



## The Digital Book in Higher Education: Beyond the Horseless Carriage

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This paper deals with the evolution of the book in the context of higher education. Digital books, or ebooks, need not be restricted to duplication of the printed page on a tablet device. As higher education embraces online learning, the tablet-based offerings from educational publishers will increasingly incorporate a variety of cloud-based learning activities and resources. These next-generation ebooks and etextbooks will look more like mobile apps than books. They will need to exchange data with a growing list of educational systems for student management, lesson planning, record keeping, learning analytics, assignment scheduling, massive open online course (MOOC) platforms, and so on. The Actionable Data Book project is a research and development effort undertaken this year to determine how to implement the added functionality required of educational ebooks in a way that will allow them to plug-and-play with other systems.

Keywords: Educational technology, ebook, mobile learning, future of higher education.

### Introduction

For the last thirty years, computing technologies have enabled transformative and innovative ways of creating, compiling, and disseminating knowledge (Arenas, 2012). Today, these various technologies are widely accepted as part of the paraphernalia of any form of education at all levels (Arenas, Richards, & Barr, 2013). Economic, demographic, and social realities are causing academics, parents, and policy makers the world over to re-examine the purpose and process of higher education. Technology is now being used to expand our educational offerings and to explore alternative ways to achieve society's educational goals (Barr, Richards, & Robson, 2013). In that regard, however, it is impossible to predict the level of influence these technologies might have in supporting the learning process and teaching practices of the future. We may only speculate or imagine it on the basis of the lessons learned from the past and current practices and trends.

Recent reports by the New Media Consortium (NMC), part of a major longitudinal research effort, offers some insight into these trends and the challenges awaiting us (Johnson et al., 2012; Johnson et al., 2013). At the top of the list of future trends that will impact higher education, according to NMC, is the expectation of being able to work, learn, and study anything, anywhere, at anytime. Within this new learning ecosystem, it will not be uncommon to have the education paradigm dominated by the blend of learning models including online, hybrid and collaborative models, and the push for more challenged-based and active learning. Along with these trends, there will be the emergence of new scholarly forms of content creation, publishing, researching and content dissemination that will present significant challenges for libraries and university collections, how scholarship is

documented, and the business models to support these activities (Johnson et al., 2012; Johnson et al. 2013). The question for publishers and content creators is how to respond to this onslaught of challenges engendered by the new mobile learning ecosystem. More specifically how will publishers' digital offerings evolve as ebooks and etextbooks get used in educational institutions?

This concise paper has been designed to answer this question. Using the NMC findings as the backdrop, we attempt to speculate and reflect on the actualisation of a global platform for connected learning called the Actionable Data Book (ADBook): a specialised ebook, grounded in learning and teaching principles, based on open standards, tailored to support science, technology, engineering and mathematics (STEM) education and that will support learner's accessibility and usage preferences (IEEE ADB Project, 2013). Our reflection borrows on the well-known horseless carriage metaphor: ebooks soon will no more resemble their paper namesakes than cars resembled their horse-drawn predecessors.

## Background

When Amazon introduced its Kindle™ tablet in late 2007, it was the beginning of a new era in reading: ebooks, newspapers, magazines and all forms of digital media. The technology continues to advance and to improve the reading experience of the users. Taking the ebook as an example and given the scholarly importance of this form of digital media in higher education, such e-readers' improvements do not comprise a significant qualitative change in the processes of learning and teaching. In terms of emerging learning technologies, there is a need to rethink the affordances of what we know as an ebook. The situation is similar to the horseless carriage metaphor where initially people's mind was set to think about the automobile as a carriage without a horse. As put by Henry Ford, the American industrialist founder of the Ford Motor Company: "If I had asked people what they wanted, they would have said faster horses". But the car is much more than a horseless carriage and the metaphor soon tired, as people began to see possibilities invisible in the horse-drawn era.

For the purposes of this discussion, a book is produced by a publisher who manages experts in specific disciplines, digital rights, editors, peer-reviewers, graphic designers, and others to produce a product with mass appeal. In this context, there might be three ways of conceptualising an ebook: the digital version of a hard copy print book. First, ebook may be defined as the digital version of a book viewed on a tablet like the Kindle™ or iPad™. In this case, the ebook simply mirrors the functionality of a traditional book with the value added of cost effectiveness, easiness to buy and update, and mass portability (you can have a whole library with you at all times) amongst others. Secondly, an ebook may be considered as a digital book with some kind of additional functionality like interactivity, term searching, and links to more information and related web sites. Thirdly, ebook may be a digital offering from a publisher that may not reassemble a book at all.

The authors believe that the ebook will soon take the latter form: something more like a mobile app than a sequence of pages with a table of contents and an index. We are actively working with our IEEE (Institute of Electrical and Electronics Engineers) colleagues on data interoperability standards that will allow ebooks to become the learner's personal window into the publisher's cloud-based learning offerings. Ebooks will be one part of a growing ecosystem of different kinds of products and services for teachers, students and administrators. As a result, authors and publishers must think about new functionality, for example:

- Integrating and exchanging data with institutional learning management systems (LMSs), online activities, learning analytics products, etc.
- Using the new Experience Application Program Interface (xAPI) activity stream protocol to update the learner's status data in a learning record store, which in turn is monitored by, for example, a dashboard app used by her teacher, e.g. using the xAPI protocol.
- Monitoring the status of a device or instrument that the student is learning to use.
- Gathering relevant background data about the student from LMSs and other systems.
- Supporting teachers and learners who work and learn in multiple organisations.
- Linking to workplace performance systems, i.e. taking the textbook to work.
- Allowing publishers to link ebook content to sophisticated online offerings: immersive simulation environments for practice and assessment; multi-player games; adaptive testing systems; robo-graders; intelligent tutoring systems; etc.
- Allowing instructors to assign, monitor, and participate in ebook-based activities in real time.
- Giving training organizations better ways of evaluating training materials and of keeping them up to date.

This model of ebooks is defined by the learning needs and demands of the future students and the teachers and institutions that help them learn. We refer to this enhanced model as the Actionable Data Book, or ADBook for short.

## A Global Platform for Connected Learning

The ADBook project grew out of a paper presented at the IEEE Global Humanitarian Technology Conference in 2011 that discussed a broadly applicable framework for building educational applications that combined field data collection and data visualization (Richards & Barr, 2011). In January 2013, the suggestions in the paper were incorporated in the ADBook project. The goal of this one-year research and development collaboration is to define and demonstrate an actionable data book consisting of a specialised ebook based on open standards that is tailored to support STEM education and supports learner accessibility and usage preferences. The project's requirements for the actionable data book are that it must be able to:

- Use camera and Global Positioning System (GPS) data from a learner's mobile platform.
- Use measurements from local lab equipment.
- Exchange results of learning interactions with cloud-based LMSs, analytics engines, and other applications.
- Retrieve content from cloud-based sources (e.g. content repositories).
- Store and retrieve student history and preferences in the cloud.

Operationally, the project is hosted by Industry Connections, an IEEE Standards Association program that facilitates the early exploration of potential interoperability solutions (Richards, 2012). Participation is free and open to interested parties. The IEEE ADBook project may continue past the initial year's charter, depending upon success. Technologically, the project anticipates the global availability of a class of mobile devices comprising smart phones and connected tablets and explores the premise that those devices, in conjunction with a new content format, may provide the first truly global platform for connected learning. The format in question is EPUB3 (Garrish, 2011; IDPF, 2013a), a new ebook format defined by the International Digital Publishing Forum (IDPF, 2013b).

Ebooks have emerged as a mass-market commercial success within the past few years. To date, as suggested above, ebooks have only replicated the static content of printed books in a digital medium, but EPUB3 introduces interactivity to ebooks by embracing JavaScript and the Hyper Text Markup Language version 5 (HTML5) standards for web page content. These characteristics make EPUB3 an attractive foundation for a more fully featured learning delivery platform. EPUB3 offers a complete solution for portable, interactive, connected content, and it is relatively simple to map the requirements for an interactive learning activity onto baseline EPUB3 capabilities. Since EPUB3 is a general-purpose technology with broad appeal outside of the education industry, it is more likely than education-specific standards to be widely adopted, to have adequate support, and to have a multi-decade life span.

Although most of the technology used by the ADBook project was developed for commercial purposes in the developed world, its application to learning was originally inspired by the desire to enable students in remote locations to collect field data and share their data and culture with other students in the world. The first use case to which it will be applied is the construction of an enhanced, interactive guidebook for the new UNESCO World Heritage site on Bali (Lansing & Watson, 2012a; Lansing & Watson, 2012b; UNESCO, 2012).

The UNESCO site covers a significant geographical area encompassing 21 communities engaged in rice production and following traditional spiritual practices. This has resulted in an enormous challenge: How does one design an interactive guidebook that promotes the conservation and preservation of the site while meeting the needs of the people who live there, the international team developing and maintaining the site, and tourists from all over the world with varying degrees of cultural sensitivity? The ADBook project aims to help meet these requirements by developing onsite learning activities and guides that adapt to the local geography and culture as well as to those of the user's culture. The project will also support remote connectivity, allowing students to vicariously experience the site from anywhere on the planet.

The UNESCO site is just an example of the affordances of the ADBook. As noted above, the project is intended to support generic STEM education as well as learner accessibility and usage preferences. In this respect, the challenge for the ADBook is to be regarded by the learning and teaching community as an improved platform that supports modern approaches to meaningful and transformative learning.

## Imagining the Future with the ADBook

In terms of STEM education, the ADBook is expected to tap into newly emerging product categories. Some will be engendered by societal requirements and others by advances in educational technology. For example, students and teachers are increasingly connected with multiple institutions at the same time (Newbaker, 2012), and many of the more innovative learning technologies are typically used outside standard classroom practice. This may require tracking of rosters, assignments, progress, and grades across multiple institutions and multiple online learning systems. Students' history and preferences will be maintained in an external "learner model" (Durlach & Ray, 2011; Sottolare, 2013; Woolf, 2009) or e-portfolio. This student-controlled data locker can be updated and queried by multiple adaptive learning systems. The natural evolution of the e-portfolio will be a personal learning record store that is:

- securely controlled by the learner;
- portable as the learner works with multiple schools, teachers, tutors, and publishers over the years; and
- contains the learner's preferences and his validated and certified formal and informal learning history.

This evolution of the learner's history records would parallel the recent evolution of Electronic Health Records and, if implemented on a global scale, would spawn a plethora of products, ranging from tools to manage learning records to learning activities that analyse this extensive background data to deliver more personalised, culturally relevant, and educationally effective learning experiences. Similarly, advances in cognitive science, computer science, and information technology are also creating both requirements and affordances for new product categories. Just as the underlying technological components of expert systems have now found their way into hundreds of products from rice cookers to mobile phones, we anticipate that the artificial intelligence (AI) components of today's intelligent tutoring systems will work their way into a wide range of learning products. The same is true for automated language understanding (Robson & Ray, 2012), automated grading (Valenti et al., 2003), affect detection (Calvo & D'Mello, 2010; Hussain et al., 2011), gesture and sketch recognition (Valentine et al., 2012; Weinland et al., 2011; Yin et al., 2010); and forms of social media that enable students to collaborate with each other and with adults (e.g. "granny tutors") (Doctorow, 2011).

## Conclusion

There are many forces re-shaping higher education, resulting in serious questions about who, what, and why we teach. Whatever future faculty teach, it is likely that much of that teaching will be done differently. We are at the beginning of a sea change in education at all levels. Eventually, through innovation, investment, trial and error, educational technologies like the ADBook will evolve to help teachers teach and students learn more thoroughly, less expensively, more conveniently, more broadly, more efficiently, and more effectively.

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