Interoperability Standards for Adaptive Instructional Systems: Summary of Use Cases

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Background

Adaptive instructional systems (AISs) – tools and methods that tailor each student's instructional experiences to their needs within a set of domain learning objectives – are becoming increasingly common. In an ideal configuration, AISs work in concert using open interoperability standards to provide a seamless experience for students and instructors, while leveraging high-frequency contextual data to inform the learning flow. With the large amount of learning interactions that can take place in AISs, however, existing industry standards are unable to support the interoperability and extensibility of components within an AIS and among different AISs.

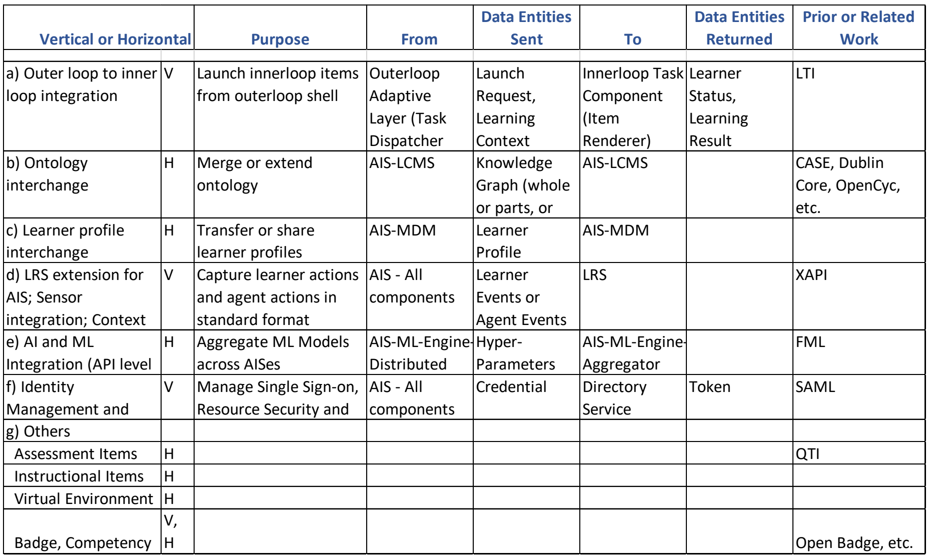
The Integration Landscape

AISs involve a highly complex process that requires a technology and data-driven system of integrating instructional resources, learning objectives, and assessment activities into single, progressive modular learning elements that can be adapted to individual learners, reordered, or shared between learning systems. The integration can happen at multiple phases and can also happen either vertically within a single AIS instance or horizontally across multiple AIS instances.

In an ecosystem of adaptive learning process and system components, the implementation typically employs a Plan-Build-Deliver-Analyze cycle. During the Plan phase, the learning map and the blueprint (i.e. goals) provide the basis for curriculum planning. During the Build phase, content including the courseware, instructional, and assessment items are created. During the Deliver phase (runtime), the AIS runtime system can be integrated with an environment like Customer Relationship Management (CRM), Student Information System (SIS), or Enterprise Resource Planning (ERP). The individual components that plug into the runtime AIS environment need to transfer control, pass runtime data entities among components and capture real-time learning event data in the Learning Record Store (LRS) for analysis and reporting purposes. Taken all together, some existing standards or conventions can provide an initial step toward both the design time and runtime integration, but all require extensions to be effective in this AIS ecosystem.

Use Cases

In order to plan and implement the interop standards, we started with an initial use case analysis and the following table is an initial attempt to capture that.



Vertical or Horizontal		Purpose	From	Data Entities Sent	To	Data Entities Returned	Prior or Related Work
a) Outer loop to inner loop integration	V	Launch innerloop items from outerloop shell	Outerloop Adaptive Layer (Task Dispatcher	Launch Request, Learning Context	Innerloop Task Component (Item Renderer)	Learner Status, Learning Result	LTI
b) Ontology interchange	H	Merge or extend ontology	AIS-LCMS	Knowledge Graph (whole or parts, or	AIS-LCMS		CASE, Dublin Core, OpenCyc, etc.
c) Learner profile interchange	H	Transfer or share learner profiles	AIS-MDM	Learner Profile	AIS-MDM		
d) LRS extension for AIS; Sensor integration; Context	V	Capture learner actions and agent actions in standard format	AIS - All components	Learner Events or Agent Events	LRS		XAPI
e) AI and ML Integration (API level	H	Aggregate ML Models across AISes	AIS-ML-Engine-Distributed	Hyper-Parameters	AIS-ML-Engine-Aggregator		FML
f) Identity Management and	V	Manage Single Sign-on, Resource Security and	AIS - All components	Credential	Directory Service	Token	SAML
g) Others							
Assessment Items	H						QTI
Instructional Items	H						
Virtual Environment	H						
Badge, Competency	V, H						Open Badge, etc.

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