e-Schoolbag in China – exploring research evidence for large scale deployment of e-Textbooks and services

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Abstract—In recent years e-Schoolbag is established as an overarching concept of large-scale Chinese implementation of digital textbooks and related services. Chinese authorities have promoted e-Textbooks and e-Schoolbag projects for international standardization, creating a strong interest from the international community to learn more about new design ideas behind e-Schoolbag and current practices. This paper presents a case study based on Chinese research literature, exploring the evidence base and research focus of the Chinese e-Schoolbag initiatives. The paper concludes that there seems to be little systematic research going on in China on e-Schoolbag; and that the main focus seems to be on conceptual framework development, general reflections on the impact of digital textbooks, and justification for implementation policies. Since 2010, many pilot projects are reported; however, this study does not find evidence of systematic design and evaluation research in the national research literature.

Keywords−e-Schoolbag; large scale e-learning innovation; e-Textbook, digital textbooks; Chinese education; smart education

I. INTRODUCTION

For an international audience, the two concepts of e-Textbook and e-Schoolbag (e-T&S) for some time now have been synonymous with development of learning technologies in China. e-Textbook is often understood as digital textbook, a term that describes the transformation of textbooks offered as ebooks. e-Schoolbag, on the other hand, is a term not much used outside of China. It hints to services surrounding the e-textbooks stored in the “school bag” – services that need to be defined and explained. The concept of e-Schoolbag was introduced to the international e-learning community when Chinese experts proposed a new work item for international standardization on e-Textbooks in 2012 [1]. This paper tries to shed some light on e-Schoolbag development in China, analyzing academic papers not easily accessible for a Western audience.

Beginning of 2012 professor Gu Xiaqing penned a proposal for a new work item on e-Textbook for the ISO standardization committee working on learning technology standards, stating that “in Shanghai alone, there are more than 2 million students across 2000 K-12 schools who are required to use the ‘e-schoolbag’ in the form of small PCs” [1]. The new standardization project of ISO/IEC JTC 1/SC36 (SC36) was proposed to come up with answers to the question of what to find in an e-Schoolbag, besides a digital terminal loaded with e-textbooks. SC36 should specify an information model and “components of the learning interface for a variety of learning activities, with the support of tools and services available within an e-schoolbag or provided by linked platforms” [1].

Within SC36, the e-Schoolbag concept had turned up three years before, in 2009, in a project on Nomadicty and Mobile Technologies1. The reference to the concept was a 2002 paper of Chang and Sheu on design and implementation of ad hoc classroom and eShoolbag systems for ubiquitous learning [2]. The ISO standard on nomadicty defined in a short annex the concept of eSchoolbag:

An eSchoolbag consists of a number of components, such as the electronic book, parents’ contact book, pencil case and can be accessed through a notebook computer or PDA. The key point is that this e-schoolbag connects automatically to any environment where the student is located, so that it can provide the student with access to additional services (printing, libraries, and so on) without the need for him/her to perform complex actions. [3]

The ISO technical report on nomadicty offered eSchoolbag as an idea of “making digital information accessible outside the classroom and on the move” [3], however, in an iPad and tablet era it is difficult to see the added value of a separate entity in addition to the device, which carries content and hooks up to the Internet. In the proposed e-Textbook project, on the other side, the bag seemed to carry more meaning as a well as a defined set of tools and services:

With the learner as the end user, an e-textbook could be used to read, operate and practise; to communicate and collaborate; and, to do assignments and tests with the support of variety of tools and services, either within an e-schoolbag or connected externally. [1]

The aim of this paper is to explore the concept of e-Schoolbag, based on data from Chinese research literature. This study could be motivated by two anecdotal observations. First, big numbers (with implied big impact) always seem to be part of the e-Schoolbag narrative observed by an international e-learning community. The rationale for a new work item in the ISO committee mentioned millions of students using this technology. Testing of new learning technologies on this scale is not usual in Western countries, and it raises the question of what could be learnt from this large-scale development.

Second, in late 2014, during a study trip to Shanghai, the author was brought to a project meeting of an e-Schoolbag group developing artifacts that could be used in e-Schoolbag

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1 ISO/IEC JTC 1/SC36 WG3 documents, e.g., N276, N366
supported courses. One artifact was a model ship with sensors communicating wirelessly with a control hub connected to the educational cloud (Figure 1). It was made a point of schools being able to assemble these artifacts from ubiquitous low cost materials, and even to 3D print missing parts, in order to support e-Schoolbag projects in remote areas in China. For this author, the observed design session raised a number of questions of how well established the idea of e-Schoolbag systems is in China; and a wish to learn how the e-Textbook fits into the picture (e.g., could adaptable content be based on information from e-Schoolbag sensor data?); and what kind of pedagogical thinking inspires Chinese learning design.

II. RELATED WORK

Most of the research on e-Schoolbag is published in Chinese in national outlets, e.g., the Journal of East China Normal University, one of the national centers of e-Schoolbag research. The Chinese full text journal database, CNKI, has 221 papers (October 2014) using the keyword 电子书, which translates to ‘eBook package’ or ‘e-Schoolbag’. However, these papers are not open access and are not easily accessible for readers outside of China without access to a good academic library.

IEEEexplore has one recent paper [4] from a 2012 workshop summarizing the e-Schoolbag project in Mainland China contrasting it with what was happening in Hong Kong. The paper is based on media reports as "research in the Mainland China and Hong Kong context is still lacking". Wang and Towey [4] builds a multifaceted picture of the development of e-Schoolbag in China starting around 2010 through industry engagement (Hanvon, a founder of national patented Chinese Handwriting Technology, and Intel Corporation); standardization efforts (formation of an e-Schoolbag group by the Chinese E-Learning Technology Standardization Committee); Shanghai Municipal planning; the Shanghai Branch of China Telecom making plans for a e-Schoolbag “learning store” (like the App Store of Apple) in the cloud; and finally, in 2011, a pilot project initiated in the Shanghai Hongkou District. Then other cities followed with their own projects, such as Suzhou, Fosan, and Ningbo [4].

The media reports found by Wang and Towey showed that the pilots were also met with criticism. News items reported on parents’ concerns about lack of learning outcomes and negative effects on children eyes; teachers’ problems finding the content and resources they wanted, and experiencing more work than expected; wait-and-see attitudes by publishers; difficult user interface of the authoring tools; and copyright issues. Wang and Towey concluded with a quote from an old paper of S.P. Marshall indicating that it still was early days for the e-Schoolbag projects: “Adding wings to caterpillars does not create butterflies... Butterflies are created through transformation” [4].

In 2013 Wu et al. [5] reported on the efforts to construct an ecosystem of e-T&S emphasizing the role of standards development at an international conference on Cognition and Exploratory Learning in Digital Age. These authors are affiliated with East China Normal University (ECNU) that has a key role in Chinese e-Schoolbag development. Wu et al. point to reports from international consultancies claiming that e-Book technologies will mature the next two to three years, and that over 50 countries plan to promote e-T&S. They refer to national and international standardization efforts in the field, but also noting “there has been limited research on the standards, industry development, and educational application of e-Textbook and e-Schoolbag” [5]. The main thesis of the ECNU researchers is that “standards of e-Textbook and e-Schoolbag must be developed before the industry development and educational applications”, and they set out to present a conceptual framework and a model of the e-T&S system. e-Schoolbag is defined as a system of four parts: content, hardware terminal, learning (virtual) tools, and services. As of May 2013, the general architecture e-T&S and the information model of e-Textbook were published as Chinese national standards. In addition a number of drafts were ready, specifying e-T&S terminology; profiles of related standards; hardware terminals; virtual tools; learning services, etc.

The Chinese e-Textbook and e-Schoolbag Standards Working Group (CETESBSWG) has more than 50 institutional members taking part in research and standards development. A number of hardware companies have developed terminals according to the draft specifications; and e-Schoolbag software for classroom teaching is being developed. The authors observe that “field research, structured questionnaires and individual interviews have been used to collect data to assess the effectiveness of e-Textbooks development and application process” [5]. Initial findings “indicated that teachers need to change their ideas of teaching, need to learn to use morphological characteristics of e-Textbook, and focus on the humanized design of e-Textbook” [5].
A. EXPLORING CHINESE E-SCHOOLBAG RESEARCH

Both papers summarized above notice the lack of research on e-Schoolbag. When describing e-Schoolbag development in China their sources of information are news reports [4] or privileged actors’ information (as project leaders) [5]. This leads to the initial research questions of this study: What are the research focus and sources of information of the e-Schoolbag papers written with a national audience in mind (i.e., published in Chinese outlets in Mandarin)? The next question relates to the e-Schoolbag narrative: What is driving the e-Textbook and e-Schoolbag innovation in China, as reflected in research papers hosted at CNKI. How are the requirements for e-T&S solicited?

This study is a single case study [6], applying a systematic qualitative literature review method [7] on research papers selected from the Chinese full text journal database, CNKI. Through a number of steps selections of papers are reviewed and re-reviewed led by the research questions, which then have been revised and extended in order to support review of additional papers. This is explorative research, which aim primarily is to raise questions about the e-Schoolbag phenomenon in order to prepare for more in-depth future analysis.

The first batch of papers was selected by the e-Schoolbag resource center at East China Normal University, 12 on e-Schoolbag and 9 on e-Textbooks, in total 21 papers. These were presented as a representative selection of the full list of 221 papers in the full text database. The papers were machine translated from Chinese and analyzed according to the review protocol. Even if machine translation gives a crude representation of the Chinese text, the author has found it good enough to glean information about the broad research questions in this study.

Based on the results of the first round of analysis, a new set of papers was selected for further analysis from all papers with the keyword e-Schoolbag in the CNKI database. Also Google Scholar was searched for keyword e-Schoolbag, and the first six papers hosted by the English version of CNKI (en.cnki.com.cn) were analyzed for an added validation of results.

III. RESULTS

Only two of the 12 e-Schoolbag papers in the first round of analysis have a clear research focus with defined research questions: One study is gathering requirements for e-Schoolbag development from a classroom teacher perspective, interviewing 28 teachers using an e-Schoolbag application [8]. This is the only empirical study of this selection of papers. The other one is extracting behavior patterns to support e-Schoolbag design based on a theoretical comparison between Chinese and Western pedagogical models [9]. The research focus of the rest of this batch of papers is more diffuse and could be described as aiming to create an overall framework for general understanding of the e-Schoolbag ecosystem; raising awareness and promoting the idea of e-Schoolbag; giving input to design and reporting on the initiative. The lack of a clear research focus follows from another characteristic of these papers (with only one exception): an almost complete absence of explicit methodology, and no stated idea of empirical validation or testing of constructs.

The positions developed in the 12 e-Schoolbag papers seem to a large extent to be self-referential and not grounded in empirical research, nor in referenced literature. Five of the 12 papers refer to NMC’s Horizon reports claiming that e-Schoolbag is a hot international trend. These papers also refer to pilots in France, Japan, Malaysia, USA, and South Korea. Besides pointing to similar projects in other countries, the papers do not do any cross-cultural comparison.

Three of the selected e-Schoolbag papers were literature reviews. One study by Li and Ling [10] of Beijing University of Posts and Telecommunications set out to review the status of e-Schoolbag based on news reports. They found 29 cases, which were analyzed with respect to type of device used, location of project, and mode of interaction with the content. The authors also identified problems and barriers, which were discussed in a “question and answer” style with the authors as the source of truth. Li and Lin, however, acknowledge that it is difficult to gather first-hand information on e-Schoolbag throughout China, and that direct access to e-Schoolbag practices across the country is “completely impossible” (Google translation).

A study by Liu and Chen of East China Normal University [11] set out to forecast trends in e-Schoolbag research based on 41 papers from the CNKI database. After a statistical analysis of the papers based on year of publishing and topic category (theory, development, application, management or appraisal) the authors discuss aspects of e-Schoolbag without any use of their own empirical findings.

The last literature review is a comparative study of e-Schoolbag use in Mainland China, Taiwan and Hong Kong by Li and Jang of Beijing Normal University [12]. They found that research on e-Schoolbag is mainly around industry standards, development of future systems, and how to implement e-Schoolbag on a big scale. The authors offer a number of personal opinions on implementation.

The 9 papers on e-Textbooks, which are the key component in an e-Schoolbag ecology, fall into two categories: Contribution to design, and Reflection on use and expectations. The latter group contains a paper written in essay style from an industry perspective concluding that China is lagging behind some foreign examples, and claiming that research is still insufficient. Another paper explores teachers’ use and expectations and finds that user-friendly design is key to adaptation. The rest of the papers propose design artifacts related to standards work on e-Textbook, on metadata models, mechanisms for personalization, vocabularies for virtual learning tools, digital rights management, etc.

Neither in the 9 e-Textbook papers, nor in the 12 e-Schoolbag papers there is any description of an overall validation or evaluation strategy being part of the large-scale development of the Chinese e-Schoolbag system. In general, most of the papers seem to lack a methodology and ideas of grounding and validation of the proposed constructs. This provisional findings make it necessary to refine the research questions of this study to focus on how Chinese e-Schoolbag
research is set up to advance knowledge about new educational practices. Are the design efforts and pilot implementations based on any methodological or empirical approach, which can be identified in papers accessible to the author through machine translation?

A. 2nd round of analysis

In order to do another round of review of CNKI papers, every tenth of the 221 papers tagged with e-Schoolbag in the database were selected for translation. This resulted in 12 papers when empty links and papers in non-readable formats were excluded.

Analysis of these 12 papers identified only one that was based on systematic selection of empirical data, again a literature review. This paper [13] followed the same structure as the one analyzed above. 278 journal papers were analyzed quantitatively according to content categories, year of publishing and regional affiliation of first author, followed by the conclusion that there is no solid theoretical foundation to guide e-Schoolbag implementation practice. The rest of the papers were personal comments, news stories and promotional reports. One paper [14] reported on the implementation plans of an e-Schoolbag project in Nanjing, giving some hints to how evaluation of e-Schoolbag pilots is done in China. The plan does not include any evaluation research, but “to carry out experiments (…) each district or county pilot school regularly organize open class displays allowing other schoolteachers and responsible personnel to observe. At the same time, each class is invited to show leadership and relevant experts to review and evaluate…” (Google translation) [14].

A third round of analysis of six CNKI papers referenced in the top Google Scholar hits on ‘e-Schoolbag’ did not add any new information to this study.

IV. DISCUSSION

Everyone trying to bridge between the East and the West knows that meaning easily gets lost in translation. This study tries something nearly impossible, namely to make sense of research in a language that is unknown to this author, only with the help of Internet translation technologies. The background is a scenario where the West is looking to the East, and the West is looking to the East to find support for claims about trends in uptake of digital textbooks and related services, struggling to see what the other side is doing.

Participatory observations in international standardization settings by this author leaves no doubt that Western experts are impressed by the big number of e-Schoolbag pilot schools and users of e-Textbooks in China. Also, a list of 23 defined Chinese standards projects with published standards on e-textbooks, learning terminals, virtual tools and learning services (Figure 2) is impressive seen from an international point of view. Especially, when it is known that ISO still has not published any standards in this domain, having a requirement report and a standard on virtual experiments under development².

This study has shown that a big part of Chinese e-T&S research could be characterized as motivational; it reports on initiatives and creates rationale for the need to design new systems. It is therefore to be expected that authors “look to the West” to substantiate that the national e-Schoolbag commitment is part of an international trend.

The e-Schoolbag development in China is just started. It was the “Long-term Educational Reform and development plan 2010 – 2020” that made it clear that IT has a revolutionary impact on education and that students should be encouraged to use information tools for active learning [12]. In an early phase of development design research has to play a major role. This is also reflected in the literature reviewed in this study. It is, however, interesting to note what could be a Chinese approach to design research. With the caveat that machine translation does not give full justice to the reviewed research papers and the selection may not be representative, we observe that conceptual modeling, often in a standardization context, plays a prominent role in Chinese e-T&S application design. The role of standards is emphasized. And it is stated that standards are a prerequisite for the industry to develop educational applications [5].

Anticipatory standards development is a high-risk activity [15] as it implies achieving consensus about constructs and frameworks before there is any established practice to support the chosen design solutions. Therefore, it is essential to focus on requirement solicitation and validation of constructs through multiple design cycles as an integral part of the design process [16].

One of the research questions of this study was about the data used in the reviewed Chinese papers. The findings imply that there might be a challenge for Chinese e-Schoolbag development related to validation of design. At least there is a very weak reference to methodology and evidence in the reviewed papers dealing with designs of e-Schoolbag artifacts. Again, this could be explained with the fact that it is still early days for this research. There could also be an issue of a development policy that is not foregrounded in the reviewed papers.

² http://www.iso.org/iso/home/store/catalogue_tc/catalogue_tc_browse.htm?comid=45392&development=on

Figure 2. Hierarchy Diagram for e-Schoolbag System
(Source: ISO/IEC JTC 1/SC36/WG2 N210)
In this study two pieces of information could point to a more informal system of validation of e-Schoolbag design. Wu et al. [5] made it known that the CETESBSWG group counted more than 50 institutional member taking part in research and standards development. The report on the e-Schoolbag project in Nanjing [14] highlighted open class demonstrations giving a variety of stakeholders a possibility to observe and respond. The question, however, is whether such an informal process gives the necessary methodological rigor to advance design and systems development. And an alternative requirement and validation process does not reduce the expectation to the use of data and a sound methodology in this field of research.

V. CONCLUSIONS

Digital textbooks will in a foreseeable future play a dominant role in education across levels [17]. Chinese e-Schoolbag initiatives have made an important contribution to the design of the digital textbook ecosystem by focusing on the technical, pedagogical and cultural context of the learning resource. By specifying not only the e-Textbook, but also the hardware (learning terminal), the virtual learning tools, and the learning services used to interact with the resource the educational system as a whole is put under scrutiny. No wonder then that the e-learning community outside of China is eager to get insights in e-Schoolbag development, especially when we know that China is now leading in bringing new low-cost tablets to the market (Figure 3) and has a huge user base to back application development.

This paper has been searching for the evidence base of this development, trying to identify research directions, methodology and driving forces behind the e-Schoolbag projects. Few other countries have the resources, the organization and access to stakeholders to do large-scale development and research as China. For this study, the research methodology and the language barrier give cause to be careful in drawing definite conclusions. However, the findings are raising questions to whether the enormous competitive advantage of Chinese e-Schoolbag development is being fully exploited.

It is still early days, and four years of development is nothing in the long history of educational reform in China. This paper raises questions that only can be answered by further research – hopefully by cross-cultural research teams, broadening the selection of e-Schoolbag research papers and carrying out interviews and participatory studies with the leading e-Schoolbag projects in China.

REFERENCES
