We are IntechOpen, the world's leading publisher of Open Access books Built by scientists, for scientists

6,300

Open access books available

172,000

International authors and editors

190M

Downloads

Our authors are among the

154

Countries delivered to

TOP 1%

most cited scientists

12.2%

Contributors from top 500 universities

WEB OF SCIENCE™

Selection of our books indexed in the Book Citation Index
in Web of Science™ Core Collection (BKCI)

Interested in publishing with us?
Contact book.department@intechopen.com

Numbers displayed above are based on latest data collected.
For more information visit www.intechopen.com

Impact of Standardisation and Open Source Software in e-Learning

Kiyoshi Nakabayashi
The Open University of Japan
Japan

1. Introduction

The trends towards open technology are forming a large stream in the field of e-learning (Iiyoshi & Kumar, 2008). These trends include open technology standardisation and open source software for e-learning as well as recent open courseware activities. The importance of e-learning technology standardisation has been well recognised since the early days of e-learning. Several organisations concerned with e-learning standards (Fallon & Brown, 2003), including the Aviation Industry CBT Committee (AICC), IMS Global Learning Consortium Inc., Advanced Distributed Learning Initiative (ADL), IEEE Learning Technology Standards Committee (LTSC), and ISO/IEC JTC1 SC36, were established from 1998 to 2000. Along with these standardisation activities, open source software e-learning platforms, such as Moodle and Sakai, have emerged.

These open trends have had a significant impact on not only e-learning and education but on the much broader information and communication technology (ICT) industry in general (Moody, 2001). These trends are not superficial phenomena but are essential driving forces for rapid progress and growth of the ICT field (Baldwin & Clark, 2000) including expansion of the Internet and recent trends of so-called “Web2.0” (O'Reilly, 2005). The impact of technology standardisation, often described as “the power of modularity” (Baldwin & Clark, 2000), has resulted in the particularly rapid growth of the ICT industry over the past 50 years. A system consisting of modules connected by standardised interfaces can be quickly improved in terms of performance and functionality because the modules can be enhanced independently without loss of system consistency. Moreover, open standards facilitate market entry by module providers because the providers can develop product modules without the need for detailed knowledge of the whole system—they simply need knowledge of the standardised interface. This promotes competition among vendors, pushing them to pursue innovations leading to higher performance, and more cost-effective products. Another important driving force in the ICT industry is open source software. The open source software community has an embedded mechanism to produce high quality products quickly. This mechanism is completely different from that of the commercial software development approach (Raymond, 1997).

This chapter first discusses the general mechanism by which technology standardisation and open source software drive the growth of the ICT industry. It then describes open

trends in the e-learning field emphasising Japanese activities promoting e-learning standards. It especially concentrates on activities for disseminating the Sharable Content Reference Object Model (SCORM) specifications in terms of support for system development and conformance programs. Last it discusses the future role of open technology in the field of e-learning.

2. Impact of Technology Standardisation and Open Source Software on ICT Industry

2.1 Technology Standardisation as Driving Force of Industry

A technology standard usually defines the interface between two entities (or “modules”) (Nakabayashi, 2004). It specifies the functions one entity provides to the other. For example, in the case of a videotape and video deck, a standard defines the shape and size of the videotape cassette, the format of the video signal recorded on the tape, and the tape driving speed. The videotape records the video signal written by the video deck. Any combination of videotape and video deck compliant with the standard should work together. Thus, users can choose the videotape they most prefer on the basis of price, recording length, image quality, etc. without having to worry about whether the tape they select will work with the video deck they own.

This user freedom to choose products from various suppliers means that suppliers face tough competition so they must continuously improve their products’ cost effectiveness and quality. Even though competition is a typical part of industry, it should be noted that standardisation accelerates competition. This is because each entity or module connected by a well-defined standard or interface can evolve independently while system functionality as a whole is retained. Vendors can develop these modules merely by considering the open interface defined by the standard and not be concerned about the whole system. If there are hidden dependencies between modules and the rest of the system, development is not easy. An open standard encourages vendors to enter the market, which increases competition. This results in products that are more cost effective and that perform better. For example, the DOS/V personal computer has a well-defined open interface through which anyone can replace or add memory, hard-disk, and display modules. Numerous hardware vendors have entered the personal computer market by taking advantage of this open interface. This competition produces today’s high-performance, low-cost, and ever-evolving personal computers.

It is important to note that the architecture into which the modules are plugged and the interface the architecture provides must be very carefully designed to achieve this competitive environment (Baldwin & Clark, 2000). The functionality of the modules may otherwise be restricted or the extensibility of the system may be limited. While it is relatively expensive and time consuming to design the architecture, designing modules on top of a good architecture is quite cost effective. In other words, designing a first-class architecture is the key to success and should be a top priority.

2.2 Open Source Software for High-Quality Products

Another important driving force in the rapid growth of ICT is “open source software”. Since the early days of the Internet, its technical progress has been supported by the widely shared concept of “rough consensus and running code”, meaning that defined specifications

or standards have real values by making them open to the public with the computer programs that actually implement these specifications or standards demonstrating that they are workable in practice. One of the recent typical examples is the World-Wide Web (WWW), consisting of specifications such as HTTP, URL, and HTML. The WWW rapidly spread and continues to grow, through the early stage initiative of the National Center for Supercomputing Applications (NCSA)-developed Mosaic browser, which implemented practically WWW's concept with HTTP, URL, and HTML, and was made open to the public with its source program code free of charge. Recently, open source software has become an indispensable infrastructure for the ICT industry. The quality and performance of some open source software, such as Linux operating system or Apache WWW server, far exceed that of commercial proprietary software having same functionality (Moody, 2001).

Why is it possible for software developed by volunteers to achieve higher quality and performance than commercial software? The tremendously high software productivity can be achieved by the software development process in the open source software community (Raymond, 1997; Raymond, 1998; Raymond, 1999). First, the members of the open source software community work as volunteers with the primary motivation of "winning the admiration of the other participants by solving technically interesting problems with solutions as smart as possible". As pointed out (Raymond, 1998), this kind of motivation, corresponding to the esteem needs in Abraham Maslow's well-known "hierarchy of values" model of human motivation (Maslow, 1970), may result in software development of extremely high quality.

Second, because the members of the community work simultaneously but independently to solve a problem, it is highly probable that a high-quality solution will be found quickly. This mechanism of open source software development is completely opposite to the common traditional view of the conventional software development approach, which claims that increase of software engineers involved in a software development project increases the probability of the failure of the project due to the increase of communication overhead between the engineers (Brooks 1975). A similar idea to this optimisation of product quality by simultaneous problem solving can be found in the mechanism of product value improvement through the competitive and parallel development of product modules enabled by the standards (Baldwin & Clark, 2000). It is also worth pointing out that this concept is closely related to the collective knowledge production or collective intelligence of Web 2.0 (O'Reilly, 2005). However, it should also be noted that the target system must have highly modular architecture, which enables this parallel optimisation or problem solving.

3. e-Learning Activities in Japan related to Open Technology

As described in the previous section, open technology standards and open source software play essential roles in the growth of the ICT industry. Neither is independent; they are like the two sides of a coin. They are also not superficial but are essential driving mechanisms for rapid progress and growth of the ICT industry. The importance of open technology standards and open source software is well recognised in the field of e-learning which is one of the application areas of ICT. Several organisations concerned with e-learning standards, including the AICC, IMS, ADL, IEEE LTSC, and ISO/IEC JTC1 SC36, have cooperated to develop those standards. The importance of open technology has also been recognised in Japan from the early stages of the introduction of e-learning. Considerable efforts have been

made by the government and corporate sector since 2000 to promote e-learning standards especially SCORM (Advanced Distributed Learning Initiative, 2001; Advanced Distributed Learning Initiative, 2009), by means of open source software and an open community of engineers. These promotion activities include

- system module development such as the SCORM RTE module, SCORM 2004 sequencing engine, and SCORM extension for mobile learning,
- seminars and publications for SCORM content and system development,
- the SCORM assessor program, which certifies skilled SCORM engineers as assessors capable of conducting content certification, and
- cooperation with other Asian countries to share experience and knowledge.

These activities have been supported mainly by two organisations that have conducted e-learning promotion in Japan. One is the Advanced Learning Infrastructure Consortium (ALIC), which is supported by the Ministry of Economy, Trade, and Industry of Japan. The other is the e-Learning Consortium Japan (eLC) which is a non-profit organisation consisting of about 100 e-learning companies. These two organisations cooperated to promote e-learning in Japan in terms of technology, human resources, and user benefits. They took the initiative in the SCORM promotion activities described in the following sections.

3.1 System Module Development

Several system modules have been developed based on SCORM 1.2 (Advanced Distributed Learning Initiative, 2001) and SCORM 2004 (Advanced Distributed Learning Initiative, 2009) specifications. Most of them are available as open source software. They were developed to minimise system development costs and interoperability problems by providing well-tested reference modules that can be integrated into commercial systems. Some of these developments are described in the following subsections.

3.1.1 Interface Modules for SCORM 1.2

Several interface modules were developed in 2001 to support implementation of a learning management system (LMS), authoring tool, and content compliant with both SCORM 1.2 and the Aviation Industry CBT Committee (AICC) Computer Managed Instruction (CMI) specifications. One is a course-structure-handling module intended for integration into a courseware-authoring tool. This module can work with both manifest files for SCORM and CSF files for AICC CMI. A pair of modules, one for servers and another for browsers, has been developed to implement the API adapter of a SCORM-compliant LMS. The HACP protocol has been used for communication between the server-side and browser-side modules so that they can handle AICC CMI specifications as well. Another module has been provided to help content developers implement sharable content objects (SCOs) containing typical test questions.

3.1.2 SCORM 2004 Sequencing Engine

Development of a sequencing engine was started in 2002 on the basis of an early version of the IMS simple sequencing specifications and the SCORM 1.3 specifications. The latest version of the sequencing engine was designed on the basis of SCORM 2004 2nd Edition. The updating process for the latest edition is underway.

A block diagram of the sequencing engine is shown in Figure 1, illustrating a full-set implementation of the SCORM 2004 specifications. The three functional modules are shown in bold boxes. The sequencing module, the primary part of the sequencing engine, executes the SCORM 2004 sequencing specifications, which are implemented as a Java class. The run-time environment (RTE) module, which is on the server, and the application programming interface (API) module, which is on the browser, together implement the SCORM 2004 RTE and navigation specifications. They communicate using HTTP. The API module provides the API adapter functionality defined in the SCORM RTE specifications. This module is invoked every time an SCO is launched, and it communicates with the RTE module during SCO execution. The RTE module is implemented as a Java object that is instantiated for each leaf activity. The RTE module object updates and stores runtime data elements exchanged with the associated SCO.

The sequencing engine has several utility functions. One is a recording function for sequencing trace logs that helps content developers debug course content with complicated sequencing rules. Another is a GUI customisation function that enables LMS and content vendors to customise the GUI of the sequencing engine by simply modifying an external definition file.

The sequencing engine has been available to the public as open source software since 2004, and more than 1500 copies have been distributed. The engine is used in several commercial LMS and e-learning services.

Fig. 1. SCORM 2004 Sequencing Engine

3.1.3 Mobile Extension of SCORM 2004 Engine

The growing use of personal mobile devices and the spread of wireless networks are making mobile learning more popular. Among the various personal mobile devices, mobile phones are broadly accepted as easy-to-use mobile terminals capable of both voice and Internet communication.

Development of a mobile learning environment in Japan started in 2005 (Nakabayashi et al., 2007). In this environment, both mobile phones and personal computers can be used as terminal devices. There were three design goals.

- (1) To provide a standards-based mobile learning infrastructure independent of device characteristics (which often differ from mobile phone to mobile phone and from carrier to carrier) using existing e-learning standards.
- (2) To enable offline learning using mobile phones.

- (3) To implement a learner adaptation function by which learning materials and a learner's status are shared between mobile phones and personal computers and the learner's status is reflected in the next learning activity in either environment.

These goals were achieved by developing a system consisting of the SCORM 2004 sequencing engine described in 3.1.2, adding content browsers to the mobile phones, and placing a protocol transformation server between the engine and mobile phones, as shown in Figure 2. The content browsers can display downloaded content offline. The results of learning on a browser are sent to the protocol transformation server, which modifies the data format so that it is compliant with SCORM 2004 learner tracking information. The learning material format of SCORM 2004 was partly extended to support mobile learning. The communication protocol specifications among the mobile phones, protocol transformation server, and SCORM 2004 engine were newly designed. The developed system is currently available to the public as open source software.

Fig. 2. SCORM 2004 Mobile Extension System

3.2 Seminars and Publications

The SCORM specifications are disseminated to the e-learning community through periodic seminars for technical and lay people. The eLC has organised two- or three-day conferences twice a year since 2001. At each conference, a full-day track is always allocated for e-learning standardisation. The seminars for lay people are designed to emphasise the benefits of introducing e-learning standards and their impact on the e-learning business model. For technical people, the seminars deal with various types of information, e.g., briefings on emerging standards, technical details, new tools, sample implementations, and use cases.

The SCORM specifications are also disseminated through publications, including translations of technical and tutorial documents. Several technical and tutorial documents have been translated into Japanese, including SCORM 1.2, SCORM 1.3 working draft 1.0, and IMS Simple Sequencing in 2002, 2003, and 2004. The "SCORM Best Practices Guide for Content Developers" from the Learning System Architecture Lab. was translated in 2004. SCORM 2004 3rd Edition is currently being translated.

Tutorial documents dealing with technical details, use cases, and interoperability issues have also been disseminated. A set of tutorial documents dealing with SCORM 1.2 was published in 2004 and has been used for the SCORM assessor program, which is described below. This set includes a document dealing with interoperability issues and solutions

gleaned from periodic surveys of both system and content vendors about interoperability problems. The SCORM 2004 tutorial, including technical digest, content design, and sample content, was issued in 2006.

3.3 Conformance Programs

Conformance programs dealing with learning management systems and content have been conducted since 2003. After each conformance test, there are periodic follow-up activities in which LMS vendors and content vendors come together to check whether their products are compatible. This promotes the sharing of experiences and knowledge of interoperability issues in the e-learning community.

A unique conformance activity in Japan is the SCORM assessor program. The original motivation for this program was to improve the technical skills of content developers. Developers come from various fields, such as multimedia design and instructional design, so they are not necessarily sufficiently skilled to deal with interoperability issues related to the SCORM specifications. Thus, in this program, skilled SCORM engineers, rather than products, are certified. As certified assessors, they can conduct the SCORM 1.2 content conformance test. The candidates attend a two-day lecture and undergo the certification test. The required skill set is defined in Table 1.

Knowledge about assessor program
Program purpose
Assessor responsibilities and authority
Content conformance procedure
Content registration procedure
Interoperability problem management
Assessor community purpose
Knowledge about SCORM specifications
General
Content aggregation
Run-time environment
Conformance requirements
Knowledge about SCORM applications
Content development
Content test
Typical interoperability issues and solutions
Knowledge about related fields
Industrial product standardisation
e-Learning product standardisation
Communication protocols
Client-side programming
Server-side programming
Basic computer knowledge

Table 1. SCORM Assessor Skill Set

The program started in 2004 with 16 assessors. There were 106, as of February 2008 (Figure 3), belonging to the SCORM Assessor Community, in which they can exchange information about commercial learning management systems and interoperability issues and obtain the latest information on specifications. The recent ongoing activities include localisation of SCORM-related tools for a Japanese language environment, tutorial and technical document creation, and publication of interoperability issues of SCORM 2004 gathered by the Assessor Community members.

Fig. 3. Increase of SCORM Assessors

3.4 Asian Country Cooperation

Several cooperative activities took place involving member countries of the Asia E-learning Network from 2002 to 2005. They included the interoperability test program called AEN LMS & Contents Interoperability Validation Experiment (ALIVE), which was conducted three times. In this experiment, participants brought their SCORM-based LMS and content for checking of interoperability with those of the other participants.

4. Future Direction

This section discusses the future impact of open technology on e-learning in terms of triggering a discontinuous change of industry structure and promotion of diverse learning environments.

4.1 Triggering Discontinuous Change of Industry Structure

Standardisation and open source software can significantly impact the structure of the existing industry. A phenomenon often observed in business called “disruptive innovation”, which disrupts a “sustaining innovation” (Christensen, 1997), is shown in Figure 4. This indicates the situation in which the sustaining innovation, which sufficiently (or superfluously) fulfils customer needs by consentingly providing high quality products, is made obsolete by the disruptive innovation, which provides low-quality but drastically

cost-effective products. The disruptive innovation often appears not from the same business segment as the sustaining innovation but from a completely different business segment.

Fig. 4. The Innovator's Dilemma (Christensen, 1997)

An example of this kind of situation is the relation between conventional telephones (sustaining innovation) and IP phones (disruptive innovation). Conventional telephone technology has achieved sufficient (or superfluous) service quality meeting the customer requirements. Very high quality voice transmission is available not only for domestic but also for international calls. One can connect to any party in the world by simply dialling the appropriate number. These high quality services are achieved due to the continuous improvement and optimisation of technologies for telephone exchanges, transmission lines, voice encoding, and so on. However, a disruptive innovation in its early stages appears as a robust, cheap, but low-quality, product compared to the sustaining innovation. For example, in the early days of the Internet, no one imagined that it might one day replace conventional telephones because it was slow and unreliable. It was good for only e-mail and file transfer. The Internet technology was designed based on a "best-effort" concept i.e., it was intended to support minimal data exchange function between computers connected through very bad quality transmission lines causing frequent packet loss.

However, in contrast to the conventional telephone system, which is based on the all-in-one technology designed by telecom companies, the Internet system is based on the open standards and open source software. In this sense, there is an embedded mechanism in the Internet architecture that very easily achieves simultaneous drastic cost reduction and quality improvement. Thus, improvements in technology will make Internet telephone quality satisfactory enough for customers despite the technology originally not being designed for voice communication. Once this happens, the disruptive innovation's cost-effectiveness will give it a significant advantage over the sustaining innovation, and conventional telephones will be made obsolete by IP phones.

There are two important issues regarding this phenomenon.

- (1) It is often very difficult for a company providing a sustaining innovation to introduce a disruptive innovation, as a disruptive innovation is characterised by low cost and low performance, which does not match the company's business structure. Their current customers require a high-performance product and are willing to pay a higher price for

it. This forces the company to continue improving the current technology and prevents them from introducing a disruptive innovation even if they know that one exists.

- (2) Technology based on standard and/or open source software often becomes a disruptive innovation. A product based on standard and/or open source software can potentially become cost effective and then quickly evolve as described above. In the early stages, however, such products tend to have poor performance and low quality compared to the all-in-one products provided by the sustaining innovation because the standard- and/or open-source-based technology is not mature. Once their quality reaches the requirements of the customer, they will make the all-in-one products obsolete.

These considerations lead to interesting questions, such as, “Can e-learning disrupt traditional learning?” and “Can standards-based e-learning disrupt non-standards-based e-learning?” In the company training field, e-learning or technology-based learning makes it possible to provide training for a large number of employees in a very short time which was impossible in traditional face-to-face training. e-Learning also makes it possible to provide individually customised or personalised learning for each learner, which was also difficult in traditional face-to-face training.

In the higher education field, numerous good e-learning practices also appear. Of the various success cases, the Open University in United Kingdom will be discussed here. The UK Open University was established in 1971 as a university dedicated to distance education aiming to provide higher education to greater number of people by exploiting technologies. The Open University was founded on the belief that communications technology could bring high quality degree-level learning to people who had not had the opportunity to attend campus universities. (<http://www.open.ac.uk/about/ou/p3.shtml>)

It is noteworthy that, despite its dedication to distance education, the Open University achieves top-level ranking among UK’s conventional universities such as Oxford and Cambridge. For example, the teaching quality of the Open University is ranked in the top five of UK universities (The Open University News Release, PR4890). According to a UK national student survey in 2005, the Open University achieves the top ranking in terms of student satisfaction (The Open University News Release, PR5064).

Here, let us consider that the Open University case can be regarded as a disruptive innovation against conventional higher education. The comparison of “Traditional universities (sustaining innovation) vs. the Open University (disruptive innovation)” as well as “Telephone (sustaining innovation) vs. IP phone (disruptive innovation)” is shown in Table 2. As discussed above, the IP phone is based on the best-effort IP technology, which was originally designed for data communication not voice communication. In addition, IP technology is general purpose standardised technology while traditional telephone technology is virtually integrated closed technology specialised for voice communication.

Now let us think about “Traditional universities vs. the Open University”. The Open University was established to provide education to greater number of people, which is a different target from that of the conventional universities accepting only high-level students. The Open University aims to provide education by exploiting technologies, which is a different means from that of the conventional universities, which usually use face to face communication. Thus, the Open University started its business for a different target by different means from that of conventional universities, though they are in the same higher education field. In terms of its educational methodology, the Open University organises

course development teams to develop technology-based learning courses with standardised methodology. A typical development team consists of members such as a media producer, graphics designer, and software engineer in addition to the subject matter expert. Thus, there are remarkable similarities between the IP phone and the Open University as disruptive innovations. Both originally have different targets and different means from those of the sustaining innovations. Both then improve their quality by standardised technology and become disruptive innovations triggering discontinuous change in a certain field.

Field	Innovation	Original Target	Means (Technology)	Standardisation of Technology
Tele-communication	Sustaining: Telephone	Voice communication	Proprietary technology	Virtual integration, Special purpose
	Disruptive: IP phone	Data communication	IP technology, Best effort	General purpose, Open standards, Open source
Higher Education	Sustaining: conventional University	High level students	Face to face	Non-standardised teaching methodology different from teacher to teacher
	Disruptive: Open University	Students not able to enter conventional universities for some reason	Communication technology	Standardised course development methodology by development team

Table 2. Comparison of Innovations in Telecommunication and Higher Education fields

4.2 Promotion of Diverse Learning Environments

As discussed, open technology is indispensable for the innovation and dissemination of technology by facilitating competition and collaboration in the ICT field. One of the recent technology trends is Web 2.0 (O'Reilly, 2005), which has been strongly affected by open technology. Web 2.0 does not correspond to specific technologies or activities but to a very comprehensive concept. The common idea underlying Web 2.0 activities is not simply use the ICT network for traditional business models, but to create novel value-added activity models themselves by introducing communication frameworks that were physically or economically impossible in the past without the existence of the ICT network. Google's advertisement or Amazon's market place business models do not simply use the ICT network for a traditional mass-communication advertisement model or mass-production sales model. They fully exploit the low-cost ICT network to create additional value by facilitating the linkage between diverse seeds and the needs of individual people in the community.

From the view point of education, noteworthy aspects of Web 2.0 are the change from one-way communication to bidirectional communication, adaptation to individuals' diverse needs, and utilisation of collective intelligence. The traditional communication model of Web 1.0 was a mass-communication one in which limited information providers send information from their Web site to massive numbers of information consumers. In contrast to this model, Web 2.0 provides a bidirectional communication model in which users actively participate to community through blogs or SNSs. Another unique characteristic of Web 2.0 is the adaptation to individuals' diverse needs, often recognised as "long tail". Typical examples of this characteristic include provision of diverse communities through blogs or SNSs and Amazon's market place model. In both cases, provision of such individualised communication fields was physically or economically impossible before the introduction of the low-cost ICT network. Such provision facilitates the mechanism of collective intelligence in which participants actively provide their information or knowledge to others in accordance with their own interests. Good examples of collective intelligence are Wikipedia or customer reviews on Amazon. This mechanism of collective intelligence has similarities to that found in open source community described in 2.2.

These characteristics of Web 2.0 might be regarded as similar features found in the recent "learner-centric" approach (National Research Council Committee on Learning Research and Educational Practice, 2000) of education or e-learning. e-Learning in its early days was mainly focused on one-way information transmission that is common to teaching in large classrooms or broadcast-type distance education. However, recent e-learning focuses on personalised learning by taking advantage of the bidirectional communication capability of the Internet. One of the background factors of this trend is the recognition that supporting learners' individual needs is essential for keeping them motivated (Simpson, 2002). Another background factor is that, to provide a much richer and higher quality learning experience, it is important to introduce activities based on the constructivism learning theory (National Research Council Committee on Learning Research and Educational Practice, 2000), such as collaborative learning in a small learner group. In contrast to the traditional view of learning – that "the knowledge is transferred from teacher to learner in one direction", – the recent view stresses that the knowledge is constructed by the learner who participates to interact with the learning field. From these perspectives, a new direction of the learning environment, sharing its basic concept with Web 2.0, would become clear, in which learners continue to learn while contributing to the construction of collective intelligence by providing their own knowledge to communities that meets their individual diverse interests and needs.

5. Conclusion

As discussed above, open technology in the ICT field has become increasingly important in this decade. It will have similar impacts for the e-learning field in the next decade. Although overlooking whole aspects of these ongoing trends is difficult, let us look at some issues that will become relevant to consider the future direction of open technology in e-learning.

5.1 Aim of Open Technology

When one thinks about standardisation or open technology, consideration of the purpose of the technology should not be forgotten. Technology standardisation is often an "enabler" for

other application technologies, and standardisation itself has no specific purpose. This general purpose characteristic of standardised technology enables it to be applied to various fields, as seen in the “The Innovator’s Dilemma” (Christensen, 1997), or allows unlimited diversity, as seen in Web 2.0. However, because it has no specific purpose, evaluating the real potential value of the technology at the research and development stage is very difficult. In the educational field, maintaining multiple viewpoints is also important. This means that, on the one hand, pursuing general-purpose aspects of the technology is necessary, while on the other hand, one should not forget that the final goal is to provide high quality education meeting learner needs in an efficient manner.

5.2 Importance of Infrastructure Architecture

A well-designed system architecture is vital to enable autonomous and distributed evolution of system modules observed in technology standardisation. The importance of the platform architecture is the same in enabling simultaneous solution search in the open source software community. It is impossible to make this happen if the architecture is poorly designed so that the change of one system module may trigger a change of other modules or complete knowledge of the whole system is needed to modify only a small part. Thus, establishing a well-designed platform is a very important issue, but it is sometimes misunderstood or not recognised. The importance of infrastructure architecture should be repeatedly stressed.

5.3 Target Area, Motivation and Quality of Open Source Software

The field in which the volunteer-based open source software development model is applicable should be carefully considered. Currently, the most successful fields of open source software are those of operating system, database, web server, and so on. They are platform software or middle ware for which developers and users overlap. There are many demands for software for these fields because they are commonly used in almost all ICT systems. Thus, these fields of open source software easily attract many volunteers highly motivated for development. In contrast, in the ICT application fields such as education, developers and users are usually different, and the number of users is relatively small compared to that of platform software. If the number of participating developers is too small to establish a community, there are few chances to create high quality product because the essential mechanisms of an open source software community, such as simultaneous solution search, does not work. Recently many educational open source software projects have emerged that are promoted by not individual volunteers but governmental organisations or corporate sectors. A future issue is to construct a success model of such open source software development communities, taking into account the source of the participants’ motivation and product quality.

As discussed in this chapter, technology standardisation and open source software have essential impacts on the growth of the e-learning field. It should be noted that open technology has strong influences on not only technical but pedagogical aspects of e-learning. One should realise that open technology is not only a support tool for conventional style of education but an enabler for a novel value-added way of learning.

6. References

- Advanced Distributed Learning Initiative (2001). *Shareable Content Object Reference Model (SCORM™) Version 1.2*.
- Advanced Distributed Learning Initiative (2009). *Shareable Content Object Reference Model (SCORM)® 2004 4th Edition*.
- Baldwin C. Y. & Clark K. B. (2000). *Design Rules, Vol. 1: The Power of Modularity*, The MIT Press, 978-0-262-02466-2, Boston, MA.
- Brooks, F. P. (1975). *The Mythical Man-Month: Essays on Software Engineering*, Addison-Wesley, 978-0-201-83595-3, Boston, MA.
- Christensen, C. M. (1997). *The Innovator's Dilemma*, Harvard Business School Press, 978-0-875-84585-2, Boston, MA.
- Fallon, C. & Brown, S. (2003). *e-Learning Standards*, St. Lucie Press, 978-1-574-44345-5, Boca Raton
- Iiyoshi, T. & Kumar, V. (Ed.) (2008). *Opening Up Education: The Collective Advancement of Education through Open Technology, Open Content, and Open Knowledge*, The MIT Press, 978-0-262-03371-8, Boston, MA.
- Maslow, A. H. (1970). *Motivation and Personality (2nd Edition)*. Harper & Row, 978-0-060-41987-5 New York, NY.
- Moody, G. (2001). *Rebel Code: The Inside Story of Linux and the Open Source Revolution*, Perseus, 978-0-738-20670-7, New York, NY.
- Nakabayashi, K. (2004). e-Learning Technology Standardization – Make It Converge!!-. *Proceedings of International Conference on Computers in Education 2004*, pp. 33–39, Melbourne, Australia, Dec. 2004, Asia-Pacific Society for Computers in Education
- Nakabayashi, K.; Nakamura, A.; Kosaka, Y. & Nagaoka, K. (2006). Design and Implementation of SCORM2004 Execution Engine and Its Performance Evaluation., *Proceedings of the 2006 International Conference on SCORM 2004*, pp. 31–35, Taipei, Taiwan, Feb. 2006
- Nakabayashi, K.; Hoshide, T.; Hosokawa, M.; Kawakami, T. & Sato, K. (2007). Design and Implementation of a Mobile Learning Environment as an Extension of SCORM 2004 Specifications, *Proceedings of the IEEE International Conference on Advanced Learning Technologies 2007*, pp. 369–373, Niigata, Japan, Jul. 2007, IEEE Computer Society
- National Research Council Committee on Learning Research and Educational Practice (2000). *How People Learn: Brain, Mind, Experience, and School*, National Academies Press, 978-0-309-07036-2, Washington, D.C.
- O'Reilly, T. (2005). What Is Web 2.0 : Design Patterns and Business Models for the Next Generation of Software, <http://www.oreillynet.com/pub/a/oreilly/tim/news/2005/09/30/what-is-web-20.html>
- Raymond, E. S. (1997). The Cathedral and the Bazaar, <http://www.catb.org/~esr/writings/cathedral-bazaar/cathedral-bazaar/>
- Raymond, E. S. (1998). Homesteading the Noosphere, <http://www.catb.org/~esr/writings/cathedralbazaar/homesteading/>
- Raymond, E. S. (1999). The Magic Cauldron, <http://www.catb.org/~esr/writings/cathedralbazaar/magic-cauldron/>
- Simpson, O. (2002). *Supporting Students in Online, Open and Distance Learning*, Kogan Page, 978-0-749-43740-4, London

Advanced Learning

Edited by Raquel Hijn-Neira

ISBN 978-953-307-010-0

Hard cover, 444 pages

Publisher InTech

Published online 01, October, 2009

Published in print edition October, 2009

The education industry has obviously been influenced by the Internet revolution. Teaching and learning methods have changed significantly since the coming of the Web and it is very likely they will keep evolving many years to come thanks to it. A good example of this changing reality is the spectacular development of e-Learning. In a more particular way, the Web 2.0 has offered to the teaching industry a set of tools and practices that are modifying the learning systems and knowledge transmission methods. Teachers and students can use these tools in a variety of ways aimed to the general purpose of promoting collaborative work. The editor would like to thank the authors, who have committed so much effort to the publication of this work. She is sure that this volume will certainly be of great help for students, teachers and researchers. This was, at least, the main aim of the authors.

How to reference

In order to correctly reference this scholarly work, feel free to copy and paste the following:

Kiyoshi Nakabayashi (2009). Impact of Standardisation and Open Source Software in e-Learning, Advanced Learning, Raquel Hijn-Neira (Ed.), ISBN: 978-953-307-010-0, InTech, Available from:
<http://www.intechopen.com/books/advanced-learning/impact-of-standardisation-and-open-source-software-in-e-learning>

INTECH
open science | open minds

InTech Europe

University Campus STeP Ri
Slavka Krautzeka 83/A
51000 Rijeka, Croatia
Phone: +385 (51) 770 447
Fax: +385 (51) 686 166
www.intechopen.com

InTech China

Unit 405, Office Block, Hotel Equatorial Shanghai
No.65, Yan An Road (West), Shanghai, 200040, China
中国上海市延安西路65号上海国际贵都大饭店办公楼405单元
Phone: +86-21-62489820
Fax: +86-21-62489821

© 2009 The Author(s). Licensee IntechOpen. This chapter is distributed under the terms of the [Creative Commons Attribution-NonCommercial-ShareAlike-3.0 License](https://creativecommons.org/licenses/by-nc-sa/3.0/), which permits use, distribution and reproduction for non-commercial purposes, provided the original is properly cited and derivative works building on this content are distributed under the same license.

IntechOpen

IntechOpen