ZEALOUS PURSUIT:
A COMMERCIAL PERSPECTIVE ON E-LEARNING STANDARDS

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Abstract

The aims of the SCORM and IMS specifications are widely supported, with the IMS Question and Test Interoperability specification of particular interest within the CAA community. This paper suggests that, despite the widespread support, these specifications will have a large market impact, but fail to fulfil their key objectives. This is because they address a poorly-bounded problem domain and thus will remain incomplete, do not have a single creator, are too large for reliable implementation, offer little real incentive for most suppliers to make them work other than for demonstrations, and do not have an integral enforcement mechanism. It is also suggested that these standards will stifle innovation, and force small companies and individuals to pay the same price for some tools as large corporates.

Why standards: the interoperability problem

Creating online questions requires time and effort even with the best software tools. As a consequence, a decision to move from CompanyA's software to CompanyB's software will entail entering all of the questions again.

The aim of interoperability standards is twofold. First, to allow users to export their questions in a common format so that they can change suppliers without having to reenter all of their questions. Second, to allow users to employ CompanyA's software to edit their questions, and CompanyB's software to deliver their tests.

Often these problems are solved by competition. A company will amend its product so it can open a competitor's files. As more competitors do this a de facto standard emerges. An obvious example of this is the Microsoft Word file format.

Changes in the law may result in a decline in this practice, as increases in desktop computing power have made it easier for companies to encrypt their file formats. Breaking these formats is difficult, but more importantly illegal under US law.

The alternative to leaving the competitors in the market to evolve standards, is to form organizations to develop standard file formats for storing and exchanging question information. Many governments support this, with a wide range of education-related UK Government organizations explicitly publicizing them despite their sometimes unfinished form, and even requiring these standards from suppliers.

A commercial perspective

Question Tools recently implemented the SCORM standard for creating Sharable Content Objects (SCOs), and partly implemented the IMS QTI standard before deciding to wait until it is completed. As a result of our experiences with both the standards and with customers, this paper will examine the characteristics for a successful technical standard, and will go on to suggest that the SCORM and QTI standards will most likely:

- fail technically and not achieve their stated aims
- fail to help users avoid one of the most damaging problems during e-learning and e-assessment implementations
- have a significant market impact, becoming a requirement in almost all tenders
- make it difficult for potential new competitors to enter the market and thus stifle competition
- suppress innovation
- impose a punishing pricing model on small companies

Using SCORM

While the IMS QTI standards are more relevant to the task of computer-based assessment, it is the SCORM standard that is most likely to be used at present. The SCORM standard has been more widely implemented, and can in theory allow tests created as Sharable Content Objects (SCOs) to be delivered using a variety of Learning Management Systems (LMS).

For the purpose of this paper we will concentrate mostly on SCORM. However, the shortfalls illustrated apply to both SCORM and the IMS standards.

What are the features of a successful standard?

Single creator

Technical standards that emerge from individuals or small groups within one organizations seem to be successful, particularly if those people have a history of working in that field. The IEEE 1394 standard for connecting hard disks, digital video cameras, computers and thelike was developed by Apple and adopted by others. The USB standard for connecting a wide range of peripherals, such as keyboards, mice, printers, etc. was largely developed by Intel and then adopted by other companies.

Clear aims

Both the USB and IEEE 1394 standards had clear aims. They were to allow devices to connect at relatively high speeds. In addition, they allow devices to be plugged in and unplugged without turning off all connected equipment.

Well-bounded

A standard that tackles a well-bounded problem, such as communication between connected devices, may be more likely to succeed than a standard that addresses an area open to interpretation. For example, file formats for mixed vector, type and bitmap graphics are many and by no means new, and yet no working standard has emerged.

Postscript has been promoted as a standard by the leading player in the market, Adobe. Postscript has become very complex in order to accommodate the vast range of user expectations. Printers are sold as postscript compatible, and yet technical support staff for the printer companies frequently advise customers to avoid postscript.

Moreover, standards that are not well-bounded are often augmented by supplier companies. For example, the HTML standard specifies page layout in web browsers, and yet all of the major browser companies have added their own tags and justified this on the basis of the incompleteness of the HTML standard. What can and should be displayed visually is not only ultimately defined by users, but is also capable of changing over time as user expectations evolve.

Complete and consistent

Some widely-requested standards are neither complete nor consistent. Within the telecoms field there are a wide range of standards to allow electronic devices to communicate over telephone lines using DTMF tones (Dual Tone Multi Frequency). Experience has shown that some standards are not only incomplete, they are logically contradictory and impossible to implement.

A complete standard would normally be one that does not have optional features. If companies can opt out of parts of a standard then most will, and

the standard is reduced to its mandatory elements. Standards that have been successful or relatively successful tend not to have optional features.

Easy to implement

Standards have to be implemented by one or more individuals in the supplier companies. A standard written in a clear style, with good examples that really follow the standard, is more likely to be implemented successfully than a very large document with confusing and repetitive sections.

In addition, a larger standard is automatically harder to implement. Not only is there more to do, but a wider variety of unusual and untested conditions are possible. The complexity of a standard does not increase in a linear fashion as options and features are added, but in an exponential fashion. The complexity is a combination of its options and features, and with some standards not all combinations can be practically tested.

Easy to check

Experienced software developers will never claim that they can implement anything without making mistakes. A good standard is one that can be checked. Developers implementing USB and IEEE 1394 communications can check their product with other products. Competing suppliers will often blame each other when products fail to operate together, and a standard that is easy to check can help prevent this situation arising.

Easy to maintain

If conforming to the standard requires ongoing effort, without an apparent benefit, then this will increase the chances that the standard is neglected. For example, the SQL standard does not require much ongoing effort. Once a database developer has implemented an interface to accept SQL commands little more work is required. An SQL developer must use SQL commands, but this is usually no more effort than using a proprietary language. On the other hand, the disability standards that require ALT tags to be added to every image on every web page is an ongoing burden, without an obvious benefit for the person or organization inserting the tags.

Mutual benefits

A recurring theme with the adoption of new technology is the often implicit cost-benefit analysis users perform when considering whether to really use a technology (Eason, 1976; 1983; Booth, 1989, Faulkner, 2000). In this context, 'user' can be taken to include the IT companies that implement these standards. Apple adopted not just its own standard, but Intel's because USB provided access to input devices available to the larger Windows PC market. In order to work a standard needs to benefit users and suppliers.

Enforcement mechanism

To work a standard needs an effective enforcement mechanism. Products that connect and communicate using the USB and IEEE 1394 standards cannot work without these standards. A new USB-based disk drive that does not properly implement the standard will not work with other equipment, and thus the enforcement mechanism inevitably arises from the operation of the products that adopt it.

The mechanism for enforcing the ISO 9000 quality standard is a paper-based bureaucratic model that often sits outside companies' real quality assurance mechanisms. Conradi & Dyba (2001) point out that a concrete lifebelt can pass the ISO 9000 quality standard providing the same amount of concrete is poured into each lifebelt.

Figure 1. Standards for the visually impaired have no integral enforcement mechanism, and even the agencies charged with enforcing them do not always apply them to their own websites, with low-contrast text the norm in places.

A more pertinent example is provided by the recent standards on disability access to web pages for people with visual impairments. These include a requirement for text to be high-contrast following the trend amongst some graphic designers to include small light-grey text on white backgrounds. The UK Adult Learning Inspectorate inspects Adult Learning Colleges, and is funded through the Department for Education and Skills (DfES). The Adult Learning Inspectorate's remit includes ensuring disability access and that disability standards are enforced. Yet, the Adult Learning Inspectorate's website clearly breaches the disability standards (see figure 1), with small light blue text on a white background and grey text on a grey background.

Becta (British Educational Communications and Technology Agency), the government agency responsible for commissioning e-learning materials that insists that its suppliers conform to the disability guidelines. Yet, its website displays light blue text on a slightly lighter blue background (see figure 1).

Enforcement mechanisms that are implicit within the operation of the product work without intervention, while paper-based procedures that sit outside everyday operation are easily forgotten and missed, even by the very organizations charged with enforcing them.

The market impact of standards

Once a standard exists it will often have a large market impact. Every supplier has to conform in order to get past the first stage of the tender process for large contracts.

Many tender processes, and particularly government procurement processes, have two stages. The first is an administrative one where all submissions are checked against a list of criteria, often by a junior member of staff. The checks are usually crude, and might include bank references, appropriate insurance, etc. However, a list of standards that need to be adhered to is also a common requirement.

Put simply, if a company does not support all standards then it will not even be considered for many contracts, regardless of the quality and usefulness of the standard. Consequently, standards have a large effect on the market and upon the behaviour of suppliers.

Innovation and competition

For example, Question Tools built some relatively sophisticated support into its editors for users with visual impairments. Spoken explanations of tooltips were available and dialogs could be spoken as well as read. However, adding the sound files needed when the product was changed required effort. Moreover, these features, no matter how much appreciated by the small group of users with visual impairments, did not help the company tick any boxes on tender applications. As a consequence, we reluctantly dropped these features with a promise to reconsider them again at a later date.

Companies that survive and prosper are driven by the need to earn an income. Where standards exist and drive procurement the available development effort will be put towards implementing these standards, regardless of the true value of the standard. This leaves less time for innovative development. In this way, standards can stifle innovation and reduce a market to a dull conformity.

Market entry

Established companies in markets where entry is difficult are valued more highly. Difficult market entry prevents new and potentially dangerous competitors emerging. New competitors are more likely to have very different products, and can potentially take a large part of a market. Established competitors are less likely to emerge with a radical, threatening product.

For example, there was a time when the Alta Vista, HotBot, Excite and Yahoo competed as the premier search engines on the internet. Yet, the winner was Google, a new company with radically different technology. Had Alta Vista, HotBot, Excite and Yahoo been able to legally exclude Google from the market then they would have undoubtedly done so. Standards can provide exactly this mechanism. Standards inevitably reflect the current mindset and the way 'things are done' at present. Standards can accidentally exclude innovative competitors.

The technical reality of standards

Errors and inconsistencies

When companies commit to standards they commit their technical staff to implementing those standards. The technical staff often discover that the standards have inconsistencies and errors which means they cannot logically work. Some of the telecoms protocols for communicating via DTMF fall into this category. As a consequence, different companies implement different and incompatible workarounds.

Varying interpretations

Standards in areas that are not well-bounded can easily be interpreted differently by different companies. The larger the standard the greater the opportunity for this to occur.

Confusing documentation

Large, complex documents with lots of sections give the (often false) impression that a standard is well-considered and 'technical'. The confusion only adds to the mystic. A standard written in plain language with a good range of examples will be easier to implement. However, technical staff know from experience that confusing and large documents are the norm. They

increase the unpopularity of the task and reduce the chances that the standard will be implemented correctly.

Standards for sales

The reputation of standards as a 'sales thing' means that many companies will assign the task of implementing a standard to the least experienced / least valued, and possibly least capable engineer. There are always more important tasks for their experienced and valued engineers. As most companies will take the same approach, there is little chance the standard will really work. Experience in the telecommunications field suggests that only if there is real working demand for a standard will a company return to it and implement it carefully once others have also begun to do the same.

Avoiding standards

If a set of products are installed at a customer site, then standards will be avoided by the technical staff where possible. The staff can either use their own proven methods, formats and protocols to get the different hardware and software components to work together, or they can add to the cost and time of the project by using the new and unproven standard.

Many technical standards appear to work with the few examples available for sales demonstrations, but once used in earnest quickly fail. In this way standards can have a large market impact, be included and demonstrated in tenders and sales presentations, and yet never perform the task for which they were intended.

SCORM

We have examined the features of successful standards, and the large effect they can have upon a market and upon suppliers in that market. The issue now is how SCORM, the most requested standard in the e-learning field, performs when considered against the criteria for a successful standard.

SCORM has proved popular. It is a requirement for most large e-learning tenders. In commercial terms, it is near-essential. Yet, many of those judging supplier submissions cannot explain what SCORM is or attempts to achieve.

SCORM is an amalgamation of parts of other standards. SCORM allows content to be produced in an editor from one supplier, exported as a Sharable Content Object (SCO), and then delivered using a learning management system from another supplier.

SCORM has three parts:

- **Metadata**. The metadata model in SCORM specifies how data such as the language, title, author should be included.
- **Interface**. The commands that are used for communication between the learning management system and the content object.
- **Packaging**. The way the files are named, and the folders in which they are put, in a sharable content object.

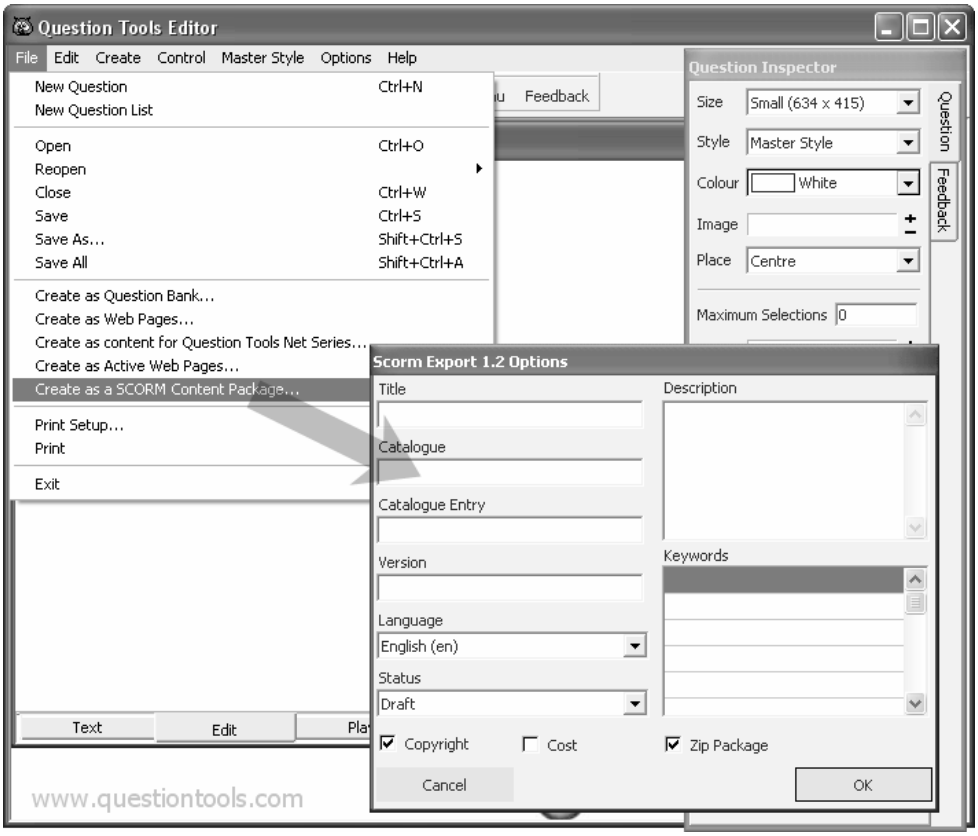

Figure 2. The metadata required for SCORM.

SCORM Metadata

The SCORM metadata model uses an XML file to store data. Essentially, the data that it stores can be seen in figure 2. Metadata is there to allow content objects to be added to databases, so that users can search and find the content they need.

The assumption is that everyone producing content will catalogue their materials in a sensible and consistent manner. Yet, experienced specialists working in libraries have difficulties with this task, and there is a precedent that suggests this will fail.

Metadata can be stored in web pages. Metatags can be used to enter the title of the page, the author, keywords, a description, as well as a variety of other data. These easy-to-use tags were employed so infrequently, and when they were used so inconsistently, that the second-generation web search engines,

such as Google, ignore this metadata and use only the content for the search instead.

In short, most popular and most effective search engines have been developed by ignoring metadata as the basis for a search. Yet, both SCORM and IMS standards are reliant on metadata — upon an approach that has already conspicuously failed.

SCORM Interface

The interface between the learning management system and the learning object is provided in SCORM through the CMI model. In brief, it has a protocol for starting the SCO, followed by a list of commands the learning object can use to communicate with the learning management system. However, the majority of commands are optional. This effectively reduces the specification to the extent that it can achieve only the following:

- The start and end time is recorded.
- A score can be saved, but the score may not exceed 100 or be less than 0.
- The state can be saved for small learning objects (less than 1Kb of space allowed).

Why question interoperability standards will probably fail

We have dealt with SCORM, which is intended to enable sharable content objects to work with learning management systems, but what about the IMS Question and Test Interoperability (QTI) standards? These standards are still being formulated, although some conclusions can be drawn from existing work.

The question interoperability standards will probably fail because they do not have a single creator, but are being designed by committee. In the case of IMS these committee members consist of any individual or company willing to pay a yearly fee who then vote on standards and changes. In a poorly-bounded problem domain, the probability of producing a huge standard that aims to do everything but does nothing well must be high.

The standard can probably never be complete, and if it is complete it will be so large as to be near-impossible to reliably implement or check. Already the standard is large and difficult to read. The use of metadata within the IMS standard rather than relying upon content search may also mean that content produced in the standard will be hard to maintain. Moreover, while there is clear market benefit from being able to claim compliance with the standard, it is not clear that there is a benefit for suppliers in ensuring that the standard truly works in a robust way. If this is the case, then ensuring the standard works technically will always remain a low priority within supplier companies.

Finally, the enforcement mechanism to check the standard is to test output against learning management systems that are believed to be compliant. The IMS organize 'plug-fests' where suppliers meet up and test their products with each others. Already there are reports of some suppliers tweaking their output to fit with others. This creates two problems. The first is that there is no true gold standard — no single and freely available piece of software or example content against with a product can be tested and declared compliant. The approach is more akin serial bigamy. The second is that the enforcement mechanism sits outside the normal operation of these products — it is not an integral part of each product, but an optional extra that will remain unused whenever the company has a choice. Its use may mirror that of postscript within the printer market — postscript compatibility is a marketing and sales claim, but a company's technical staff will advise customers to avoid it.

Destroying the price-value link

Linking the price of a product to its value to the customer is a common business practice. For example, companies supplying learning management systems will charge according to the number of users. In this way, a small company with 100 employees is not expected to pay the same amount as a large university with 20,000 students and an undoubtedly larger support requirement.

Question Tools adopts a similar approach, with its editors available free, and its NetSeries webserver / databases for collecting results priced per user. However, if our editors export content in a form that is delivered by other learning management systems we have no means of enforcing licensing conditions. Our only approach is to charge a large single fee for an editor that can export standards-compliant learning objects. In this way the standard forces a licensing model that disadvantages companies producing editors, and compels an individual trainer wishing to test 30 people to pay the same price as a multinational embarking on a programme to assess skill levels across 50,000 staff.

The omission

Committees formed from supplier companies are not going to set a standard such that it highlights a major problem, affecting many customers, if almost all of them suffer from this drawback. The SCORM and IMS QTI standards do little to highlight a problem that frequently catches out those new to the area and kills e-learning projects, wasting much effort and money.

A number of blue-chip companies have embarked upon e-learning experiments only to discover that their content cannot be rolled out to users because it requires a specialist web browser plug-in. Most of the major competitors in this area use Macromedia's products, and are dependent upon Flash, Director and Authorware plug-ins in web browsers. Yet, network

managers are frequently refuse to accept browser plug-ins in the interests of the economy of management and security. With security an ever-increasing problem, and attacks now coordinated and automated, it is likely that more network managers will begin to exclude plug-ins and anything else they view as a security risk.

Conclusion

If a standard had been written for web searching then it would have undoubtedly insisted upon a search based upon metadata and metatags. This would have excluded Google and the other second-generation search engines. Fortunately, the internet was not regulated and so competition through innovation could occur. Which radical and exciting approaches will SCORM and the IMS specifications exclude? How many paradigm-breaking companies will never enter the market because of these hurdles?

SCORM and the IMS Interoperability standards / specifications have already made a large impact in the marketplace, frequently appearing as essential requirements on calls for tender.

- All serious market players will sign up to these standards or face exclusion from most tenders, unless they have an alternative revenue base.
- The standards, however, have a profile which suggests they will not succeed. They will be important for sales, but will probably fail technically.
- The standards will provide a significant barrier to new market entries and will most likely stifle innovation and competition. They will entrench the current way of doing things, which may be unwise when the field is far from mature.

While the standards have acquired a ‘Emperor’s New Clothes’-like status, those that have read the standards in detail have grave doubts. Arneil and Holmes (2003), the creators of the very successful Hot Potatoes editors from Half-Baked Software, have raised a number of questions about the IMS QTI specification and the way it has been implemented.

From a company perspective Question Tools will most likely benefit from the standards, even if we join Half Baked Software and refuse to support them as they stand, as Question Tools already has a revenue base and registered users in 97 countries. In a crowded and emerging marketplace competitors will fall away as either their products prove inadequate or their development debt overtakes them. The problem with web browser plug-ins will further damage and remove our competitors, while the standards will make it difficult, expensive and time-consuming for new competitors to enter the marketplace.

The standards are good news for Question Tools, although it is hard to celebrate when these standards are likely to be bad news for education, innovation, users, choice and competition.

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