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Working Together to Strategically Connect the K–12 Enterprise:
Interoperability Standards for Education

A Resource for Non-Technical Leaders

Contents

This CoSN resource is related to the IT Management and Data Management skill areas from CoSN's *Framework of Essential Skills of the K–12 CTO.*

SECTION 1

Why Interoperability Standards Matter in K–12 Education

K–12 education institutions increasingly are looking to digital content and related e-learning technologies to meet evolving education needs and goals. Technology-based products, services and resources are making positive impacts on education and are improving efficiency and outcomes in teaching, learning, and classroom and school management. And yet, as educators grow more sophisticated in their use of technology, there are roadblocks that prevent the full promise of education technology from being fulfilled.

Today, most digital resources and tools are not *interoperable*. That is, generally, data from one system or software package cannot be shared with others – it is trapped in "data siloes". As a result, if a teacher wants to gain a comprehensive view of a student's performance, she must take data from a number of systems such as summative and formative assessment data plus grade book plus data from various software programs, plus student information, export it to a spreadsheet and then manipulate it manually. If a teacher wants to mix and match different digital resources, her students will have to log in to each resource separately requiring multiple ID's and passwords. If a district wants to enroll students in a digital offering such as interactive math or language arts software, they will have to export all the information about what class, teacher, and students are to be signed up, manipulate it to be the correct format, then send it to the vendor – this has to be done every time a student joins or leaves the class.

The promise of education technology is a learning environment where students have seamless access to multiple resources covering the same content, targeted at that student's current level of understanding. Students have real-time dashboards that show what they have accomplished and what they have yet to master. Student dashboards roll up into teacher dashboards which roll up into grade level and building level dashboards for the principal. Student learning is adaptive and based on real time performance data. Teaching is adaptive and data-informed. Parents can see how their student is doing at a glance. The promise of education technology relies on interoperability.

Interoperability also is a logical response to the growing demand for data warehousing, sophisticated analytics, accountability reporting, and performance management tools. Districts

are seeking to leverage their content and data assets strategically across a number of systems and assemble best-of-breed solutions that integrate content and applications from a variety of sources and vendors. For cost efficiencies, as well as teaching and learning effectiveness, interoperability standards are a necessary component of these emerging systems.

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Over the past decade, K–12 stakeholders have been collaborating to define the underlying and architectural standards necessary for plug-and-play interoperability. These initiatives are producing useful and promising results. Although the process is far from complete, the foundation for interoperability exists today.

There are many different, overlapping categories of interoperability, each with its own challenges and evolving standards. File sharing, for example—involving common file formats such as CSV, HTML, XML, PDF and Open Document Format—is a simple form of interoperability that has matured to such a degree that many of us take for granted the ability to use our choice of tools to read, and even edit, files created in a totally separate application. Digital accessibility, on the other hand, is more complex, with laws, guidelines and standards that could be the topic of an entirely separate publication.

Eight Key Areas of Interoperability Standards

This primer focuses on eight key areas of interoperability standards

1. Digital content
2. Data connectivity
3. Data integration
4. Authentication, authorization and identity management
5. Rostering
6. Portals and portlets
7. File sharing
8. Network infrastructure
9. Digital accessibility

This primer also covers interoperability governance at the district level, and looks ahead with salient questions about using interoperability standards.

SECTION 2

Eight Key Areas of Interoperability Standards

Digital Content

Digital content interoperability allows seamless access to digital content and software for students and teachers, generally through a student learning platform or learning management system (LMS.) The LMS provides access to content, whether developed by teachers, purchased from vendors, or accessed as Open Educational Resources (OER) with mix-and-match functionality. The teacher can assign differentiated material to groups of students, specific material for a specific student, or shared content. Content can be pulled from a variety of sources, using OER for one lesson and a vendor purchased software package for the next. Further, students need only log in once to their LMS which handles authenticating to all the other digital resources and services – a feature referred to as Single Sign-On (SSO).

Single Sign-On solutions are common among leading districts whether they are implemented using an LMS, a portal, or a 3d party software solution.

With the development of the IMS Learning Consortium Standards, content interoperability is now increasingly prevalent.

Efforts to standardize content formats and interfaces emerged to connect content most efficiently to relevant users. Three main standards for content interoperability grew out of specifications established by the IMS Global Learning Consortium, an international, nonprofit community of educational institutions, suppliers and government organizations. IMS Global originally started in 1997 as an initiative of EDUCAUSE, a nonprofit association of IT leaders and professionals in higher education. Over time, the scope was broadened to include K–12, as well as corporate and government e-learning initiatives. Now a separate entity from EDUCAUSE, IMS Global developed these standards for content packaging and metadata:

1. Common Cartridge (CC)
2. Question and Test Interoperability (QTI™)
3. Learning Tools Interoperability (LTI)

In addition to these standards, IMS Global maintains a conformance certification process for content providers and delivery systems, which includes Common File Format (CFF) and Accessible Portable Item Protocol™ (APIP).

Digital Content Interoperability Standards

Common Cartridge (CC)
www.imsglobal.org/commoncartridge.html
www.imsglobal.org/digitallearningservices.html.
Common Cartridge, *Common Cartridge Content Hierarchy* and *Learning Tools Interoperability*.

Question and Test Interoperability (QTI)
Accessible Portable Item Protocol (APIP)
http://www.imsglobal.org/apip/
http://www.imsglobal.org/question/.
http://www.imsglobal.org/cc/statuschart.cfm.

Learning Tools Interoperability (LTI)
http://www.imsglobal.org/toolsinteroperability2.cfm

SCORM (Sharable Content Object Reference Model)
Content Aggregation Model (CAM)
http://www.adlnet.gov/scorm/

Case Study

Content Integration in Katy ISD

Katy ISD is a flourishing suburban school district that encompasses 181 square miles in southeast Texas. Student enrollment is around 73,000 students served by over 60 schools. It is located in one of the fastest growing areas in the country, growing by about 3,000 students per year. Katy ISD strives to create an environment where students have an equal opportunity to be connected inside and outside the classroom. Early on, Katy ISD pioneered the adoption of Bring-Your-Own-Device (BYOD) as a way to promote technology integration into the classroom. The district has since continued on with a more comprehensive strategy of integrating technology into the learning process by supporting more devices in the classroom, bridging the digital divide, providing access via cloud technology, training for leadership and teachers, supporting decision-making through effective data systems and building a robust network infrastructure.

The most important work in support of this strategy is the seamless integration of content into the district's online learning platform. The platform allows teachers and students as well as parents to access interactive and engaging online content and resources specific to each classroom in a standard and consistent way. Teachers are able to identify instructional materials, personalize activities, assign and prepare learning tasks inside and outside the school environment. In an effort to move away from the costly customization of content integration, Katy ISD recently has embarked on a substantial effort of streamlining the integration of digital resources into its online learning platform.

The Challenge: Katy ISD has adopted an online learning platform that is compliant with IMS Global open standards, which are a key factor in supporting the seamless data and security integration strategy that the district is seeking.

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Case Study

Content Integration in Katy ISD

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Previously, the district purchased content from high school publishers through the state of Texas adoption process for instructional materials. Although the district's platform supports open standard integration, many providers, including textbook publishers, were not in compliance with these standards. Additionally, some existing content and tools were not standards-compliant—and vendors were not eager to jump on the bandwagon to quickly bring those products into compliance.

The Solution. Katy ISD started work on a district content integration strategy by engaging stakeholders with a variety of expertise in technology, curriculum, textbook publishing and district administration. Their first step was to build common consensus and understanding as well as to identify the overall benefits, goals and objectives. The following are some of the main objectives identified early on in the process:

- Preserve the long-term investment in the learning platform.
- Lower the cost of acquisition and integration of content and digital resources.
- Improve the flexibility of integrating content and digital resources.
- Allow for seamless integration of content and digital resources.

Some long-term measures taken to address the challenge made it a requirement of the acquisition process that all new content providers be in compliance with the IMS Global Learning Tools Interoperability (LTI) and/or Common Cartridge (CC) standards (or commit to be in compliance within a specified period of time). For the short-term—and to create more leverage with existing vendors—Katy ISD has joined forces with neighboring Houston ISD to negotiate content integration.

Houston ISD was in the process of implementing its own online learning platform, a different platform than Katy ISD's, and was running into similar challenges. Because of its size, it was easier for Houston ISD to build good partnerships with willing publishers, such as Houghton Mifflin Harcourt, and negotiate for CC integrations for its science digital adoptions. Katy ISD knew of the publishers who were working with Houston ISD, and was able to more effectively communicate with these publishers to deliver its own district content, specifically in the chemistry course adoption as a Common Cartridge. The effort to integrate content in Katy ISD will continue as more content and resources are added through new state of Texas instructional materials adoptions.

Katy ISD believes that conformance to open standards will lower its cost of acquisition and improve its ability to adapt to changing content and technology. By allowing school districts to "plug-and-play" content and tools from other vendors, districts can adopt one platform only, while affording the flexibility of access to multiple sources of content. It is less costly and much more efficient. Katy ISD is committed to open interoperability standards and will continue to work with other school districts and organizations such as IMS Global to promote this effort.

Katy ISD is currently a member of IMS Global and CoSN, which also supports open interoperability standards in education. This collective effort is important to the future of interoperability in education.

Data Connectivity

Data connectivity is the ability to transfer data into and out of databases in an efficient and cost-effective way.
Mission-critical applications, including enterprise resource planning (ERP), student information systems (SIS), learning management systems (LMS) and data warehouse applications use databases. These systems have zero tolerance for delays or errors in accessing, processing and storing data. Unreliable data connectivity design can lead to poor performance, availability and scalability, and to data integrity issues that have direct impact on cost and risk for districts.

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There are several data connectivity standards described below. These are implemented by "drivers" that can translate from one standard database language to another. By using these drivers, systems can access different databases. Sometimes database vendors will provide free drivers, but it is important to evaluate whether these meet the performance requirements for critical systems and whether they include proprietary extensions that make it very difficult to switch to a different database vendor in the future.

Several connectivity standards are on the market today for accessing the most popular database platforms. Making a proactive, conscious decision to use enterprise products that support a single data connectivity standard can help greatly with production performance, reliability and scalability. When this is not possible, it is necessary to find data solutions that address the connectivity challenges offered by multiple standards.

Third-party database connectivity products offer an alternative for critical system deployments. Such products serve a specialized purpose—facilitating data connectivity among all the components of a data system—and typically support required features without forcing lock-in to a specific database or version.

Open Standards vs. Interoperability
It is important to note that there is a difference between open standards and interoperability. While open standards tend to be more inclusive and broad, interoperability is less broad and can be limited to certain vendors or products. Interoperability can be between two products or among a range of products, or driven by a dominant product. Open standard is more inclusive and a result of an open protocol adopted by a community of vendors and stakeholders. For example, Internet Protocol (IP) is an open specification that allows networks

to function. Any vendor can take advantage of IP by developing hardware and software around it.

It is also important to note that open source has played a big role in IT world. Several open source communities are developing and distributing data connectivity standards on an ad hoc basis. Although these are still in progress, the open source community—given its commitment to open standards and history of success at providing open solutions such as

Data Connectivity Standards
Open Database Connectivity (ODBC)
msdn.microsoft.com
http://www.simba.com/odbc.htm

Java Database Connectivity (JDBC)
http://docs.oracle.com/javase/tutorial/jdbc/basics/

ActiveX Data Objects (ADO)
ActiveX Data Objects for .NET (ADO.NET)
https://msdn.microsoft.com/en-us/library/aa286484.aspx

Object Linking and Embedding Database (OLE DB)
https://msdn.microsoft.com/en-us/library/ms722784(VS.85).aspx

Data Integration

Data integration involves combining data residing in different sources and providing users with a unified view of these data. It begins with *data connectivity* (described above), but goes beyond connecting a system to a database to make the data usable by each application.

In order for real-time dashboards to become a reality, for instance, data from numerous sources need to be integrated automatically, rather than manually using a spreadsheet or other tool. Since the data from different sources look different, data integration means putting them in a standard format so each application can understand them.

Once all the data is in a standard format, it is possible to create applications like dashboards that take disparate data and create useful user views.

One challenge of data integration is that data structures often reside on different platforms. Integration specifications and standards have emerged to define how systems manage the exchange of information.

Consider these examples:

- **Data warehousing applications.** The data warehouse system extracts, transforms and loads data from several sources into a single schema. As a result of data integration, disparate data silos can be combined logically into a single and uniform data source in the data warehouse without having to migrate the physical data.
- **Integrating information systems together.** For example, most student information, learning management and assessment systems use the same data elements. A complex integration is required to streamline the sharing of student information, content and assessment data and, therefore, reduce the classroom setup time on teachers and students. Additionally, data integration is essential for ERP systems that combine finance, human resources and student information from different sources to simplify and automate business processes.

Data integration is not yet a mature field and numerous open problems remain unsolved. Much work has been invested by organizations such as Ed-Fi Alliance and initiatives such as Common Education Data Standards (CEDS), both described below, to develop integration standards.

Data Integration Standards and Tools

Common Education Data Standards (CEDS)
http://ceds.ed.gov/

Ed-Fi Alliance
http://www.ed-fi.org/

Learning Information Services (LIS)
http://www.imsglobal.org/lis/

School Interoperability Framework (SIF)
https://www.sifassociation.org/

Enterprise Service Bus (ESB)
http://en.wikipedia.org/wiki/Enterprise_service_bus

Authentication, Authorization and Identity Management

In order for districts to manage access to resources so that students can see the materials for their specific classes, teachers can see information and resources across all their classes, and administrators can see building-level information, there is a system in place to identify a person every time they log on (authentication) and to keep a record of the tools, resources, and data they are allowed to access or do (authorization).

The infrastructure and processes for creating the digital identities and performing authentication and authorization is referred to as identity management.

Authentication and Authorization
The majority of K–12 organizations use Microsoft Active Directory as their primary directory for authentication and authorization to digital resources. The challenge has been integrating the large number of applications used both on-premise and on the Internet to allow for a secure method of authentication and authorization from a school's primary directory.

There are two important "gatekeeper" processes involved with identity management:

- **Authentication** identifies a user through a username or ID, password, smart card, fingerprint or some other means.
- **Authorization** specifies access rights to resources. During the authorization process, the system uses a set of access control rules to decide whether requests are granted or rejected. In the K–12 world, this is generally accomplished by feeding user demographic data from human resources and/or student information systems to the identity management system. Additional information is derived from user demographics to determine authorization to various systems. For example, the system knows to automatically grant classroom teachers access to the grading system.

A variety of external systems used by schools also benefit from being able to authenticate from the same primary directory. This multitude of online systems requiring identifying information creates evolving identity management challenges. A new approach, known as federated identity management (FIM), allows users to sign on to multiple enterprise networks using the same user ID and password. Authentication and authorization over the Internet, where the types of communication are typically limited to HTTP and HTTPS, are performed through a number of communications protocols (described below).

Authentication and Authorization Protocols
Security Assertion Markup Language (SAML)
WS-Federation

OAuth 2.0

Identity Management

Identity management involves the business processes and supporting infrastructure needed for the creation, maintenance and use of digital identities. The central questions an identity management system (IDM) seeks to answer are:

- **Who are you?**
- **What are you allowed to do?**
- **How will the resources be managed to provide required access?**

The first two questions refer to authentication and authorization, discussed above. The third question relates to the *administration* of resources available for authenticated users. The administration of a central identity management repository across systems to create a single user account within a directory services system, such as Microsoft's Active Directory or Novell's eDirectory, can be further enhanced using open standards protocols such as LDAP (see directory).

In an educational setting, one example of identity management might be a K–12 school district and local community college agreeing to federate identities so high school students can log on to the wireless system at the community college to access online resources. This would require that the community college trust the quality of the district's identity system, and agree that the district policies for ensuring authentication are acceptable for students to access the wireless system. In this scenario the risk is reasonably low, so the trust required would likely be low as well. On the other hand, if a school wanted to have its students log on to take online tests, access grades or participate in classes, the risk of poor authentication would clearly be much higher.

Identity Management Standards

Shibboleth
shibboleth.internet2.edu/

Lightweight Directory Access Protocol (LDAP)
www.tech-faq.com/ldap-lightweight-directory-access-protocol.htmlhttp://www.tech-faq.com/ldap-lightweight-directory-access-protocol.html
http://www.tech-faq.com/ldap-lightweight-directory-access-protocol.html

OpenID
http://openid.net/foundation/

Rostering

Rosters are used to enroll large groups of students into software solutions and create their ID's and passwords. This is too cumbersome to do as a manual process and needs to be automated.

Rosters associate students and a teacher with a specific class, section, or program as well as associating the teacher with each group of students. Rosters can be used to manage digital access of groups of students by giving them access privileges to specific content and tools. They are also used for setting up accounts for students for 3d party applications.

These 3d party applications have traditionally been written with proprietary rostering formats. As a result, teachers or the IT organization have been forced to create a separate roster for each program purchased. This usually involves translating rosters from the school's internal format to many different proprietary formats. When there is a roster change, the updates have typically been done manually for each 3d party offering.

Rostering standards make it possible to readily automate the creation and sharing of rosters with 3d parties that support that standard. Schools and districts can maintain their rosters in any format, then automate the translation to a rostering standard. When a change happens, the roster needs only be updated once, then propagated to all 3d parties.

Rostering Data Standards and Tools

Common Education Data Standards (CEDS)
http://ceds.ed.gov/

SIF xPress Roster
https://www.sifassociation.org/

OneRoster
http://www.imsglobal.org/toolsinteroperability2.cfm

Portals and Portlets

Student portals, parent portals, employee portals and more are extremely common on school web sites. A portal is made up of portlets – or mini-portals – that sit in their own small window and act like a mini-portal for a given purpose such as email, weather reports, discussion forums, and news.

The availability of standards-compliant portlets allow districts to take advantage of the abundance of libraries with portlets ready to plug into their portals. Although smart apps and the cloud are beginning to replace some portal concepts, portals are still a mainstream product in many districts—and this environment is not going away anytime soon.

Portal and Portlet Standards

Java Specification Request (JSR) 168

Java Specification Request (JSR) 286
jcp.org/

Web Services for Remote Portals (WSRP)
www.oasis-open.org/committees/wsrp

File Sharing

File sharing is one of the earliest forms of electronic data and information exchange. Files are shared via the network, emails or flash drives. Files of all kinds are downloaded via the cloud or from an Internet website. In fact, the majority of information exchange happens via file sharing.

The challenge for school districts isn't so much the sharing of files, but the complex process of integrating large amounts of data stored in the files into another system. The process relies heavily on selecting the right file format, appropriate to the type of data, and data normalization, transformation and integration processes. This requires a significant investment in time and resources by district IT staff and vendors to build a comprehensive process using file transfers. This process normally ends up being a highly customized solution that isn't easily replicated by a vendor for other customers.

Data exchange is another area where file sharing plays a large role. The process involves taking data structured under one file format and subsequently transformed into data structured under another file format.

File Sharing Standards

Extensible Markup Language (XML)

XML for Analysis (XMLA)
http://www.xml.com/

Network File System (NFS)
http://pages.cs.wisc.edu/~remzi/OSTEP/dist-nfs.pdf

File Transfer Protocol (FTP)
http://www.w3.org/Protocols/rfc959/
http://www.coviantsoftware.com/what-is-secure-ftp.php

Common Internet File System (CIFS)
http://technet.microsoft.com/en-us/library/cc939973.aspx

Web Distributed Authoring and Versioning (WebDAV)
http://www.webdav.org/

Simple Mail Transfer Protocol (SMTP)
http://tools.ietf.org/html/rfc5321

Post Office Protocol 3 (POP3)
https://www.ietf.org/rfc/rfc1939.txt

Internet Message Access Protocol (IMAP)
https://tools.ietf.org/html/rfc3501

Multi-Purpose Internet Mail Extensions (MIME)
https://tools.ietf.org/html/rfc2045

Network Infrastructure

Network infrastructure is a vital component of the learning process in school districts. There are more devices supporting a variety of standards and providing a range of services, including Voice over IP (VoIP) communications, security cameras, badge readers, tablets and phones. Access to wired and wireless networks is expected everywhere in schools—with the ability to provide high-performance services in a cost-effective way.

As districts integrate more content from many Internet, social media and video sources into their curriculum, demand on the network infrastructure is increasing. Additionally, with the recent growth in the use of personal devices across all levels in districts, expectations from the infrastructure are high. It is important to address some of the critical standards that must be considered when implementing a wireless or wired network to support a high density and mission-critical environment such as education.

Network infrastructure encompasses an array of topics, typically including:

- Local or wide area network (LAN or WAN) telecommunication
- Computer hardware
- Databases
- Security and privacy
- Applications
- Cabling

Data, middleware, people, management systems and more are sometimes considered part of the infrastructure as well.

School districts must always select from the best and most appropriate national and international standards when determining which path to follow for the network infrastructure and architecture. Such decisions are typically made early on in the design process or when major upgrades to existing infrastructure are about to take place.

Network Architecture Standards
IEEE 802.x.
http://standards.ieee.org/about/get/

Network Encryption Standards
Wi-Fi Protected Access (WPA)
Wired Equivalent Privacy (WEP)
http://en.wikipedia.org/wiki/IEEE_802.11i-2004

Network Cabling Standards
EIA/TIA-568
http://www.linktionary.com/t/tia_cabling.html
http://www.tiaonline.org/

Network Management Standards
ISO Fault, Configuration, Accounting, Performance and Security (ISO FCAPS)
http://en.wikipedia.org/wiki/FCAPS http://www.iso.org/iso/home.html
http://www.itlibrary.org

Network Security and Privacy Standards
ISO 27001
ISO/IEC 27002:2013
http://www.iso.org/iso/home/standards/management-standards/iso27001.htm
http://www.27000.org/iso-27002.htm

The Payment Card Industry Data Security Standards (PCI DSS)
https://www.pcisecuritystandards.org/security_standards/

Security and Privacy Laws

To address privacy and security laws, it is important for districts to implement a comprehensive information security plan to protect the network and information systems from any potential threats. Security plans must include building a robust network infrastructure that adheres to the best industry standards for network connectivity and security.

The Family Educational Rights and Privacy Act (FERPA) is a federal law that sets the standards for student record privacy and confidentiality for all school districts that receive federal funding. FERPA deals directly with education records of students in terms of privacy and security. It gives parents and students the right to inspect and review educational records, request a correction on records if incorrect and decide to whom the records can be released. Network security plays a crucial role in ensuring compliance with privacy and security requirements dictated by this law. FERPA imposes certain requirements on how confidential data is stored and transmitted throughout a network. It also has ramifications on the destruction of data as well as the management of user access to student education records. Additionally, sharing information internally through district systems and externally via websites must be examined against FERPA requirements to avoid privacy violations of staff and students.
http://www2.ed.gov/policy/gen/guid/fpco/ferpa/index.html

The Children Internet Protection Act (CIPA) is a federal law to protect students from accessing offensive content while on school computing systems. It imposes requirements on school systems that receive funding for Internet access or network support from the federal E-rate program. The requirements include establishing an Internet safety policy that defines technology measures to deal with filtering and blocking of inappropriate content, including images and video through emails, chats or Internet.
http://www.fcc.gov/guides/childrens-internet-protection-act

The Children's Online Privacy Protection Act (COPPA) is a federal law that regulates the collection of personal information about children under the age of 13 via websites through school district Internet connections. The law requires that all websites post a clear and comprehensive privacy policy that states the requirement of parental permission before collecting personal information about a student under the age of 13. Personally identifiable information (PII) includes full name, home address, email address, telephone number or any other information that would allow someone to identify or contact a child. COPPA also addresses other kinds of information, such as hobbies and interests collected through website tracking mechanisms such as cookies, that can connect information to an individual.

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Security and Privacy Laws
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There are some exceptions to this law that allow a website operator to collect certain identifiable information without parent permission. For example, an operator can collect an email address to provide a notice or seek consent or respond to a one-time request from a child and then delete it. An exception is made for multiple communications of the same type via email with a child in the case of a newsletter subscription. In this case, the operator must notify the parent of such regular communication and allow the parent to opt out if desired.
http://www.coppa.org/

The Health Insurance Portability and Accountability Act (HIPAA) is a federal law that regulates individual student health records and other identifiable health information in schools and districts. Although HIPPA seems to overlap with FERPA, since many consider student health records to be educational records, the U.S. Department of Health and Human Services and the U.S. Department of Education require that both laws be applied in districts.
http://www.hhs.gov/ocr/privacy/index.html

Digital Accessibility

School districts are about educating all children regardless of their physical or mental ability. It is important for technology to be accessible to all students with diverse abilities. Digital accessibility standards address a host of impairments that include visual, hearing, physical or learning disabilities.

In many districts, the assistive technology department provides assistance and training to the more severely impaired students through specialized technology and staff. Some students needing assistance are in the low impairment category, requiring lower-level accommodations when it comes to accessing mainstream technology tools for their learning. For example, students with vision impairment should be able to easily enlarge screen size, listen to content or distinguish color for color blindness.

There may be legal implications to districts that do not provide reasonable accommodations to students with disabilities. Several federal laws explicitly address accessibility for information technology—and prohibit any federally funded entity from discriminating on the basis of disability.

Digital Accessibility Laws, Guidelines and Standards

Section 508
http://www.access-board.gov/guidelines-and-standards/communications-and-it/about-the-section-508-standards/section-508-standards

Web Content Accessibility Guidelines (WCAG)
http://www.w3.org/WAI/WCAG20/glance/
http://www.w3.org/WAI/intro/wcag.php

Website Accessibility Conformance Methodology (WCAG-EM)
http://www.w3.org/WAI/eval/conformance

Accessible Portable Item Protocol (APIP) also provides an interface to make tests and items accessible by students with disabilities.

AChecker
http://achecker.ca/checker/index.php

Universal Design for Learning (UDL)
http://www.cast.org/udl/index.html

National Instructional Materials Accessibility Standard (NIMAS)
http://www.education.nh.gov/instruction/special_ed/nimas.htm

SECTION 3

Interoperability Governance

IT interoperability and standards have become a strategic issue for technology leaders and school districts. In today's technology environment where cloud computing, virtual servers, desktops and mobility are transforming learning and the working of districts, the demand for a more strategic approach to interoperability for the whole organization is becoming increasingly important.

At the heart of interoperability is the ability for all systems and platforms to work together and deliver services seamlessly and in the most efficient manner across the whole district. When systems work well together, so will the organizational ability to collaborate, deliver services, cut costs, improve system security and privacy, drive transformation and serve customers efficiently.

However, to achieve effective interoperability, districts must first identify and agree on a set of standards and specifications that should define what is acceptable when procuring systems and platforms. In other words, there must be a governance model established by the whole organization to manage interoperability strategically.

There are inherent efficiencies for districts adopting interoperability standards. The most significant is the impact on teachers and students. Using open and adaptable standards provides teachers and students access to current content and curriculum resources, and ensures continued access if the technology delivery platform or the learning management system change over time. Changes to technology platforms should not result in loss of access for students or teachers. An additional benefit could be fiscal savings to districts. If content can be easily moved among systems, this means less cost and loss of productivity for staff.

When K–12 content providers each deliver digital material in their own proprietary formats, teachers, students, parents and district administrators encounter significant challenges. Managing data in multiple locations creates additional IT management cost, user access complexity and user experience problems—and it limits or eliminates the possibility of personalizing learning and making data-driven decisions. Lack of standardization also poses a challenge to vendors who have to integrate other content into their platforms by investing in creating one-time APIs that can't be replicated for other customers.

Developers of open standards strive to provide universal language for digital integration so that all content, activities, assessments, practices and data associated with digital resources can be

accessed in a single, content-agnostic platform. The significance of open standards integration packages is that they are non-proprietary, meaning that platform or management systems remain open to multiple sources of digital resources and vendors. The integration scripts are reusable with other platforms or LMS. Districts that adopt open interoperability standards retain their right to replace an LMS or platform without losing all the content integrations they have built with content providers over the years. Digital Interoperability standards allow purchased or developed content to be reintegrated into a new platform.

Teachers, students and parents can access day-to-day student activities and performance data, enhancing their ability to intervene or adjust their strategies in a timely fashion. Learners benefit from choices or and access to different formats for a given topic, such as audio, visual or written data; organizers, case studies and projects; languages, Lexile levels and other accommodations needed or desired. Districts and schools retain their right to replace or change their LMS without losing digital content. Digital content providers need to build only one integration package, which can be reused in other LMS or platforms.

Case Study

Interoperability Governance at Houston ISD

Houston Independent School District (ISD) is the largest school district in Texas and the seventh largest in the United States, with more than 215,000 students and 283 schools. Located in southeast Texas, the district serves the city of Houston and several nearby communities. Houston ISD prides itself on providing students with rigorous academic courses designed to prepare them for college and meaningful careers.

The Challenge. Houston ISD purchases instructional resources from more than 200 different content and tools providers. In addition, the district wants to leverage the collective knowledge and experience of its best teachers by supporting their ability to develop content. To make all of this content and tools available to teachers, students, parents and administrators, Houston needed a platform that could house all curriculum planning guides, content and tools.

Like other K–12 districts, Houston ISD has taken a stand on students' right to effective and even transformational use of technology in teaching and learning environments, so students can be prepared for the careers and/or college degrees of their choice. This means that students must have the ability to choose the content and tools that best suit their learning needs and preferences, with teachers, parents and administrators providing guidance in support of these choices and needs. In addition, students, teachers and parents should be able to access user and performance data in one single platform. This situation forced the district to reconsider how it purchases, produces and delivers content, and which digital communication, collaboration and productivity tools it needed.

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Case Study

Interoperability Governance at Houston ISD

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The Solution. Before making decisions, Houston ISD learned that some curriculum, content and learning management systems (platforms) are compliant with digital content interoperability standards—and some were not. The same is true of digital content providers. This difference determines whether or not a platform can provide, in a single location, searchable and discoverable content from multiple sources, from a large number of content producers, in a wide range of formats to accommodate learners' interests, preferences and needs. This is a critical component for personalized instruction.

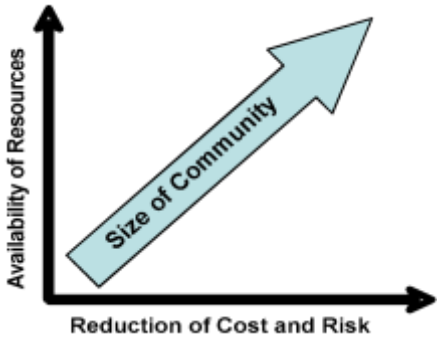
To meet this vision, Houston ISD chose a platform compliant with IMS Global digital content interoperability standards. The district also:

- Announced to all its vendors and partners that it now requires Common Cartridge, Thin Common Cartridge, and/or LTI and QTI integrations, depending on the best fits for each adopted digital material.
- Provided informational sessions about digital content interoperability for district leaders and procurement staff
- Modified its instructional materials purchasing process. Every digital content or resource, no matter who the purchasing agent is in the district, goes through the scrutiny of a digital content interoperability standards committee, which determines the ideal type of integration required, based on the nature of the digital material, before the contract goes through the procurement and legal departments.

SECTION 4

Looking Ahead

There is no one-size-fits-all approach to realizing the benefits of standardization. The development of robust, reliable industry standards is a complex and time-intensive process involving costs as well as benefits. How do you know when a set of interoperability standards is worth adopting?



To some degree your decision should be based on a realistic assessment of the maturity and empirical support for any standard. The more mature the approach or standard, the more likely it is to have support in the form of a community of practitioners, available documentation, examples, training and a pool of skilled staff members. On the other hand, a newer standard may be supported by enthusiastic pioneers and offer professional development and collaboration opportunities that compensate for the lack of industry maturity.

Even more important is determining how well the standard meets your needs. Will adopting it enable a critical user activity or high-priority enterprise capability? Will it lower costs, shorten development time or facilitate the maintenance and evolution of crucial systems? If the need is there, then carefully researching the different options to invest in products and approaches that support a chosen standard will be well worth the time.

With the rising importance of cloud computing, online learning, portals, modularity, data warehousing and performance management, interoperability standards have become more crucial than ever before. As the IT world shifts from a product-oriented to a service-oriented environment and schools struggle to make ends meet, it is essential for K–12 technology leaders to learn how to maximize the benefits of existing enterprise systems while adding new solutions that are cost-effective and scalable. None of this is possible without interoperability.

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