

Educational standards supporting UN Sustainable Development Goal 4

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It could be argued that better education for all will have best effect on all UN Sustainability goals. The same could be argued for all of other Sustainability goals as well. The arguments used for standardization in this paper, would also be viable arguments for ICT standardization used within all of the other Sustainability goals, to build better services and gain more insight, we must focus on interoperability and harmonization of how we view and gather data.

A standard is in principle a document with a common agreement among a group of experts, on how a specific problem should be solved. Within ICT is mostly about how we describe, exchange, access data or the processes we follow in achieving a given goal. What separates the different “formal” standardization bodies are the rules and procedures for how documents are being governed, rules for approval of an agreed document, rules for how a document is being updated, and rules for how errors and flaws are being solved and addressed. ISO and IEC are among the most recognized formal standardization organizations.

The committee within ISO and IEC responsible for standardization of all ICT used to address different aspects of education has the numbered name of ISO/IEC JTC 1¹/SC 36², this indicates that this is a group governed by the rules of both ISO and IEC. The title of the committee is “Information Technology for Learning, Education and Training”, this indicate that we are responsible for developing IT standards for Learning, Education and Training (ITLET), covering all aspects from formal education within schools and higher education, to training within industry and lifelong learning.

One of the promises of standards from ISO and IEC is that they have some longevity, and most of the standards have a lifespan of at least 10 years. Even if we live in a world where technology changes rapidly, it is standards that are at the core of all this innovation. Without standards at the core of all technology where would not have been any innovation of services. Just to give an example, the language behind all information we consume through a internet browser (HTML) is based on research done by IBM in the 1960s and from a standard published in 1986. How we use and extend and build on top of many of the global standards are innovative, and we see new products, increased speed and a huge uptake and use of new technology. And since standards are requirements that will not change for some time, the investment in implementing standards into a product is smaller than implementing a proprietary specification. When the risk of implementing a standard is small, the benefits will be large and the cost of the consumer will be lower.

When a standard from ISO and IEC are approved each country participating in the

¹ <https://www.iso.org/isoiec-jtc-1.html>

² <https://www.iso.org/committee/45392.html>

committee have a vote, and within each country there exists a number of topic experts that scrutinize the proposed standards, identify flaws and provide suggestions for how to improve the standard. When all comments and improvements have been managed, the document is voted on, published and made available to everyone globally on equal terms.

When technology is made available to more people at an affordable cost, because of standards, more people get access to knowledge and information. Technology is now becoming omnipresent, and almost all aspects of society and work have technology as part of it. We see this change within the educational sector also, where digital content are made freely available to everyone in their own language as provided by the Global Digital Library³. And by using technology and a combination of technologies content are made available to more people, also people on the fringes that normally do not have access or the possibility to consume digital content.

When more people have access to high quality educational resources and tools, it becomes easier to meet the goal of UN SDG #4 “Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all”. And technology have the potential of meeting these requirements within education with support of standards. There are several areas we need to address to ensure that we meet these requirements. Technology have the potential to deliver rich media and VR/AR (Virtual reality and Augmented reality) experiences that truly enhances and transforms the learning experience, however many do not have access to tools that could utilize such media, or they do not have the capacity to participate in the learning experience. Since most learning have a learning goal, we could use technology to search and find alternative resources that meet the personal needs and preferences of everyone ensuring the same learning outcome. To make even such a simple task available we are depending on a series of global standards. Every resource should be described using the same metadata models⁴, learner descriptions of their personal preferences are described the same way, and every teacher need to describe their learning goals using the same principles. In addition, the learners should describe their pedagogical learning style so that the learning resource provided are a better fit to meet the learner’s potential.

There are two types of learning resources. On type are resources with a commercial license, where there exists different restriction on how the resource could be used, eg. you cannot change, adapt or repurpose the resource. The other type is OER resources where there is a open license (Creative Commons⁵) with the opportunity to change, modify and repurpose the resource to your needs. (E.g. translate to your language). Most of OERs are free to use at no cost.

As technology evolves and new trends surfaces such as AI (Artificial intelligence) and ML (Machine Learning) these are also being “embedded” into learning resources, providing a more adapted learning experience, where the resource “automatically” adapts to how the learner are progressing. We see this happen to more and more commercial resources, as a way of providing more value and to justify an increased cost of access to the resources. This trend of embedding learning services into the learning resource is in many cases used as a way of differentiating against OER, and to justify a higher cost of using the resources. Many providers of OER do not have the resources to

³ <https://digitallibrary.io/>

⁴ https://en.wikipedia.org/wiki/ISO/IEC_19788

⁵ <https://creativecommons.org>

add this added value to the resources, and as a consequence there is no equal access to quality education, however, this could be solved by using global standards.

For global standards to be implemented we need that the owners of schools and ministries of education start requesting that standards are followed by everyone providing technology to our educational systems. The competition between providers of technology should be on the quality of the learning resources, and their pedagogical value, not on the embedded services.

As IT becomes an integrated part of all aspects of our educational systems, there is an increased need for systems to exchange information about their learners, their educators, the curriculums, the learning goals, the grades and badges, the achievements, the attendance, and all other aspects of the schools activities. Today when systems are exchanging information each exchange of information needs a specialized integration, where providers of different services need to create API's and information models for the exchange for each system. For systems that exchange information with several other systems the cost of integration are high, and the cost of maintenance are higher. With standards for interoperability between systems, the providers only need to create one integration point for each service that are well known and documented as a global standard. With global standards the cost will be lower, and we have increased flexibility when choosing a provider of the services.

In our work we have identified four domains that are in need for a series of standards. Where standards should specify how the different systems within these domains share and exchange information. When systems within these domains have standardized its models for sharing, exchanging and governing data, we are more likely to get equal high-quality education for all.

The 4 domains identified are 1) School Administrative Systems (SAS), 2) Learning Management Systems (LMS) 3) Digital Learning Resources (DLR) and 4) Pedagogical Learning Services (PLS).

The SAS are used to manage and run the educational institution, with information about the educators, learners, classes, schedule, subjects, grades, attendance etc. Each of these information types should be standardized. The information about the learners, their classes and subjects should be used as a basis for a Single Sign On (SSO) solution for access to all other relevant IT systems made available for the educational institution. In many cases the SAS are at the core of the educational institution and are seen as the master holder of many of the vital data necessary to manage the schools.

The LMS are used by educators to manage the work of learners. What tasks they are assigned, when submissions are due, collaboration and other learner centric tasks. In the LMS would find information about the learning paths of the individual learner, and the learning resources they should access to meet the planned learning goal. In some cases, we see that there are overlap between functionality what data the LMS manages and what the SAS manages, increasing the need for standardized information models and API's.

DLRs are the resources and learning services accessed by the learners to get the knowledge and insight required to acquire the planned skills and competencies. Usually DLR are designed to meet learning outcomes as specified in different national curricula,

and learning goals as specified by the educators for their classes. DLRs exist in many variants from simple text files to immense complex VR models and interactions. Some DLRs cover all aspects of a curriculum within a subject, other covers one specific small learning goal. From talking to educators we know that they would like to choose freely among all resources available, for them to provide the resource that are the best fit for the individual learner. As mentioned above, tools and services are developed that suggests individual learning paths for learners within resources from one provider, to get an even more personalized learning path we need services that can choose among all available resources when suggesting a personalized learning path. To give everyone the benefits and advantages of individualized learning paths, we need to separate between the learning resources, their components and the services recommending individualized learning paths, and this is best realized with global standards.

PLS are services that guides and supports the educational institutions in ensuring that the educators reach their learning and educational goals e.g. by providing individualized learning paths. There are pedagogical tools free from subject and levels that only supports and facilitates for deep learning. For many PLS to work, we need a new way of governing data produced by the learners in all their digital learning activities, PLS are mostly driven by data, where data is used to develop better pedagogical services, in the same way Google and Facebook uses data to provide better services, schools should also use data to provide better education. Since education is mandatory in most countries, and many learners within our educational systems are not old enough to give consent to how their data are used, we need to provide extra protection of data produced within the educational context. We need to make sure that data produced by learning activities are kept private and only made available for the educators who would benefit from the data. The only person who should be able to access and act on the data that identifies an individual learner is the educator. No one, except the educator should have access to data could be used to identify individualized learners, everyone else should have access to anonymized de-identified aggregated data. For schools to get the freedom and possibility to choose freely among all available DLRs, all data should be governed by the educational institution, and then the educational institution can decide how the data could be used to provide for better "services" at the school. The educators could use this data to provide education of better quality. It is important that school owners and ministries of education establishes a principle that all data produced within digital educational activities should be managed and governed by the institution.

To provide high quality learning for all, we need systems and procedures in place that supports the educators, and that follows the learners when the learners roam. Educational institutions should start requesting that all IT systems used within the educational sector are based on global standards so that information flows easily between systems. When a school would like to change from one system or solution to another, the competition between vendors are not on how they lock data into their siloes, but on the value and functionality it provides for the educational institution.

For DLRs we need to agree on a series of standards on how we describe the resource. Some aspects that need to be described are: the subject of the resource, the type of resource and its technical requirements, the learning goals the resource meets, the pedagogical style of the resource, in what types of learning activities the resource is designed to be used, the license for the resource, the cost and cost model of the resource, etc. We also need to find a way of governing all data produced by a DLR, this

data should be used by the educational to provide for better high-quality education, with reports and analysis that gives value for the individual educator.

For PLS we need to provide true value for the educational institutions and for the educators, the educational institutions need to govern all data produced by the tools and resources used by the learners. Such tools are assessment tools, discussion tools, chat tools, curricula tools, testing tools, deliverables in any form etc. We see that in the future we would have services based on AI and ML that could help educators with some of their tedious work, we see that AI and ML tools would be able to analyze the data produced by the learners, and use that insight into suggesting and supporting the educators in their daily teaching activities.

When we realize that use of IT tools is becoming an integrated and increasingly important part of our educational systems, we should also expect that the educational institutions start requesting the use global standards for all systems being used. To prepare for more innovation within the educational space, we must start by requesting the use of standards. The only way to provide high quality education for all on an equal basis is by requesting and anticipating that all systems used within ITLET is based on global standards. To make this happen, all globally recognized standard development organizations such as ISO/IEC, IEEE, OASIS, ECMA and others need to collaborate. As outlined in this paper, there is a need for more standards, and there is a need for true global standards that provides for equal access to quality education for all.

Even with technology and support of technology, educators are still the most important person within our educational systems. Technology should be designed to support the educators in becoming a better educator.