about the course and how the system receiving the course should launch and run the content. Any system that supports Rustici Launch's packaging will be able to import and run this content based on that tincan.xml file.

Manual Creation of Query Parameters
Since the Rustici Launch mechanism leverages the URL search query parameters, these can be manually added to the URL of the content. This process would be useful in the case where the course is hosted on a simple web server. The developer could create a link to the content and manually add the query parameters to the link's URL to the content. In this case, the link would need to be manually updated to reflect different LRS and xAPI details.

Example URL with Query Parameters
http://localhost:8080/run.html?endpoint=https://lrs.adlnet.gov/xAPI/&auth=Basic%20dG9tOjEyMzQ=&actor={%22mbox%22:%22mailto:tom@test.example.com%22}&activity_id=http://xapi.composica.com/activity/course/3dd6134f-e922-45b4-a741-3a461aa480d7

Example URL Decoded and Formatted for Readability
http://localhost:8080/run.html
    ?endpoint=https://lrs.adlnet.gov/xAPI/
    &auth=Basic dG9tOjEyMzQ=
    &actor={"mbox":"mailto:tom@test.example.com"}
    &activity_id=http://xapi.composica.com/activity/course/3dd6134f-e922-45b4-a741-3a461aa480d7

2.1.3 Configuration Improvements

Default Configuration
The course has been updated to include a default configuration. The xAPI tracking file (Content/Runtime/trkapi.js) now contains code which will look for launch values, and supply configuration details if those launch values do not exist. See `_initFromQueryString` on line 330 in trkapi.js for the specific implementation.

Default Configuration Values
- **endpoint** - https://lrs.adlnet.gov/xAPI/
- **auth** - Basic dG9tOjEyMzQ= (tom:1234)
- **actor** - {"mbox": "mailto: tom@example.com"}
- **activity_id** -
  http://xapi.composica.com/activity/course/3dd6134f-e922-45b4-a741-3a461aa480d7

2.2 DAU xAPI Content Module Recommendations

The FPD420 Reviewer Training Course was exported as an xAPI package from Composica and tested against an xAPI-conformant LRS. During the analysis, the team documented general findings, usage, and recommendations for consideration. Those are summarized throughout the main body of this report. In order to arrive at the recommendations, it was necessary to conduct an in-depth analysis of the current xAPI statements generated by the content. A copy of the current JSON statements are provided in Section 5.1 of the Appendix. In addition, recommended updates to the JSON statements are highlighted in yellow and provided in Section 5.2 of the Appendix.

These findings are not intended to be perceived negatively, but are the result of examining how the course was designed, exported, and other unknown configuration settings in Composica. It's important to note that this analysis report is simply a collection of findings and recommendations and does not imply that the xAPI output of the course is incorrect or in error. In fact, out-of-the-box, the current xAPI statements produced by the course actually generated very useful analytics and visualizations without any modification at all. The current statements generated by the course actually come close to resembling the structure of SCORM Profile statements. The recommendations provided in this analysis report are intended to highlight areas that could be improved to align more closely with best practices for SCORM courseware tracking. If these recommendations are followed, they will likely result in enhanced reporting and analytics. However, since DAU leadership is especially interested in converting SCORM content to xAPI, then interoperability would be significantly enhanced if the SCORM Profile of xAPI was completely adopted since that is one of the primary reasons it was created.

2.2.1 General Recommendations

Table 1 below lists the global findings, description, and recommendations.

#	Finding	Description	Recommendation
1	Lack of xAPI for video interactions	Videos are embedded in the content using MP4 and HTML5, but don't currently make use of the xAPI Video Profile for tracking video interactions.	Add video profile support to content exported from Composica. See the official Video Profile Documentation.
2	Missing xAPI Statements per page view	The content currently reports a limited set of statements, mainly attempted, initialized, completed, and some pre-test interactions. Page views, and data about the page interaction, would enable	At a minimum, add page views with a timestamp - either through a viewed verb, or issuing both an initialized and a terminated statement. This would make it easier to visualize a learner's path

		enhanced analysis.	through the content. The timestamps would also help identify pages that learners took an abnormally short or long time to get through.
3	Maintain a clear parent/child relationship in the statements through the context activities	Use of context.contextActivities grouping and parent properties will inform analytics of the relationship of statements within a session. This relationship could be visualized to show path progression or to aggregate graphs into relevant dashboards.	Use grouping for the course activity as well as any other grouping necessary such as modules. Use parent for the activity when reporting about assessments, interactions or objectives. See more about this pattern in the xAPI SCORM Profile.
4	Use of "und" on language map lang codes	Statement properties that have a place for human readable text use a language map format ({"en-US": "initialized"}) to represent that text. This allows statements to have different languages for the same property. Currently the statements use English text but identify it with 'und'. This causes some displays to show either a blank or the IRI for the property instead of the human readable text.	Since the statements use English text, update the language codes to be either 'en' or a more specific code, such as 'en-US'.
5	Course completion remains false after passing pre-test	After successfully passing the pretest, the learner has the option to review the pretest results or continue to the capstone (full course). If the user exits after the pretest, then their completion status is false. If the intent is for the learner to adaptively "test out" of the capstone by passing the pretest then the course should be equally set to to complete. *NOTE: This might be attributed to how the course was designed or exported for this analysis effort.*	This can be done by setting result.completion property to true when sending a Terminated Statement after the pretest is passed.
6	No distinction between pre-test question types	The pre-test is comprised of both multiple choice and	Update the statements to set object.definition.interactionType

		true-false types of questions. The current statements provided for FPD420 have all the pre-test types set to "choice."	to "true-false" for true-false question types in the pre-test.

Table 1: General Recommendations

2.2.2 Current xAPI Content Module Data Elements

Since the FPD420 Reviewer Training Course was originally authored as a SCORM course, many of the xAPI concepts (e.g., verbs, activity types) were naturally borrowed from the xAPI SCORM Profile. The following tables (Verbs Used, Activity Types Used, and Properties Used) list all of the current xAPI concepts that were observed by analyzing the xAPI Statements generated by the Composica export.

Verbs Used

The table below lists all of the current verbs in alphabetical order. For each item in Table 2, the verb title, description, and IRI are provided for reference and describe current usage. Please see Section 5.1 of the Appendix for the current usage of these verbs in xAPI statements.

Verb	Description	IRI
Attempted	Used after the content is initialized to indicate the course content (pre test path or course path) was attempted by the actor.	http://adlnet.gov/expapi/verbs/ attempted
Answered	Used to indicate a question was answered a question (with a correct or incorrect response) in the pre-test.	http://adlnet.gov/expapi/verbs/ answered
Completed	Used to indicate the user has completed the content.	http://adlnet.gov/expapi/verbs/ completed
Failed	Used to indicate the unsuccessful action of failing the pre-test.	http://adlnet.gov/expapi/verbs/ failed
Initialized	Used to indicate the content was launched or started by the actor.	http://adlnet.gov/expapi/verbs/ initialized
Passed	Used to indicate the successful action of passing the pre-test.	http://adlnet.gov/expapi/verbs/ passed
Progressed	Used to indicate the progress in terms of percentage the user has made toward 100% completion.	http://adlnet.gov/expapi/verbs/ progressed
Resumed	Used to indicate the user has resumed a previously suspended attempt of the content.	http://adlnet.gov/expapi/verbs/ resumed
Suspended	Used to indicate the user has left the content and	http://adlnet.gov/expapi/verbs/

	suspended their attempt.	suspended
Terminated	Used to indicate the user has closed the content and terminated their attempt.	http://adlnet.gov/expapi/verbs/terminated

Table 2: Verbs Used

Activity Types Used

The table below lists all of the current activities in alphabetical order. For each item in Table 3, the activity title, description, and IRI are provided for reference and describe current usage. Please see Section 5.1 of the Appendix for the current usage of these activity types.

Activity Type	Description	IRI
CMI Interaction Question (Choice)	Used to identify each question activity associated with the pre-test.	"http://adlnet.gov/expapi/activities/cmi.interaction"
Course	Used to identify a course activity.	"http://adlnet.gov/expapi/activities/course"
Objective (Activity)	Used to identify the overall objective activity associated with passing the pre-test.	http://adlnet.gov/expapi/activities/objective

Table 3: Activity Types Used

Properties Used

The table below lists all of the current properties in alphabetical order. For each item in Table 4, the property title, description, and statement location are provided for reference and current usage. Please see Section 5.1 of the Appendix for the current usage of these properties.

Property	Description	Statement Location
Completion	Used to indicate the completion status of the activity as a boolean value.	result.completion
Description	Used to provide a general description of the activity.	object.definition.description
Display	Used to provide a human readable version of the verb used in a statement.	verb.display
Duration	Used to provide the total amount of time spent in an activity.	result.duration
Name	Used to provide the general name or title of the activity.	object.definition.name
Grouping	Used to identify an activity's relationship with a larger / broader activity.	context.contextActivities.grouping

Maximum Score	Use to provide a value when expressing the actor's highest possible score on a scale of 0 to 100.	result.score.min
Minimum Score	Use to provide a value when expressing the actor's lowest possible score on a scale of 0 to 100.	result.score.max
Raw Score	Use to provide a value when expressing the actor's measured performance on a scale of 0 to 100. Used for the overall raw score on the pre-test.	result.score.raw
Scaled Score	Used to provide a decimal value between -1 and 1 when expressing the actor's measured performance on an activity. Used for the scaled score on each question and also for overall scaled score on the pre-test.	result.score.scaled
Timestamp	Used to provide a specific time in which the statement was sent to the LRS.	statement.timestamp

Table 4: Properties Used

2.2.3 Recommended xAPI Content Module Updates

The table below lists all of the recommended updates based on the xAPI Statements analyzed from the Composica export. For each item in Table 5, the data element, description, and statement location or IRI are provided for reference and intended usage. Please see Section 5.2 of the Appendix for the recommended updates to the full statements (highlighted in yellow).

Recommended Data Element	Recommendation Description	Location or IRI
Assessment	Use assessment as the "type" instead of objective when recording statements about the pre-test. An assessment is the measurement of learning objective(s), not the objective itself. There could be multiple learning objectives associated with an overall assessment or even a direct mapping between a learning objective and a question in an assessment.	http://adlnet.gov/expapi/activities/assessment
Attempt	Set the context.contextActivities. grouping array to include the	http://adlnet.gov/expapi/activities/attempt

	attempt activity and the course activity. The activity type should be set to "attempt" as the IRI.	
Grouping	Use grouping to associate the activity with an attempt and also to establish a relationship for each activity with the overall course. Adding this relationship will provide a richer structure to the statements, and as a result will improve the analytics.	context.grouping
Parent	Use parent for the activity when reporting about assessments, interactions or objectives. A statement about a quiz question typically would have the quiz as its parent Activity.	context.contextActivities. parent
Registration	The context.registration property of an xAPI Statement can be used to link statements into a session. This makes the grouping of statements by session more accurate. Generate and include a context.registration UUID to all Statements. Statements that are considered in the same session or logical group should have the same context.registration UUID.	context.registration
Responded	Use the "responded" verb instead of the "answered" verb when building assessment questions and following the SCORM profile of xAPI. The responded verb more accurately conveys the activity and aligns with the result.response property.	http://adlnet.gov/expapi/verbs/ responded

Table 5: Recommended Content Module Updates

2.3 SCORM to xAPI Recommendations for Future Implementation

This section describes a transition from SCORM to xAPI and associated recommendations for converting SCORM to xAPI. Although the move from SCORM to xAPI is often treated as simple, it is not, and must be planned for and executed with care to ensure all of the relevant pieces are in place. To ease this transition, organizations can move from *SCORM* to

SCORM+xAPI, and then to *xAPI Native*. This transition reaps the benefit of xAPI early in the transition, but also accounts for the use of existing systems and content that are not refreshed often and can be expensive to replace.

In addition, this section includes considerations for the specific DAU target environment. For example, for the foreseeable future, DAU will use the Cornerstone LMS to launch their e-learning content. This requirement tends to lead to two recommendations for moving to an xAPI-enabled environment. The next few sections describe these recommendations.

2.3.1 SCORM + xAPI Recommendations

Adding xAPI tracking to existing SCORM content is a good way to begin using xAPI for organizations that already have a SCORM-conformant LMS (in DAU's case, Cornerstone) and associated content. It can be relatively straightforward to add xAPI to a SCORM environment if you plan ahead. Further, there are several open source resources available for this integration.

To update an existing SCORM course to track xAPI, you can instrument the (Sharable Content Objects) SCOs (HTML/JavaScript) to track xAPI data when a SCO issues a *SetValue()* call. This is a good way to get data tracked without significant development. There are several open source projects that employ this approach to adding xAPI to SCORM courses.

SCORM also includes well-defined data model initialization behaviors. Some data model elements are initialized by entering data in the imsmanifest.xml file present in all SCORM courses, and then importing the course an LMS. This process provides an interoperable means to initialize SCO run-time data and then use that data in corresponding xAPI statements.

For example, SCORM data model values can be used to initialize data for the LRS and xAPI statements. When content sends an xAPI statement to an LRS, the content must know:

1. **LRS Endpoint** - The location of the LRS endpoint (URL)
2. **LRS Authority** - The authority information used to authorize the communication with the LRS (often a username and password)
3. **Actor Identity** - Some identifier for the actor or the user
4. **Activity Identifier** - Some identifier (IRI) for the activity
5. [optional] **Course Identifier** - Some identifier (IRI) for the parent course that contains the activity (if applicable)
6. [optional] **Grouping Context Activity** - JSON activity used to group statements together using context

In many xAPI introductory examples, the values above are hard coded. This is problematic for many reasons including security concerns with passwords hard coded into client-side JavaScript. Also, each launch of the content, the endpoint (#1 above) and the actor (#3 above)

likely change. So, introductory resources often do not describe how these are initialized, leaving a large gap in implementation for those trying to integrate xAPI into their environment.

The *SCORM + xAPI* recommendation uses the LMS to provide access to this required data model initialization. Specifically, the LMS provides:

1. **LRS Endpoint** - Initialized in the imsmanifest.xml using the `<adlcp:dataFromLMS>` element
2. **LRS Authority** - Initialized in the imsmanifest.xml using the `<adlcp:dataFromLMS>` element
3. **Actor Identity** - An xAPI account object. Home page initialized in the imsmanifest.xml using the `<adlcp:dataFromLMS>` element. Account identifier ("name" object) initialized via a SCORM run-time GetValue call on the `cmi.learner_id` data model element.
4. **Activity Identifier** - Initialized in the imsmanifest.xml using the `<adlcp:dataFromLMS>` element
5. **Course Identifier** - If there is a parent course that this activity belongs to, initialized in the imsmanifest.xml using the `<adlcp:dataFromLMS>` element
6. **Grouping Context Activity** - If there is an additional grouping context activity, initialized in the imsmanifest.xml using the `<adlcp:dataFromLMS>` element

The `<adlcp:dataFromLMS>` element initialization is usually accomplished via a JSON object with this information. An example of this JSON is included in the example below.

```
{
   "lrs":{
      "endpoint":"https://my_test_lrs.lrs.io/xapi/",
      "user":"my_lrs_auth_user",
      "password":"my_lrs_auth_pw"
   },
   "courseId":"http://veracity.it/courses/xapi_example_course",
   "lmsHomePage":"http://lms.veracity.it",
   "isScorm2004":true,
   "activityId":"veracity.it/courses/xapi_example_course/my_activity",
   "groupingContextActivity":{
      "definition": {
         "name": {
            "en-US": "DAU Demo"
         },
         "description": {
            "en-US": "My Demo of the Example Course for DAU"
         }
      },
      "id": "http://adlnet.gov/event/xapiworkshop/myworkshop",
      "objectType": "Activity"
   }
}
```

The LMS also provides user login, launch, sequencing, navigation, data model initialization, and temporal model (session/attempt) management. These are often critical features overlooked in xAPI environments.

The *SCORM + xAPI* recommendation uses well-defined SCORM features, all in conformance with SCORM, to add xAPI to the environment. This also can automate xAPI tracking of SCORM data model elements to an LRS as well as intentionally added xAPI statements.

There are many benefits of adding xAPI to a SCORM environment. This approach is discussed in the _Opening Legacy Data Soilos Using Experience Data for Educational Impact paper_ from I/ITSEC 2015.

In summary,

Pros:
1. Easy to implement in organizations with an investment in SCORM
2. Does not require expensive acquisition of many new learning management components
3. Uses existing, vetted approaches to identity, authorization, and identity
4. Gets xAPI data that is similar to SCORM data out of LMS silos and accessible for additional user-created reports

Cons:
1. Does not easily provide detailed and granular tracking of xAPI events without development
2. Does not easily introduce mobile applications, simulations and other non-web-based content types into a learning environment
3. Requires that content packages be updated and re-uploaded into an LMS or the LMS content player updated

2.3.2 xAPI Native Recommendations

Although the *SCORM + xAPI* recommendation is an excellent way for an organization to get started with xAPI, it does not provide all of the benefits of an *xAPI Native* environment. This type of environment reduces or eliminates the reliance on an LMS for content launch, sequencing, initialization, etc. This creates a gap that requires filling, but also significantly increases the benefits of using xAPI natively. For example, using a *xAPI Native* environment, an organization can:

1. Host authoritative source content in a content repository, maintain it in one place, but use it in many contexts and systems

2. Introduce mobile applications, simulations and other non-web-based content to the environment and get/visualize data about these experiences in the same place as traditional e-learning
3. Track more granular and content type-specific data with xAPI resulting in more useful analytics and visualizations

In order to use xAPI Native content in the DAU environment but still use the LMS (Cornerstone) as the entry point to web-based content, the LMS can be instrumented with IMS Learning Tool Interoperability (LTI) to an LTI Tool Provider which supports one of the various launch mechanisms (like TinCan Launch or xAPI Launch). Such a Tool Provider receives information from the LMS such as the learner ID and/or email, the course content ID or URL, or styling and presentation data via the standard LTI interface. This allows a launching service to exercise the launch mechanism without support being directly available in the LMS. Critically, an LTI based Launch Service which is integrated into an LRS can manage its own session and credentials, allowing an implementation to securely launch content without the LMS having long lived credentials to the LRS.   This allows the LMS to control access to the content, manage users and user login, but still not hardcode the values into the content. The LMS makes an LTI request to the launch service including the required information and from there, the launch service can launch and initialize the xAPI-enabled content as required by the launch specifications. LTI launch takes the following values from the LMS and passes them to the launch service

1. **endpoint** - The endpoint URL to the LRS's xAPI (ex. https://lrs.adlnet.gov/xAPI/)
2. **auth** - The value of the authorization header used for access to the xAPI endpoint (e.g. Basic dG9tOjEyMzQ=)
3. **actor** - The JSON representation of the actor that is currently taking the course (e.g. {"mbox": "mailto: tom@example.com"})
4. **activity_id** - The URI of the activity representing this course (ex. http://xapi.composica.com/activity/course/3dd6134f-e922-45b4-a741-3a461aa480d7)
5. [optional] **activity_platform** - The platform on which the course was run (ex. 'Moodle')
6. [optional] **registration** - A UUID that can be used to represent a unique registration ID on statements related to that session/registration (ex. 760e3480-ba55-4991-94b0-01820dbd23a2)
7. [optional] **grouping** - The URI of an activity that is considered a parent or encompasses the current activity (ex. http://xapi.composica.com/activity/course/)

As you can see, similar information is required in this situation as in a *SCORM + xAPI* environment. There is no reliance on a SCO to provide this information and instead the LMS initiates the LTI call with the required data.

In summary,

Pros:
1. Allows content to be hosted in a content server or CDN
2. Allows mobile apps, simulations and other non-web-based content in the learning environment
3. More easily track granular information and content type-specific data

Cons:
1. Requires an LMS LTI configuration that can be more complex than updating SCORM courses
2. Requires a system that supports LTI and xAPI launch. Some LRSs and learning platforms support, others do not
3. Requires content include a player for sequencing and navigation since controls are no longer provided by the LMS

2.3.3 Near-Term General Recommendations

In addition to the recommendations above, there are several near-term considerations to help facilitate a transition to xAPI. These recommendations are included below.

SCORM Version
Although both SCORM Version 1.2 and SCORM 2004 (3rd and 4th Ed.) content can be instrumented with xAPI, there is a benefit to using SCORM 2004. SCORM 2004 includes more well defined data model initialization and behaviors that allow for more accurate xAPI statements, better interoperability, and easier overall xAPI integration.

The bottom line

If content updates are made prior to an investment in SCORM, target SCORM 2004 when possible

Package Structure and Single Sharable Content Objects (SCOs)
When an LMS is used to launch learning content, it can interpret the rules in a SCORM imsmanifest.xml file and sequence the content appropriately. If a *SCORM + xAPI* environment is targeted and will be maintained for a relatively long duration, then single or multiple SCO packages will work. If a *xAPI Native* environment is to be used in the near term, targeting single SCO packages initially may be better to facilitate the eventual transition away from an LMS.

LMSs provide a player that displays the content, provides navigation controls, and sequences the content. If the goal is to move away from an LMS, these features need to be provided by the content or a custom player outside of the LMS. Single SCO packages include all of the navigation, adaption, and sequencing in the SCO itself and are better candidates for an *xAPI Native* environment outside of an LMS. In addition, single SCO packages do not necessarily

reduce the resolution of xAPI statements. Single SCO packages can still be made to send statements when different modules are launched, terminated, what the duration of a session is, and more.

The bottom line

If you plan to move your learning outside of your LMS in the near future, target single SCO packages to minimize the sequencing and navigation work outside of an LMS environment

Profiles and Reporting Requirements

Determining and/or creating the xAPI Profile (or Profiles) to suit specific content is an important upfront step. Although data can be cleaned once tracked, good data tracking results in good data reporting and analytics, as opposed to garbage in; garbage out.

It is also important to think about analytics and visualizations that could benefit your organization. Working backwards from visualizations to a profile is a great way to ensure the data you track has the information necessary for your organizations use cases.

The bottom line

Don't just track everything. Determine reporting and analytic requirements up front and use that to inform xAPI Profiles used

Data Generation & Dashboards

It can be difficult to visualize what a dashboard or analytic may look like with real data. It's even harder to build visualizations without a significant amount of data. It is important to generate test data, real or simulated, to test your design. This helps ensure that the xAPI Profile contains the information you need so that potentially expensive modifications are not needed in the future

The bottom line

Generate data and test your analytics and visualizations. Use the outcomes to refine your profile approach

3. Summary

Previous testing of xAPI support by DAU only investigated whether the statements were successfully sent to an LRS. No prior in-depth analysis was conducted on whether the xAPI implementation worked correctly or produced useful xAPI statements. The purpose of this analysis was threefold: 1) create new xAPI configuration & launch instructions and documentation to enable the course, 2) to provide recommendations for improving the quality of the xAPI implementation, and 3) to provide some general considerations for converting SCORM content to xAPI.

As part of the analysis effort, edits were made to a few of the exported course configuration files and JavaScript source code in order for the content to launch and track data correctly with an LRS. The instrumentation and configuration changes were documented in this report and serve as a guide for future xAPI testing efforts. Once the course was configured correctly, an analysis of the xAPI statements followed. The analysis effort required all of the current FPD420 Reviewer Training Course xAPI data elements to be documented. As a result, a listing of all the verbs, activity types, and properties and their current usage in xAPI statements were provided in this analysis report. Open source resources to aid in adding xAPI tracking to existing SCORM content are also provided in the resources section of this report. The Appendix section of this report provides a genuine log of the current xAPI statements generated by the course as well as highlighted recommendations for improving the statements.

Some of the statement recommendations in the Appendix section were based on the fact that the course was developed as a single "SCO" using the Composica authoring tool. For example, the recommendation to add a course grouping association for the statements was based on only having access to a single SCO course package (the FPD420 Reviewer Training Course). If the course had multiple lessons, then the grouping recommendation would associate a lesson activity with a course, similar to the recommendation was made to establish a structural relationship between the Pre-Test and the course in updates provided in the Appendix.

The USALearning team evaluated the current level of xAPI support in the FPD420 Reviewer Training Course and determined that only minimal updates are needed to improve the quality of data tracked. The xAPI output is fundamentally sound, follows some good practices for tracking courseware interactions, and the statements produced were able to be visualized out of the box. However, when an organization must convert SCORM content to xAPI,interoperability would be significantly enhanced if the SCORM Profile of xAPI was completely adopted, especially since conversion of SCORM to xAPI is one of the reasons the profile was created in the first place. The SCORM profile was also built with the expectation that organizations would eventually want or need to convert SCORM content to support xAPI, and eventually want to transition to a native xAPI strategy. The SCORM to xAPI recommendations in this analysis report highlight pros and cons to implementing these approaches. Additional xAPI recommendation research and

analyses are likely warranted for other types of SCORM-specific content that utilize sequencing, navigation, and multi-SCO structures. However, a majority of the xAPI recommendations provided in this analysis report simply reinforce strong practices for improving xAPI data collection and enhancing dashboard visualizations.

4. Resources

Opening Data Silos Using Experience Data for Educational Impact,
https://www.academia.edu/18930732/Opening_Legacy_Data_Silos_Using_Experience_Data_for_Educational_Impact

TinCan Launch,
https://github.com/RusticiSoftware/launch/blob/master/lms_lrs.md

SCORM to xAPI Wrapper,
https://github.com/adlnet/SCORM-to-xAPI-Wrapper

Starting from SCORM: A Developer's Guide,
https://github.com/adlnet/Starting-from-SCORM-A-Developers-Guide

xAPI Launch,
http://adlnet.github.io/xapi-launch

xAPI SCORM Profile,
https://github.com/adlnet/xAPI-SCORM-Profile/blob/master/xapi-scorm-profile.md

xAPI SCORM Profile Documentation,
https://adl.gitbooks.io/scorm-profile-xapi/content/

xAPI Video Profile,
https://liveaspankaj.gitbooks.io/xapi-video-profile/content/statement_data_model.html

5. Appendices

5.1 Current xAPI Content Module Statements

This section provides a listing of all of the types of xAPI statements that were generated by the FPD420 Reviewer Training Course. No modifications were made to any of these statements. Section 2.2.2 provides a summary of the xAPI data elements currently used by the FPD420 Reviewer Training Course. Section 5.2 provides recommended additions and updates to these same statements, highlighted in yellow.

5.1.2 Initialized Statement

```
{
  "id": "e283ada6-48e9-4073-a0ec-cc8ba73496d3",
  "timestamp": "2019-08-14T16:56:09.551Z",
  "actor": {
    "objectType": "Agent",
    "mbox": "mailto:tom@example.com"
  },
  "verb": {
    "id": "http://adlnet.gov/expapi/verbs/initialized",
    "display": {
      "und": "initialized"
    }
  },
  "context": {
    "contextActivities": {
      "grouping": [
        {
          "id":
"http://xapi.composica.com/activity/course/3dd6134f-e922-45b4-a741-3a461aa480d7",
          "objectType": "Activity"
        }
      ]
    }
  },
  "object": {
    "id": "http://xapi.composica.com/activity/course/3dd6134f-e922-45b4-a741-3a461aa480d7",
    "objectType": "Activity",
    "definition": {
      "type": "http://adlnet.gov/expapi/activities/course",
```

```
      "name": {
        "und": "FPD420 Reviewer Training Course "
      },
      "description": {
        "und": "Duplicate of Deployed FPD420 v2.0.0 for migration"
      }
    }
  }
}
```

5.1.3 Attempted Course Statement

```
{
  "id": "8bf5d98b-c5ea-4baa-a0dd-63603fcf5bc9",
  "timestamp": "2019-08-14T16:56:09.552Z",
  "actor": {
    "objectType": "Agent",
    "mbox": "mailto:tom@example.com"
  },
  "verb": {
    "id": "http://adlnet.gov/expapi/verbs/attempted",
    "display": {
      "und": "attempted"
    }
  },
  "context": {
    "contextActivities": {
      "grouping": [
        {
          "id":
"http://xapi.composica.com/activity/course/3dd6134f-e922-45b4-a741-3a461aa480d7",
          "objectType": "Activity"
        }
      ]
    }
  },
  "object": {
    "id": "http://xapi.composica.com/activity/course/3dd6134f-e922-45b4-a741-3a461aa480d7",
    "objectType": "Activity",
    "definition": {
      "type": "http://adlnet.gov/expapi/activities/course",
      "name": {
```

```
    "und": "FPD420 Reviewer Training Course "
  },
  "description": {
    "und": "Duplicate of Deployed FPD420 v2.0.0 for migration"
  }
 }
 }
}
```

5.1.4 Attempted Pre-Test Statement

```
{
  "id": "077cc0b1-4e4a-4fa2-9a0b-e26dbd5723ae",
  "timestamp": "2019-08-14T17:13:18.666Z",
  "actor": {
    "objectType": "Agent",
    "mbox": "mailto:tom@example.com"
  },
  "verb": {
    "id": "http://adlnet.gov/expapi/verbs/attempted",
    "display": {
      "und": "attempted"
    }
  },
  "context": {
    "contextActivities": {
      "parent": [
        {
          "id":
"http://xapi.composica.com/activity/course/3dd6134f-e922-45b4-a741-3a461aa480d7",
          "objectType": "Activity"
        }
      ],
      "grouping": [
        {
          "id":
"http://xapi.composica.com/activity/course/3dd6134f-e922-45b4-a741-3a461aa480d7",
          "objectType": "Activity"
        }
      ]
    }
  },
```

```
  "object": {
    "id":
"http://xapi.composica.com/activity/course/3dd6134f-e922-45b4-a741-3a461aa480d7/objective/te
st-ixi0zvmt1",
    "objectType": "Activity",
    "definition": {
      "type": "http://adlnet.gov/expapi/activities/objective",
      "name": {
        "und": "Pre-Test Path"
      }
    }
  }
}
```

5.1.5 Answered Multiple Choice Question Statement (Correct Response)

```
{
  "id": "7d9c5eed-59bd-422d-ae27-00aefdfd5ad0",
  "timestamp": "2019-08-14T17:14:11.975Z",
  "actor": {
    "objectType": "Agent",
    "mbox": "mailto:tom@example.com"
  },
  "verb": {
    "id": "http://adlnet.gov/expapi/verbs/answered",
    "display": {
      "und": "answered"
    }
  },
  "result": {
    "success": true,
    "duration": "PT53.31S",
    "response": "Because,_once_the_CR_is_submitted,_[,]Because_the_Stage_indicates_when_th",
    "score": {
      "scaled": 1,
      "raw": 3.125,
      "min": 0,
      "max": 3.125
    }
  },
  "context": {
    "contextActivities": {
```

```
      "parent": [ u he was  ayw u go back home yet best part time job at the he
        {
          "id": for
the"http://xapi.composica.com/activity/course/3dd6134f-e922-45b4-a741-3a461aa480d7/objective
/test-ixi0zvmt1",
          "objectType": "Activity"
        }
      ],
      "grouping": [I love how's the weather there today Andrew he ui
       is
          "id":
"http://xapi.composica.com/activity/course/3dd6134f-e922-45b4-a741-3a461aa480d7",
          "objectType": "Activity"
        }
      ]
    }
  },
  "object": {
    "id":
"http://xapi.composica.com/activity/course/3dd6134f-e922-45b4-a741-3a461aa480d7/interaction/
page-j13tri7x2/0",
    "objectType": "Activity",
    "definition": {
      "type": "http://adlnet.gov/expapi/activities/cmi.interaction",
      "name": {
        "und": "Q1.11"
      },
      "description": {
        "und": "Why is it important that you select the proper STAGE when you're entering a
CR?  Select all that apply."
      },
      "interactionType": "choice",
      "correctResponsesPattern": [
        "Because,_once_the_CR_is_submitted,_[,]Because_the_Stage_indicates_when_th"
      ]
    }
  }
}
```

5.1.6 Passed Statement

```
{
```

```
  "id": "2dbd0a48-02d4-4f95-84f7-50c4f933ad40",
  "timestamp": "2019-08-14T17:44:39.313Z",
  "actor": {
    "objectType": "Agent",
    "mbox": "mailto:tom@example.com"
  },
  "verb": {
    "id": "http://adlnet.gov/expapi/verbs/passed",
    "display": {
      "und": "passed"
    }
  },
  "result": {
    "success": true,
    "duration": "PT1880.65S",
    "score": {
      "scaled": 1,
      "raw": 100,
      "min": 0,
      "max": 100
    }
  },
  "context": {
    "contextActivities": {
      "parent": [
        {
          "id":
"http://xapi.composica.com/activity/course/3dd6134f-e922-45b4-a741-3a461aa480d7",
          "objectType": "Activity"
        }
      ],
      "grouping": [
        {
          "id":
"http://xapi.composica.com/activity/course/3dd6134f-e922-45b4-a741-3a461aa480d7",
          "objectType": "Activity"
        }
      ]
    }
  },
  "object": {
    "id":
"http://xapi.composica.com/activity/course/3dd6134f-e922-45b4-a741-3a461aa480d7/objective/te
st-ixi0zvmt1",
```

```
      "objectType": "Activity",
      "definition": {
        "type": "http://adlnet.gov/expapi/activities/objective",
        "name": {
          "und": "Pre-Test Path"
        }
      }
    }
  }
}
```

5.1.7 Failed Statement

```
{
  "id": "afb661ff-a4ac-4864-ab3e-35f0a50a190a",
  "timestamp": "2019-08-15T19:30:00.054Z",
  "actor": {
    "objectType": "Agent",
    "mbox": "mailto:tom@example.com"
  },
  "verb": {
    "id": "http://adlnet.gov/expapi/verbs/failed",
    "display": {
      "und": "failed"
    }
  },
  "result": {
    "success": false,
    "duration": "PT112.32S",
    "score": {
      "scaled": 0.375,
      "raw": 37.5,
      "min": 0,
      "max": 100
    }
  },
  "context": {
    "contextActivities": {
      "parent": [
        {
          "id":
"http://xapi.composica.com/activity/course/3dd6134f-e922-45b4-a741-3a461aa480d7",
          "objectType": "Activity"
```

```
          }
        ],
        "grouping": [
          {
            "id":
"http://xapi.composica.com/activity/course/3dd6134f-e922-45b4-a741-3a461aa480d7",
            "objectType": "Activity"
          }
        ]
      }
    },
    "object": {
      "id":
"http://xapi.composica.com/activity/course/3dd6134f-e922-45b4-a741-3a461aa480d7/objective/te
st-ixi0zvmt1",
      "objectType": "Activity",
      "definition": {
        "type": "http://adlnet.gov/expapi/activities/objective",
        "name": {
          "und": "Pre-Test Path"
        }
      }
    }
  }
}
```

5.1.8 Progressed Statement

```
{
  "id": "de73e42e-36cf-498d-9125-af98640050d4",
  "timestamp": "2019-08-14T21:05:53.219Z",
  "actor": {
    "objectType": "Agent",
    "mbox": "mailto:tom@example.com"
  },
  "verb": {
    "id": "http://adlnet.gov/expapi/verbs/progressed",
    "display": {
      "und": "progressed"
    }
  },
  "result": {
    "score": {
```

```
      "scaled": 0.356
    }
  },
  "context": {
    "contextActivities": {
      "grouping": [
        {
          "id":
"http://xapi.composica.com/activity/course/3dd6134f-e922-45b4-a741-3a461aa480d7",
          "objectType": "Activity"
        }
      ]
    }
  },
  "object": {
    "id": "http://xapi.composica.com/activity/course/3dd6134f-e922-45b4-a741-3a461aa480d7",
    "objectType": "Activity",
    "definition": {
      "type": "http://adlnet.gov/expapi/activities/course",
      "name": {
        "und": "FPD420 Reviewer Training Course "
      },
      "description": {
        "und": "Duplicate of Deployed FPD420 v2.0.0 for migration"
      }
    }
  }
}
```

5.1.9 Suspended Statement

```
{
  "id": "578d3b36-bd28-4cbb-b048-595c21c9a5a0",
  "timestamp": "2019-08-14T21:05:53.221Z",
  "actor": {
    "objectType": "Agent",
    "mbox": "mailto:tom@example.com"
  },
  "verb": {
    "id": "http://adlnet.gov/expapi/verbs/suspended",
    "display": {
      "und": "suspended"
```

```
    }
  },
  "context": {
    "contextActivities": {
      "grouping": [
        {
          "id":
"http://xapi.composica.com/activity/course/3dd6134f-e922-45b4-a741-3a461aa480d7",
          "objectType": "Activity"
        }
      ]
    }
  },
  "object": {
    "id": "http://xapi.composica.com/activity/course/3dd6134f-e922-45b4-a741-3a461aa480d7",
    "objectType": "Activity",
    "definition": {
      "type": "http://adlnet.gov/expapi/activities/course",
      "name": {
        "und": "FPD420 Reviewer Training Course "
      },
      "description": {
        "und": "Duplicate of Deployed FPD420 v2.0.0 for migration"
      }
    }
  }
}
```

5.1.10 Resumed Statement

```
{
  "id": "835d8f4d-76e3-4f64-a744-8769d39564e1",
  "timestamp": "2019-08-14T21:06:26.982Z",
  "actor": {
    "objectType": "Agent",
    "mbox": "mailto:tom@example.com"
  },
  "verb": {
    "id": "http://adlnet.gov/expapi/verbs/resumed",
    "display": {
      "und": "resumed"I love how
    }
```

```
    },
    "context": {
      "contextActivities": {
        "grouping": [
          {
            "id":
"http://xapi.composica.com/activity/course/3dd6134f-e922-45b4-a741-3a461aa480d7",
            "objectType": "Activity"
          }
        ]
      }
    },
    "object": {
      "id": "http://xapi.composica.com/activity/course/3dd6134f-e922-45b4-a741-3a461aa480d7",
      "objectType": "Activity",
      "definition": {
        "type": "http://adlnet.gov/expapi/activities/course",
        "name": {
          "und": "FPD420 Reviewer Training Course "
        },
        "description": {
          "und": "Duplicate of Deployed FPD420 v2.0.0 for migration"
        }
      }
    }
  }
}
```

5.1.11 Completed Statement

```
{
  "id": "cfb6ef82-5db0-4410-b69f-180393287be0",
  "timestamp": "2019-08-14T21:22:28.466Z",
  "actor": {
    "objectType": "Agent",
    "mbox": "mailto:tom@example.com"
  },
  "verb": {
    "id": "http://adlnet.gov/expapi/verbs/completed",
    "display": {
      "und": "completed"
    }
  },
```

```
  "result": {
    "duration": "PT962.11S",
    "score": {
      "min": 0,
      "max": 100
    },
    "completion": true
  },
  "context": {
    "contextActivities": {
      "grouping": [
        {
          "id":
"http://xapi.composica.com/activity/course/3dd6134f-e922-45b4-a741-3a461aa480d7",
          "objectType": "Activity"
        }
      ]
    }
  },
  "object": {
    "id": "http://xapi.composica.com/activity/course/3dd6134f-e922-45b4-a741-3a461aa480d7",
    "objectType": "Activity",
    "definition": {
      "type": "http://adlnet.gov/expapi/activities/course",
      "name": {
        "und": "FPD420 Reviewer Training Course "
      },
      "description": {
        "und": "Duplicate of Deployed FPD420 v2.0.0 for migration"
      }
    }
  }
}
```

5.1.11 Terminated Statement

```
{
  "id": "e0af420a-901b-4eaf-ba9b-10ac98994500",
  "timestamp": "2019-08-14T21:22:28.598Z",
  "actor": {
    "objectType": "Agent",
```

```
    "mbox": "mailto:tom@example.com"
  },
  "verb": {
    "id": "http://adlnet.gov/expapi/verbs/terminated",
    "display": {
      "und": "terminated"
    }
  },
  "result": {
    "duration": "PT962.11S",
    "score": {
      "min": 0,
      "max": 100
    },
    "completion": true
  },
  "context": {
    "contextActivities": {
      "grouping": [
        {
          "id":
"http://xapi.composica.com/activity/course/3dd6134f-e922-45b4-a741-3a461aa480d7",
          "objectType": "Activity"
        }
      ]
    }
  },
  "object": {
    "id": "http://xapi.composica.com/activity/course/3dd6134f-e922-45b4-a741-3a461aa480d7",
    "objectType": "Activity",
    "definition": {
      "type": "http://adlnet.gov/expapi/activities/course",
      "name": {
        "und": "FPD420 Reviewer Training Course "
      },
      "description": {
        "und": "Duplicate of Deployed FPD420 v2.0.0 for migration"
      }
    }
  }
}
```

5.2 Recommended xAPI Content Module Statement Updates

This section provides recommended xAPI statement additions and updates for the FPD420 Reviewer Training Course. The updates are highlighted in yellow. The purposes for making these updates are covered in Section 2.2.1 and Section 2.2.3.

5.2.1 Initialized Statement

```
{
  "id": "e283ada6-48e9-4073-a0ec-cc8ba73496d3",
  "timestamp": "2019-08-14T16:56:09.551Z",
  "actor": {
    "objectType": "Agent",
    "mbox": "mailto:tom@example.com"
  },
  "verb": {
    "id": "http://adlnet.gov/expapi/verbs/initialized",
    "display": {
      "en-US": "initialized"
    }
  },
  "context": {
    "registration": "ec531277-b57b-4c15-8d91-d292c5b2b8f7",
    "contextActivities": {
      "grouping": [
        {
          "id": "http://xapi.composica.com/activity/course/3dd6134f-e922-45b4-a741-3a461aa480d7",
          "type": "http://adlnet.gov/expapi/activities/course"
        },
        {
          "id":"http://xapi.composica.com/activity/course/3dd6134f-e922-45b4-a741-3a461aa480d7?attemptId=50fd6961-ab6c-4e75-e6c7-ca42dce50dd6",
          "definition":{
            "name":{
              "en-US":"Attempt of FPD420 Reviewer Training Course"
            },
            "description":{
              "en-US":"The activity representing an attempt of the  FPD420 Reviewer Training Course"
            },
            "type": "http://adlnet.gov/expapi/activities/attempt"
```

```
              }
          }
        ]
    }
  },

  "object": {
    "id": "http://xapi.composica.com/activity/course/3dd6134f-e922-45b4-a741-3a461aa480d7",
    "objectType": "Activity",
    "definition": {
      "type": "http://adlnet.gov/expapi/activities/course",
      "name": {
        "en-US": "FPD420 Reviewer Training Course"
      },
      "description": {
        "en-US": "Duplicate of Deployed FPD420 v2.0.0 for migration"
      }
    }
  }
}
```

5.2.2 Attempted Course Statement

```
{
  "id": "e283ada6-48e9-4073-a0ec-cc8ba73496d3",
  "timestamp": "2019-08-14T16:56:09.551Z",
  "actor": {
    "objectType": "Agent",
    "mbox": "mailto:tom@example.com"
  },
  "verb": {
    "id": "http://adlnet.gov/expapi/verbs/attempted",
    "display": {
      "en-US": "attempted"
    }
  },
  "context": {
    "registration": "ec531277-b57b-4c15-8d91-d292c5b2b8f7",
    "contextActivities": {
      "grouping": [
        {
          "id":
```

```
"http://xapi.composica.com/activity/course/3dd6134f-e922-45b4-a741-3a461aa480d7",
            "type": "http://adlnet.gov/expapi/activities/course"
          },
          {
"id":"http://xapi.composica.com/activity/course/3dd6134f-e922-45b4-a741-3a461aa480d7?attempt
Id=50fd6961-ab6c-4e75-e6c7-ca42dce50dd6",
            "definition":{
                "name":{
                    "en-US":"Attempt of FPD420 Reviewer Training Course"
                },
                "description":{
                    "en-US":"The activity representing an attempt of the  FPD420 Reviewer
Training Course"
                },
                "type": "http://adlnet.gov/expapi/activities/attempt"
            }
          }
        ]
    }
  },

  "object": {
    "id": "http://xapi.composica.com/activity/course/3dd6134f-e922-45b4-a741-3a461aa480d7",
    "objectType": "Activity",
    "definition": {
      "type": "http://adlnet.gov/expapi/activities/course",
      "name": {
        "en-US": "FPD420 Reviewer Training Course"
      },
      "description": {
        "en-US": "Duplicate of Deployed FPD420 v2.0.0 for migration"
      }
    }
  }
}
```

5.2.3 Attempted Pre-test Statement

```
{
  "id": "077cc0b1-4e4a-4fa2-9a0b-e26dbd5723ae",
  "timestamp": "2019-08-14T17:13:18.666Z",
  "actor": {
```

```
    "objectType": "Agent",
    "mbox": "mailto:tom@example.com"
  },
  "verb": {
    "id": "http://adlnet.gov/expapi/verbs/attempted",
    "display": {
      "en-US": "attempted"
    }
  },
  "context": {
    "registration": "ec531277-b57b-4c15-8d91-d292c5b2b8f7",
    "contextActivities": {
      "parent": [
        {
          "id":
"http://xapi.composica.com/activity/course/3dd6134f-e922-45b4-a741-3a461aa480d7",
          "type": "http://adlnet.gov/expapi/activities/course"
        }
      ],
      "grouping": [
        {
          "id":
"http://xapi.composica.com/activity/course/3dd6134f-e922-45b4-a741-3a461aa480d7",
          "type": "http://adlnet.gov/expapi/activities/course"
        },
        {
"id":"http://xapi.composica.com/activity/course/3dd6134f-e922-45b4-a741-3a461aa480d7/objecti
ve/test-ixi0zvmt1?attemptId=50fd6961-ab6c-4e75-e6c7-ca42dce50dd6",
          "definition":{
            "name":{
                "en-US":"Attempt of Pre-Test"
            },
            "description":{
                "en-US":"The activity representing an attempt of the Pre-Test"
            },
            "type": "http://adlnet.gov/expapi/activities/attempt"
          }
        }
      ]
    }
  },
  "object": {
    "id":
"http://xapi.composica.com/activity/course/3dd6134f-e922-45b4-a741-3a461aa480d7/objective/te
```

```
st-ixi0zvmt1",
    "objectType": "Activity",
    "definition": {
      "type": "http://adlnet.gov/expapi/activities/assessment",
      "name": {
        "en-US": "Pre-Test Path"
      }
    }
  }
}
```

5.2.4 Answered Multiple Choice Question Statement (Correct Response)

```
{
  "id": "7d9c5eed-59bd-422d-ae27-00aefdfd5ad0",
  "timestamp": "2019-08-14T17:14:11.975Z",
  "actor": {
    "objectType": "Agent",
    "mbox": "mailto:tom@example.com"
  },
  "verb": {
    "id": "http://adlnet.gov/expapi/verbs/responded",
    "display": {
      "en-US": "responded"
    }
  },
  "result": {
    "success": true,
    "duration": "PT53.31S",
    "response": "Because,_once_the_CR_is_submitted,_[,]Because_the_Stage_indicates_when_th",
    "score": {
      "scaled": 1,
      "raw": 3.125,
      "min": 0,
      "max": 3.125
    }
  },
  "context": {
    "registration": "ec531277-b57b-4c15-8d91-d292c5b2b8f7",
    "contextActivities": {
      "parent": [
        {
```

```
          "id":
"http://xapi.composica.com/activity/course/3dd6134f-e922-45b4-a741-3a461aa480d7/objective/te
st-ixi0zvmt1",
          "type": "http://adlnet.gov/expapi/activities/assessment"
        }
      ],
      "grouping": [
        {
          "id":
"http://xapi.composica.com/activity/course/3dd6134f-e922-45b4-a741-3a461aa480d7",
          "type": "http://adlnet.gov/expapi/activities/course"
        },
        {
"id":"http://xapi.composica.com/activity/course/3dd6134f-e922-45b4-a741-3a461aa480d7/objecti
ve/test-ixi0zvmt1?attemptId=50fd6961-ab6c-4e75-e6c7-ca42dce50dd6",
          "definition":{
             "name":{
                "en-US":"Attempt of Pre-Test"
             },
             "description":{
                 "en-US":"The activity representing an attempt of the Pre-Test"
             },
          "type": "http://adlnet.gov/expapi/activities/attempt"
          }
        }
      ]
    }
  },
  "object": {
    "id":
"http://xapi.composica.com/activity/course/3dd6134f-e922-45b4-a741-3a461aa480d7/interaction/
page-j13tri7x2/0",
    "objectType": "Activity",
    "definition": {
      "type": "http://adlnet.gov/expapi/activities/cmi.interaction",
      "name": {
        "en-US": "Q1.11"
      },
      "description": {
        "en-US": "Why is it important that you select the proper STAGE when you're entering
a CR?  Select all that apply."
      },
      "interactionType": "choice",
      "correctResponsesPattern": [
```

```
        "Because,_once_the_CR_is_submitted,_[,]Because_the_Stage_indicates_when_th"
      ]
    }
  }
}
```

5.2.5 Answered True-False Question Statement (Correct was x you,

5.2.7 Failed Statement

```
{
  "id": "afb661ff-a4ac-4864-ab3e-35f0a50a190a",
  "timestamp": "2019-08-15T19:30:00.054Z",
  "actor": {
    "objectType": "Agent",
    "mbox": "mailto:tom@example.com"
  },
  "verb": {
    "id": "http://adlnet.gov/expapi/verbs/failed",
    "display": {
      "en-US": "failed"
    }
  },
  "result": {
    "success": false,
    "duration": "PT112.32S",
    "score": {
      "scaled": 0.375,
      "raw": 37.5,
      "min": 0,
      "max": 100
    }
  },
  "context": {
  "registration": "ec531277-b57b-4c15-8d91-d292c5b2b8f7",
    "contextActivities": {
      "parent": [you can check uuu it
        {
          "id":
"http://xapi.composica.com/activity/course/3dd6134f-e922-45b4-a741-3a461aa480d7",
```

```
                    "type": "http://adlnet.gov/expapi/activities/course"
                }
            ],
            "grouping": [
                {
                    "id":
"http://xapi.composica.com/activity/course/3dd6134f-e922-45b4-a741-3a461aa480d7",
                    "type": "http://adlnet.gov/expapi/activities/course"
                },
                {
"id":"http://xapi.composica.com/activity/course/3dd6134f-e922-45b4-a741-3a461aa480d7/objecti
ve/test-ixi0zvmt1?attemptId=50fd6961-ab6c-4e75-e6c7-ca42dce50dd6",
                    "definition":{
                        "name":{
                            "en-US":"Attempt of the Pre-Test"
                        },
                        "description":{
                            "en-US":"The activity representing an attempt of the Pre-Test"
                        },
                        "type": "http://adlnet.gov/expapi/activities/attempt"
                    }
                }
            ]
        }
    },
    "object": {
        "id":
"http://xapi.composica.com/activity/course/3dd6134f-e922-45b4-a741-3a461aa480d7/objective/te
st-ixi0zvmt1",
        "objectType": "Activity",
        "definition": {
            "type": "http://adlnet.gov/expapi/activities/assessment"
            "name": {
                "en-US": "Pre-Test Path"
            }
        }
    }
}
```

5.2.8 Progressed Statement

```
{
```

```
"id": "de73e42e-36cf-498d-9125-af98640050d4",
"timestamp": "2019-08-14T21:05:53.219Z",
"actor": {
  "objectType": "Agent",
  "mbox": "mailto:tom@example.com"
},
"verb": {
  "id": "http://adlnet.gov/expapi/verbs/progressed",
  "display": {
    "en-US": "progressed"
  }
},
"result": {
  "score": {
    "scaled": 0.356
  }
},
"context": {
 "registration": "ec531277-b57b-4c15-8d91-d292c5b2b8f7",
  "contextActivities": {
     "grouping": [
        {
         "id":
"http://xapi.composica.com/activity/course/3dd6134f-e922-45b4-a741-3a461aa480d7",
         "type": "http://adlnet.gov/expapi/activities/course"
       },
        {
"id":"http://xapi.composica.com/activity/course/3dd6134f-e922-45b4-a741-3a461aa480d7?attempt
Id=50fd6961-ab6c-4e75-e6c7-ca42dce50dd6",
         "definition":{
             "name":{
                "en-US":"Attempt of FPD420 Reviewer Training Course"
             },
             "description":{
                "en-US":"The activity representing an attempt of the FPD420 Reviewer
Training Course"
             },
             "type": "http://adlnet.gov/expapi/activities/attempt"
          }
        }
     ]
  }
},
"object": {
```

```
    "id": "http://xapi.composica.com/activity/course/3dd6134f-e922-45b4-a741-3a461aa480d7",
    "objectType": "Activity",
    "definition": {
      "type": "http://adlnet.gov/expapi/activities/course",
      "name": {
        "en-US": "FPD420 Reviewer Training Course "
      },
      "description": {
        "en-US": "Duplicate of Deployed FPD420 v2.0.0 for migration"
      }
    }
  }
}
```

5.2.9 Suspended Statement

```
{
  "id": "578d3b36-bd28-4cbb-b048-595c21c9a5a0",
  "timestamp": "2019-08-14T21:05:53.221Z",
  "actor": {
    "objectType": "Agent",
    "mbox": "mailto:tom@example.com"
  },
  "verb": {
    "id": "http://adlnet.gov/expapi/verbs/suspended",
    "display": {
      "en-US": "suspended"
    }
  },
  "context": {
    "registration": "ec531277-b57b-4c15-8d91-d292c5b2b8f7",
    "contextActivities": {
      "grouping": [
        {
          "id":
"http://xapi.composica.com/activity/course/3dd6134f-e922-45b4-a741-3a461aa480d7",
          "type": "http://adlnet.gov/expapi/activities/course"
        },
        {
"id":"http://xapi.composica.com/activity/course/3dd6134f-e922-45b4-a741-3a461aa480d7?attempt
Id=50fd6961-ab6c-4e75-e6c7-ca42dce50dd6",
          "definition":{
```

```
            "name":{
                "en-US":"Attempt of FPD420 Reviewer Training Course"
            },
            "description":{
                "en-US":"The activity representing an attempt of the FPD420 Reviewer
Training Course"
            },
            "type": "http://adlnet.gov/expapi/activities/attempt"
        }
      }
    ]
  }
},
"object": {
  "id": "http://xapi.composica.com/activity/course/3dd6134f-e922-45b4-a741-3a461aa480d7",
  "objectType": "Activity",
  "definition": {
    "type": "http://adlnet.gov/expapi/activities/course",
    "name": {
      "en-US": "FPD420 Reviewer Training Course "
    },
    "description": {
      "en-US": "Duplicate of Deployed FPD420 v2.0.0 for migration"
    }
  },
  "result": {
    "success": false,     // <-- Assuming the pre-test was failed -->
    "duration": "PT942.11S",
    "score": {
      "scaled": 0.375 // <-- Assuming the pre-test was failed with this score -->
    },
    "completion": false // <-- Assuming the course was exited before completed -->
  }
}
}
```

5.2.10 Resumed Statement

```
{
  "id": "835d8f4d-76e3-4f64-a744-8769d39564e1",
  "timestamp": "2019-08-14T21:06:26.982Z",
  "actor": {
```

```
    "objectType": "Agent",
    "mbox": "mailto:tom@example.com"
  },
  "verb": {
    "id": "http://adlnet.gov/expapi/verbs/resumed",
    "display": {
      "en-US": "resumed"
    }
  },
  "context": {
    "registration": "ec531277-b57b-4c15-8d91-d292c5b2b8f7",
    "contextActivities": {
      "grouping": [
        {
          "id":
"http://xapi.composica.com/activity/course/3dd6134f-e922-45b4-a741-3a461aa480d7",
          "type": "http://adlnet.gov/expapi/activities/course"
        },
        {
"id":"http://xapi.composica.com/activity/course/3dd6134f-e922-45b4-a741-3a461aa480d7?attempt
Id=50fd6961-ab6c-4e75-e6c7-ca42dce50dd6",
          "definition":{
            "name":{
              "en-US":"Attempt of FPD420 Reviewer Training Course"
            },
            "description":{
              "en-US":"The activity representing an attempt of the FPD420 Reviewer
Training Course"
            },
            "type": "http://adlnet.gov/expapi/activities/attempt"
          }
        }
      ]
    }
  },
  "object": {
    "id": "http://xapi.composica.com/activity/course/3dd6134f-e922-45b4-a741-3a461aa480d7",
    "objectType": "Activity",
    "definition": {
      "type": "http://adlnet.gov/expapi/activities/course",
      "name": {
        "en-US": "FPD420 Reviewer Training Course "
      },
      "description": {
```

```
        "en-US": "Duplicate of Deployed FPD420 v2.0.0 for migration"
      }
    }
  }
}
```

5.2.11 Completed Statement

```
{
  "id": "cfb6ef82-5db0-4410-b69f-180393287be0",
  "timestamp": "2019-08-14T21:22:28.466Z",
  "actor": {
    "objectType": "Agent",
    "mbox": "mailto:tom@example.com"
  },
  "verb": {
    "id": "http://adlnet.gov/expapi/verbs/completed",
    "display": {
      "en-US": "completed"
    }
  },
  "result": {
    "duration": "PT962.11S",
    "score": {
      "min": 0,
      "max": 100
    },
    "completion": true
  },
  "context": {
    "registration": "ec531277-b57b-4c15-8d91-d292c5b2b8f7",
    "contextActivities": {
      "grouping": [
        {
          "id":
"http://xapi.composica.com/activity/course/3dd6134f-e922-45b4-a741-3a461aa480d7",
          "type": "http://adlnet.gov/expapi/activities/course"
        },
        {
          "id":"http://xapi.composica.com/activity/course/3dd6134f-e922-45b4-a741-3a461aa480d7?attempt
Id=50fd6961-ab6c-4e75-e6c7-ca42dce50dd6",
          "definition":{
```

```
            "name":{
                "en-US":"Attempt of FPD420 Reviewer Training Course"
            },
            "description":{
                "en-US":"The activity representing an attempt of the FPD420 Reviewer
Training Course"
            },
            "type": "http://adlnet.gov/expapi/activities/attempt"
        }
      }
    ]
  }
},
"object": {
  "id": "http://xapi.composica.com/activity/course/3dd6134f-e922-45b4-a741-3a461aa480d7",
  "objectType": "Activity",
  "definition": {
    "type": "http://adlnet.gov/expapi/activities/course",
    "name": {
      "en-US": "FPD420 Reviewer Training Course "
    },
    "description": {
      "en-US": "Duplicate of Deployed FPD420 v2.0.0 for migration"
    }
  }
}
}
}
```

5.2.12 Terminated Statement (Completed and Passed)

```
{
  "id": "e0af420a-901b-4eaf-ba9b-10ac98994500",
  "timestamp": "2019-08-14T21:22:28.598Z",
  "actor": {
    "objectType": "Agent",
    "mbox": "mailto:tom@example.com"
  },
  "verb": {
    "id": "http://adlnet.gov/expapi/verbs/terminated",
    "display": {
      "en-US": "terminated"
    }
```

```
    },
  "result": {
    "duration": "PT962.11S",
    "score": {
      "scaled": 1, // <-- Assuming the pres-test was passed -->
      "raw": 100,
      "min": 0,
      "max": 100
    },
    "success": true // <-- Assuming the pres-test was passed -->
    "completion": true // <-- Assuming the course was completed -->
  },
  "context": {
    "registration": "ec531277-b57b-4c15-8d91-d292c5b2b8f7",
    "contextActivities": {
      "grouping": [
        {
          "id":
"http://xapi.composica.com/activity/course/3dd6134f-e922-45b4-a741-3a461aa480d7",
          "type": "http://adlnet.gov/expapi/activities/course"
        },
        {
"id":"http://xapi.composica.com/activity/course/3dd6134f-e922-45b4-a741-3a461aa480d7?attempt
Id=50fd6961-ab6c-4e75-e6c7-ca42dce50dd6",
          "definition":{
            "name":{
              "en-US":"Attempt of FPD420 Reviewer Training Course"
            },
            "description":{
              "en-US":"The activity representing an attempt of the FPD420 Reviewer
Training Course"
            },
            "type": "http://adlnet.gov/expapi/activities/attempt"
          }
        }
      ]
    }
  },
  "object": {
    "id": "http://xapi.composica.com/activity/course/3dd6134f-e922-45b4-a741-3a461aa480d7",
    "objectType": "Activity",
    "definition": {
      "type": "http://adlnet.gov/expapi/activities/course",
      "name": {
```

```
        "en-US": "FPD420 Reviewer Training Course "
      },
      "description": {
        "en-US": "Duplicate of Deployed FPD420 v2.0.0 for migration"
      }
    }
  }
}
```

5.2.12 Terminated Statement (Not Completed or Passed)

```
{
  "id": "e0af420a-901b-4eaf-ba9b-10ac98994500",
  "timestamp": "2019-08-14T21:22:28.598Z",
  "actor": {
    "objectType": "Agent",
    "mbox": "mailto:tom@example.com"
  },
  "verb": {
    "id": "http://adlnet.gov/expapi/verbs/terminated",
    "display": {
      "en-US": "terminated"
    }
  },
  "result": {
    "duration": "PT962.11S",
    "score": {
      "scaled": 0.375, // <-- Assuming the pres-test was failed -->
      "raw": 37.5,
      "min": 0,
      "max": 100
    },
    "success": false // <-- Assuming the pres-test was failed -->
    "completion": false // <-- Assuming the course was not completed -->
  },
  "context": {
    "registration": "ec531277-b57b-4c15-8d91-d292c5b2b8f7",
    "contextActivities": {
      "grouping": [
        {
          "id":
"http://xapi.composica.com/activity/course/3dd6134f-e922-45b4-a741-3a461aa480d7",
```

```
        "type": "http://adlnet.gov/expapi/activities/course"
      },
      {
"id":"http://xapi.composica.com/activity/course/3dd6134f-e922-45b4-a741-3a461aa480d7?attempt
Id=50fd6961-ab6c-4e75-e6c7-ca42dce50dd6",
        "definition":{and I will
            "name":{
                "en-US":"Attempt of FPD420 Reviewer Training Course"
            },
            "description":{
                "en-US":"The activity representing an attempt of the FPD420 Reviewer
Training Course"
            },              "type": in m"http://adlnet.gov/expapi/activities/attempt"
            }
        }
      ]
    }
  },
  "object": {
    "id": "http://xapi.composica.com/activity/course/3dd6134f-e922-45b4-a741-3a461aa480d7",
    "objectType": "Activity",
    "definition": {
      "type": "http://adlnet.gov/expapi/activities/course",
      "name": {
        "en-US": "FPD420 Reviewer Training Course "
      },
      "description": {
        "en-US": "Duplicate of Deployed FPD420 v2.0.0 for migration"
      }
    }
  }
}
```