What Library 2.0 has taught libraries in Taiwan about e-learning

Tien-Chi Huang
Department of Information Management, National Taichung University of Science and Technology, Taichung, Taiwan, R.O.C.

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Abstract

Purpose – This paper aims to review the four elements of Library 2.0, which represents a major innovation, and adopts several pedagogical concepts to investigate other innovations libraries in Taiwan could implement to become ideal libraries.

Design/methodology/approach – This paper presents an overview of the essential principles of Library 2.0 and examines the current state of libraries in Taiwan. The authors then present a reciprocal feedback model of Library 2.0+.

Findings – A Library 2.0+ model and a concept map of the mutualism between e-learning education and Library 2.0+ were proposed to diminish the gap between the status quo and Library 2.0. Two recommendations are provided: to develop a library learning platform to maximize the education value of the library, and to regard library development as part of the overall community's development. Users can access library resources anytime/anywhere by visiting the library learning platform without visiting the library. Allowing an individual approach is necessary to realize the social educational value of the library. Moreover, a Library 2.0 library engages more in community development and invites participation with participation in community first. Universities in the community would be good technology partners when developing a Library 2.0 library.

Originality/value – Although there has been extensive research of library development in view of Library 2.0, such a topic has never been explored with an educational perspective, especially an e-learning perspective. Given that the definition of Library 2.0 is abstract and fairly broad, the authors take the view of an e-learning platform to make Library 2.0 more figurative. Moreover, through interdisciplinary exploration, concrete suggestions regarding library development are provided to librarians, especially those with similar conditions as those in Taiwan.

Keywords Taiwan, E-learning, Library 2.0

Paper type Case study

Introduction

Since the development of the Internet and its subsequent widespread use, the boundaries of traditional libraries have broken down. Traditional libraries played the

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role of a temple for literature in which librarians were regarded as temple guardians (Nguyen *et al.*, 2012). The traditional library functions to provide users with a space to read and study literature. Librarians' tasks consisted of acquisition, cataloging, organizing and serving users. However, owing to several limitations, users generally have difficulty carrying out learning with others.

In the Internet era and with modern communication technology, traditional libraries have begun to play a different role. In the past, traditional libraries were self-centric. The display and arrangement of books and learning resources were based on library science techniques. In other words, the placement was library-centric, not user-centric. Readers in the library usually received what were provided by libraries passively. They went to the library when they needed to find specific books or resources. Thus, readers learn what they seek to learn. Therefore, the traditional library status quo was, to some degree, a passive position – a library would provide arranged book collections and learning resources for learners to seek by themselves.

It is undeniable that a library is an important channel for social education. With the technical support of the Internet, e-libraries overcame the past problem of libraries in that physical locations are limiting. With the rise of the Library 2.0 era, libraries have begun to move toward a more e-learner-oriented stance with changes in participation and sharing. Although the field of e-learning has developed quickly and online educational technology tools have grown rapidly, there are questions about whether technology really does create a better educational environment. In view of this, the present study considers e-learning platforms as a specific characteristic of Library 2.0 development to open the gateway between e-learning and libraries. In this study, the opportunity for the growth of e-learning is discussed through exploring e-learning materials and platforms in relation to libraries.

Literature review

Following the trend of Web 2.0, the concept of "Library 2.0" was coined by Michael Casey in 2005 (Casey and Savastinuk, 2006) and was popularized in research and academic fields (Lwoga, 2014). Meanwhile, four principles of Library 2.0 were defined in that same year. These principles emphasize that Library 2.0 is everywhere, has no barriers, provides equal participation, is flexible and encourages best-of-breed systems. Chad and Miller (2005, p. 11) noted:

> The concept of Library 2.0 builds upon all that has been best about libraries to date, harnesses technological potential and community capability in order to deliver valuable, valued and world-class services directly to those who stand to benefit from them, whether they (ever) physically enter a library building or not.

A year later, Maness (2006) further proposed and indicated four elements of Library 2.0 and distinguished them from Library 1.0 in several aspects. These elements emphasized user-centered, multimedia experience and socially rich and communally innovative concepts, and explained how such Library 2.0 libraries could provide better library services for distant leaners.

Although the concept of Library 2.0 has had an enormous impact on the development of modern libraries (Gosling *et al.*, 2009; Kim and Abbas, 2010; Shafi *et al.*, 2013; Xu *et al.*, 2009), these papers discussed Library 2.0 only conceptually, without referencing the fundamental role of the library. As Gelfand (1971, pp. 24-25) stated:

> The fundamental role of the library is education. It should not be operated as a mere store house of books attached to a reading room, but as a dynamic instrument of education.

Parry (2008) noted that the emergence of academic libraries was positioned right at the center of learning for children and young adults. The most well-known study was the Colorado Studies, which proved that academic libraries have a direct impact on student achievement (Library Research Service, 2007). The authors proposed an argument to resolve this issue, as illustrated in Figure 1. The core of Library 2.0 should be education surrounded by four principles. Library 2.0 has much to offer to distance learners (Tummala *et al.*, 2007). Although most of its features can be successfully used by regular users, they have specific value to fit the needs of distance education. This purpose coincides with the nature of e-learning. The phenomenal growth of e-learning platforms in the past few years has given Library 2.0 a new frontier to explore. Within the extensive literature on Library 2.0, comparatively little research has focused on the relationship between Library 2.0 and e-learning. Library 2.0 strives to make modern libraries become the most appropriate environments for self-learners, while modern existing e-learning platforms, such as Coursera (www.coursera.org), Khan Academy (www.khanacademy.org) and TED-Ed (ed.ted.com), also dedicate themselves to self-learning. This paper discusses what Library 2.0 is able to bring to the development of e-learning materials and platform.

Notwithstanding the widespread adoption of Library 2.0 in society, the transformative effects of this model on education are not yet widely understood, particularly regarding the impact on e-learning. As has been suggested by Garrison (2011), e-learning has not simply played an add-on role in the framework integration level. Through this study, it is expected that e-learning will become a specific category in the development of library services.

Library 2.0 e-learning platform

The development of digital courses in higher vocational education has been highly valued during the transformation of vocational education (Yang and Chuang, 2005). To encourage sharing of resources, and to reduce learning gaps influenced by time and space, many higher vocational institutes have established Internet colleges. Such a phenomenon implies the essential necessity of linking digital learning to higher vocational education.

The authors created e-learning materials and course content for the subject of electronics, and applied for these materials and content to be certified. In 2013, they were

Figure 1.
The essential core of Library 2.0 is education

granted Ministry of Education (MOE) certification for these e-learning materials and content in Taiwan. However, this quality information was simply limited in one course. Other students could not reach and access this course information without an appropriate method to deliver it widely. Based on this concern, the authors have proposed a new prospective that future library services could integrate the e-learning platform into their services to maximize access to quality information (Horn and Owen, 2011).

Learning cycle in the platform

The authors introduce the mapping of the certified materials and course content on the platform according to the four principles of Library 2.0. First, a state transition diagram with a similar e-learning study in 2010 (Shih *et al.*, 2010) is adapted to the current study. The state diagram shown in Figure 2 includes six states and indicates the learning behaviors on the platform. Except for the self-regulated learning state, all states map the four principles of Library 2.0 mentioned in the previous section.

When a learner enters the platform, he or she needs to register for an account, then he or she can use log into the platform from the e-portal, regardless of location. Thus, a login Web-based e-portal state leads to the "library is everywhere" principle. Learners can undertake asynchronous or synchronous learning via browsers as long as network access is available. When learners learn online, various portfolio items are recorded by the system, including login times, log on durations and discussions with peers. The instructor is able to assess achievements not only from the grades scored, but also from the interaction with teachers or peers. Therefore, a diversity assessment can be made. Learners can also undertake help-seeking during the discussion process. Peers can answer questions during this process. Furthermore, multimedia materials availability

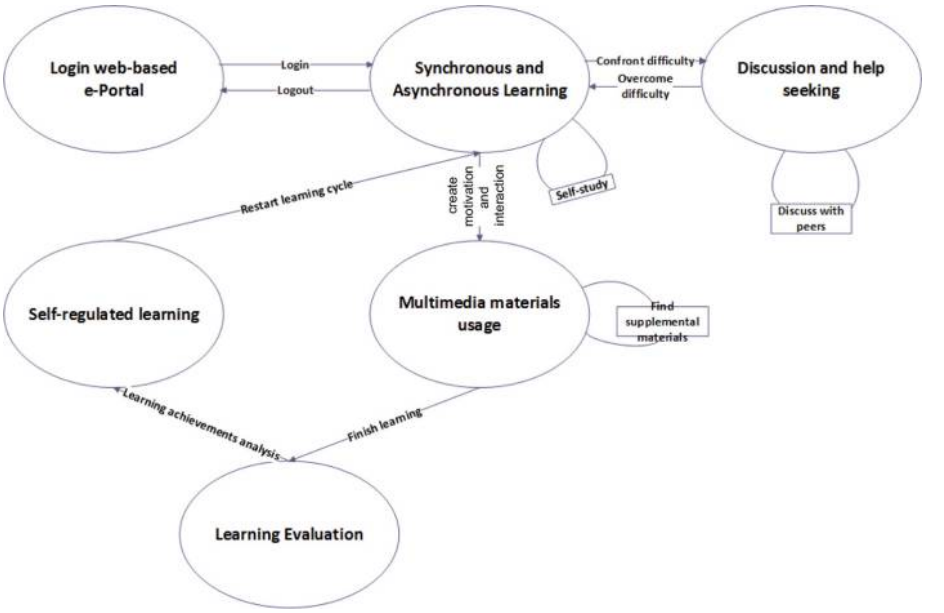

Figure 2.
State transition diagram of the proposed platform

increases the motivation of learners (Alessi and Trollip, 2001) and learners can find supplemental materials within the multimedia resources. Clearly, these two states provide an opportunity to reduce barriers for novices, which maps to the "library has no barriers" principle.

In the learning evaluation state, learners can assess his or her own learning results through self-assessment tests. The system arranges several quizzes for each unit, which are implemented in Flash format and are presented interactively. This allows learners to not only be evaluated by the instructor, but also by themselves, which would encourage them to participate in learning. Accordingly, this state maps to the "library invites participation" principle. Finally, Library 2.0 asks a library to build a flexible and best-of-breed system for its users (Lai *et al.*, 2014). The proposed learning platform completely maps to this principle by its content (multimedia and interactive materials), its ways of learning (synchronous and asynchronous) and its roles (instructor, student, teaching assistance and peers).

A new Library 2.0 model with e-learning paradigm – Library 2.0+

Although public libraries, especially urban libraries, in Taiwan have moved toward Library 2.0, most of them face challenges. Therefore, this study examines the essential principles of Library 2.0 and reflects on the status quo in Taiwan, to provide direction for libraries. Meanwhile, from a pedagogical perspective and, in particular, an e-learning perspective, the authors modify the existing Library 2.0 model to develop a new model referred to as Library 2.0+, which provides suggestions to librarians in a different way.

Everywhere

According to Chad and Miller's (2005) stated opinion, "the library is everywhere", it indicates that:

> Libraries should move beyond the notion of "libraries without walls", in which they offered a destination web site that attempted to reproduce the total library experience online. Instead, relevant aspects of that library experience should be reproduced wherever and whenever the user requires them, without any need to visit a separate web site for the library (p. 9).

In Taiwan, most libraries have started digitization processes. Serantes (2009) predicted that future Web 2.0-compliant libraries would be without books and physical space. With recent developments in Web technology, this prediction seems to be gradually coming true. The biggest and newest digitized library in Taiwan, the National Library of Public Information, is different from traditional libraries. In addition to warehousing books, the library is equipped with hundreds of personal computers and lots of navigation machines. Even though the services are highly digitized, and the readers are able to access the resources almost everywhere in this library via the Internet, they still have to be physically in the library to acquire the book or the magazine using their feet to move to the specific area and bookcase. In other words, the walls still exist; thus, the boundary of the library is clear and unchangeable.

In this sense, to create space and time flexibility and reach the goal of everywhere, the library would have to adopt a digital learning platform for readers (Kratochvil, 2014), so that they can, for example, browse e-books (Wilson *et al.*, 2014) and digital materials on geology and watch videos of earthquakes on the Internet anytime and anywhere, as long as the readers want. Using Web browsers, learners can access the course on demand whenever and wherever they need. This will create a pervasive impact on education.

No barriers

"No barriers" refers to two dimensions for the portal:

(1) that it is accessible and age-friendly (WHO, 2014; NYAM, 2011); and

(2) that it provides access to the library's resources.

In the past few decades, the aging society and disadvantaged groups have become the core concepts of the domestic and education policies in Taiwan (Ministry of Health and Welfare, 2013). Public libraries are all required to meet the standards of the policy and the law. Therefore, library facilities in Taiwan are relatively comprehensive for disabled and elderly people. However, most resources in libraries, such as books, magazines and videos, are visually dependent, which causes obstacles for visually impaired people. Even though the Internet is widely used in Taiwanese libraries, most services are still tied to the self-serve machines located in the library. Therefore, most resources are not available at the point of need, as users are required to go to the library when they need resources, which incur time and cost implications for users.

To achieve the goal of no barriers, the National Federation of the Blind has sued libraries to halt the development of online learning models (such as e-textbooks) until such time that the reading software can meet certain standards for access by blind students (Danielsen, 2012). In this study, the proposed e-learning platform not only can provide positive support for learners with physical handicaps, but also allows handicapped students to access abundant resources (e.g. text, video, flash animation) with no barriers. More specifically, from the perspective of modern education theories, this is one principle that libraries can refer to and adjust to achieve the no barriers element, which is individualized across users.

Individualized refers to actively providing readers with diversified content according to their needs. There are distinctive differences between readers depending on domain and learning pace, and reader data have become digitized. For additional information on this, the authors refer librarians investigating Library 2.0+ libraries to the study done by Huang *et al.* (2009) that proposed a recommendation-generating mechanism to provide individualized learning content. According to the histories recorded in the database, the modern library can recommend resources for readers actively with e-mail, library apps and Facebook even when they are not in the library, or show the same recommended information while they are using computers in the library. In this way, the library can not only diminish the barriers of accessing useful information but can also actively provide information that meets readers' needs by creating a learning path and recording mechanism as most e-learning platforms do.

Inviting participation

"Inviting participation" includes at least two dimensions, namely, who is invited to participate and how those members begin interacting with each other. Chad and Miller (2005, p. 10) proposed that "Library 2.0 facilitates and encourages a culture of participation, drawing upon the perspectives and contributions of library staff, technology partners, and the wider community". Therefore, participants include staff, readers, technology partners and communities.

In addition, to arouse the motivation for participation, related studies of social constructivism and social psychology point out that technology and interaction play important roles (Huang *et al.*, 2011). In the past, readers respectively obtained resources

in the library. Hence, past interactions were library-centric and the library affects readers separately.

The most modernized library in Taiwan has begun holding activities for citizens. Besides activities, the library sets up a home page and Facebook page to broadcast citizen activity information. There are 2.7 million citizens in Taichung city and about 120,000 people live in the area of South District (Taichung City Hall, 2014), but only 8,583 people have liked this page on Facebook, which is less than 10 per cent of the area's inhabitants. The data indicate that the library should work on inviting participation in the community.

Flexibility and best-of-breed systems

Finally, following the concept of Library 2.0, libraries should use the best-of-breed systems that enable modules to interoperate. Compared to what was implemented in the past, Library 2.0 emphasizes the role of technology in libraries and has higher expectations of the work the systems are capable of handling (e.g. system architecture and human–machine interfaces that can be adjusted according to user status, the high efficiency of the system, low-error stability, etc.). On the other hand, Chad and Miller (2005, p. 11) noted that the "library must engage and actively participate with a wide range of technology partners, ensuring that a modular and interoperable set of core systems remains reliable and robust".

The e-learning platforms used in educational settings are usually acquired to be customized and flexible according to the needs of different subjects. However, it often costs a lot if customized and flexible modules are part of the procurement contracts. Therefore, more and more schools in Taiwan seek help from local universities and, as cooperation across different departments is encouraged by the Taiwanese Government, this creates a win-win situation (MOE, 2014).

In this sense, the study proposed that libraries should obtain technological support not only from profit organizations but also seek technology assistance from universities and colleges in their local community. Especially in Taiwan, many universities and colleges are willing to devote their research and development efforts to areas beyond the campus, including industries, enterprises and libraries (Chen *et al.*, 2015; Chen and Tsai, 2012). Through cooperation across different domains and departments, such as information technology, library science and social education, strategic alliances are developed to provide sustainable and the latest technology support for the Library 2.0 library.

In summary, the authors propose a pedagogical perspective, called Library 2.0+, to enhance the Library 2.0 model. The model, shown in Figure 3, is a developmental and complementary cycle illustrating the gap between Library 2.0 and e-learning, and what can be supported by the other. As Curran and colleagues said in their study:

> […] librarians will be called upon more and more to be pedagogy and curriculum consultant teachers […] [and their] library […] [will be] the base for curriculum support resources in all their varied formats (Curran *et al.*, 2007, p. 290).

The authors believe that this model provides a different perspective with which Library 2.0 and e-learning can relate to one another.

Figure 3.
The proposed Library 2.0+ model

Discussion and conclusion

This study takes Library 2.0 as a guide for developing an e-learning platform and treats the e-learning platform as a specific feature of Library 2.0. The authors wish to clarify that the proposed e-learning platform is not a substitute for the modern e-library, but rather creates an innovative viewpoint to give explanatory notes concerning the differences between the modern e-library and the proposed one. With the interaction between e-learning education and library concepts, more aspects of mutual emulation can be explored, such as connecting people with information, lifelong learning, librarians, information literacy and e-learning education. To explain the complex mutualism, the authors provide a concept map to illustrate the idea. It is shown in Figure 4.

Developing a library learning platform to maximize the educational values of the library

The authors proposed that a Library 2.0+ library should consider itself as an active educational institution. Traditional libraries focus on the richness of resources and emphasize the value of the services provided, while future libraries aim to bring readers more active educational values, such as providing systematic knowledge courses that meet the personal needs of patrons. In this sense, Library 2.0+ libraries will attempt to expand the functions of the current library Web site into a personal learning platform, in which readers can trace their own histories and further obtain recommended resources automatically, and exchange ideas synchronously or asynchronously with other readers of different ages and backgrounds. In other words, the library could expand its functions to create more educational opportunities which promote its importance in the era of the knowledge economy.

Regarding library development as part of community development

In the past, library development and community development were usually discussed and carried out separately. This study proposed that, as invitation participation and technology partners are vital elements in the Library 2.0 era, modern libraries would have to engage more with the community. Strategies include adopting Web 2.0

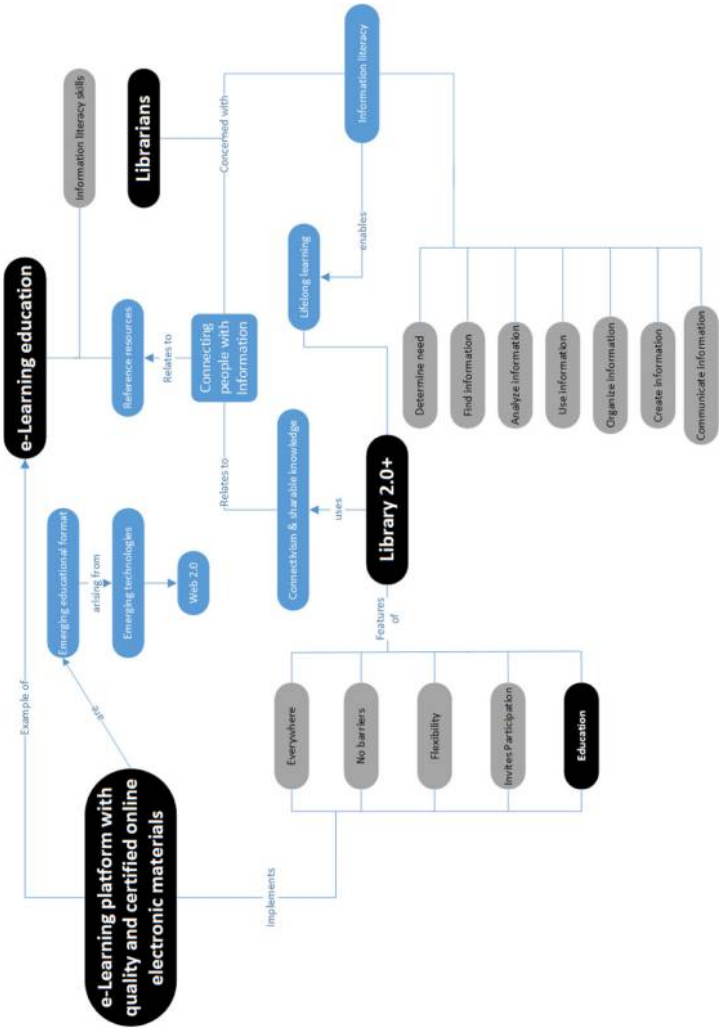

Figure 4.
Concept map explaining the mutualism between e-learning education and Library 2.0+

technologies to interact with members in the community, holding learning activities in the library to enhance community identity and leading cross-domain cooperation between libraries and universities in the community, among other concepts. Having all the abovementioned features, a Library 2.0 library can become a part of the daily life of community members, which may create even more external benefits for society.

References

Alessi, S.M. and Trollip, S.R. (2001), *Multimedia for Learning: Methods and Development*, Allyn and Bacon, Boston, MA.

Casey, M.E. and Savastinuk, L.C. (2006), "Service for the next-generation library", *Library Journal*, Vol. 131 No. 1, pp. 40-42.

Chad, K. and Miller, P. (2005), "Do Libraries matter? The rise of Library 2.0, white paper version 1.0", available at: www.talis.com/downloads/white_papers/DoLibrariesMatter.pdf (accessed 15 January 2014).

Chen, C.C., Huang, T.C., Park, J.J. and Yen, N.Y. (2015), "Real-time smartphone sensing and recommendations towards context-awareness shopping", *Multimedia Systems*, Vol. 21 No. 1, pp. 1-12.

Chen, C.M. and Tsai, Y.N. (2012), "Interactive augmented reality system for enhancing library instruction in elementary schools", *Computers & Education*, Vol. 59 No. 2, pp. 638-652.

Curran, K., Murray, M. and Christian, M. (2007), "Taking the information to the public through Library 2.0", *Library Hi Tech*, Vol. 25 No. 2, pp. 288-297.

Danielsen, C. (2012), "National Federation of the Blind Assists in Litigation Against Free Library of Philadelphia", available at: https://nfb.org/national-federation-blind-assists-litigation-against-philadelphia-free-library (accessed 14 February 2014).

Garrison, D.R. (2011), *E-learning in the 21st Century: A Framework for Research and Practice*, Routledge, London.

Gelfand, M.A. (1971), *University Libraries for Developing Countries*, Unipub, New York, NY.

Gosling, M., Harper, G. and McLean, M. (2009), "Public Library 2.0: some Australian experiences", *The Electronic Library*, Vol. 27 No. 5, pp. 846-855.

Horn, A. and Owen, S. (2011), "Deakin University Library: an active partner in the implementation of the new generation e-learning platform Desire2Learn", *IATUL 2011: Libraries for an Open Environment, Strategies, Technologies and Partnership: Proceedings of the 32nd International Association of Scientific and Technological University Libraries Conference, Cape Town*, pp. 1-11.

Huang, T.C., Cheng, S.C. and Huang, Y.M. (2009), "A blog article recommendation generating mechanism using an SBACPSO algorithm", *Expert Systems with Applications*, Vol. 36 No. 7, pp. 10388-10396.

Huang, T.C., Huang, Y.M. and Yu, F.Y. (2011), "Cooperative weblog learning in higher education: its facilitating effects on social interaction, time lag, and cognitive load", *Educational Technology & Society*, Vol. 14 No. 1, pp. 95-106.

Kim, Y.M. and Abbas, J. (2010), "Adoption of Library 2.0 functionalities by academic libraries and users: a knowledge management perspective", *The Journal of Academic Librarianship*, Vol. 36 No. 3, pp. 211-218.

Kratochvil, J. (2014), "Efficiency of e-learning in an information literacy course for medical students at the Masaryk University", *The Electronic Library*, Vol. 32 No. 3, pp. 322-340.

Lai, C.F., Chiu, P.S., Huang, Y.M., Chen, T.S. and Huang, T.C. (2014), "An evaluation model for digital libraries' user interfaces using Fuzzy AHP", *The Electronic Library*, Vol. 32 No. 1, pp. 83-95.

Library Research Service (2007), "School Library impact studies", available at: www.lrs.org/impact.php (accessed 15 January 2014).

Lwoga, E.T. (2014), "Integrating Web 2.0 into an academic library in Tanzania", *The Electronic Library*, Vol. 32 No. 2, pp. 183-202.

Maness, J.M. (2006), "Library 2.0 theory: Web 2.0 and its implications for libraries", *Webology*, Vol. 3 No. 2, available at: www.webology.ir/2006/v3n2/a25.html (accessed 15 January 2014).

Ministry of Education (MOE) (2014), "Industry-academy cooperation information", available at: http://admin.must.edu.tw/english/06_link.aspx?UnitID=20510 (accessed 19 September 2015).

Ministry of Health and Welfare (2013), "People with disabilities rights protection act", available at: http://law.moj.gov.tw/Eng/LawClass/LawContent.aspx?PCODE=D0050046 (accessed 11 July 2014).

New York Academy of Medicine (NYAM) (2011), "10 Ways to make your library age-friendly", Age-friendly NYC and the New York Public Library, available at: www.nyam.org/agefriendlynyc/docs/10-Ways-to-Make-Your-Library-Age-Friendly-02-22-11.pdf (accessed 10 July 2014).

Nguyen, L.C., Partridge, H. and Edwards, S.L. (2012), "Towards an understanding of the participatory library", *Library Hi Tech*, Vol. 30 No. 2, pp. 335-346.

Parry, F. (2008), "Information literacy meets Library 2.0", *The Electronic Library*, Vol. 26 No. 6, pp. 926-927.

Serantes, L.C. (2009), "Untangling the relationship between libraries, young adults and Web 2.0: the necessity of a critical perspective", *Library Review*, Vol. 58 No. 3, pp. 237-251.

Shafi, S.M., Gul, S. and Shah, T.A. (2013), "Web 2.0 interactivity in open access repositories", *The Electronic Library*, Vol. 31 No. 6, pp. 703-712.

Shih, K.P., Chen, H.C., Chang, C.Y. and Kao, T.C. (2010), "The development and implementation of scaffolding-based self-regulated learning system for e/m-learning", *Educational Technology & Society*, Vol. 13 No. 1, pp. 80-93.

Taichung City Hall (2014), "The population statistics of Taichung City", available at: http://demographics.taichung.gov.tw/Demographic/Web/Report01.aspx?DIST=3 (accessed 10 July 2014).

Tummala, A.B., Reddy, M.S. and Kumar, H. (2007), *E-libraries: Problems and Perspectives*, Allied Publishers, Mumbai.

Wilson, C.S., D'Ambra, J. and Drummond, R. (2014), "Exploring the fit of e-books to the needs of medical academics in Australia", *The Electronic Library*, Vol. 32 No. 3, pp. 403-422.

World Health Organization (WHO) (2014), "WHO age-friendly environments programme", available at: www.who.int/ageing/age_friendly_cities/en/ (accessed 10 July 2014).

Xu, C., Ouyang, F. and Chu, H. (2009), "The academic library meets Web 2.0: applications and implications", *The Journal of Academic Librarianship*, Vol. 35 No. 4, pp. 324-331.

Yang, Y.C. and Chuang, C.P. (2005), "The strategy of dealing with information technology integrated instruction from vocational high school", *Proceedings of the Faculty of Education of CUHK 40th Anniversary International Conference, Hong Kong Chinese University, Hong Kong*.

Further reading

Erhel, S. and Jamet, E. (2013), "Digital game-based learning: impact of instructions and feedback on motivation and learning effectiveness", *Computers & Education*, Vol. 67 No. 1, pp. 156-167.

Law, K.M.Y., Lee, V.C.S. and Yu, Y.T. (2010), "Learning motivation in e-learning: facilitated computer programming courses", *Computers & Education*, Vol. 55 No. 1, pp. 218-228.

Libraries and Social Software in Education (LASSIE) (2007), "Libraries and social software in education project", available at: http://clt.lse.ac.uk/Projects/LASSIE.php (accessed 15 January 2014).

Ting, Y.L. (2013), "Using mobile technologies to create interwoven learning interactions: an intuitive design and its evaluation", *Computers & Education*, Vol. 60 No. 1, pp. 1-13.

About the author

Tien-Chi Huang is currently an Associate Professor at the Department of Information Management, National Taichung University of Science and Technology in Taichung, Taiwan. He received his MS and PhD degrees in computer engineering from National Sun Yat-Sen University and National Cheng Kung University in Taiwan in 2005 and 2009, respectively. Dr Huang hosts several National Science Council projects about science education in Taiwan, and his research interests focus on educational technology, educational psychology and user behavior analysis. Tien-Chi Huang can be contacted at: tchuang@nutc.edu.tw