IN A WORLD OF EXPLODING POSSIBILITIES IN DISTANCE LEARNING, DON'T FORGET ABOUT THE LIGHT BULB

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This article looks closely at decisions about technology choices and suggests that many are driven by markets and perceptions, and not the problems that the technology might solve. The example of market manipulation related to the commercial light bulb in the early 20th century is used to demonstrate the powerful influence of global markets to technology choices and to the concept of obsolescence (Reich, 1992). As a result of these market dynamics, older technologies and distance education solutions may be discounted well before their time. Similarly, the assumptions that people make about technology obsolescence are often tainted with the myopic perspective that access to the Internet and cell technology is almost universal and most learners at a distance do so through the fastest and most synchronized method over the Internet (e.g., Allen & Seaman, 2013). But in the developing world this is not the case. Radio, telephone and other older technologies still provide valuable access to educational materials and educational opportunities to learners for all levels of education (Bosch, 2001). Distance learning technologies such as radio or telephone may also offer a bridge to newer or more robust technology systems. These bridges enable expanded participation despite poor technology infrastructure. An example in Indonesia is provided by the Higher Education Leadership and Management organization (HELM) where mobile and landline phones are used to call into webinars and other live Internet-based interactive learning sessions designed for higher education courses (HELM, 2014). A second example in Liberia demonstrates how radio technology is far from obsolete as a distance learning technology in Africa when schools are closed due to a crisis, such as the Ebola epidemic (Centers for Disease Control, 2015). In the end, the authors conclude that distance learning has benefited from innovators and educators trying to find new methods to deliver quality education and interaction to people at a distance. It is the problem solving nature of distance learning that has produced some of the most interesting use and effective systems and technologies.

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When problem solving is the goal rather than the technology itself or market trends, the interpretations of technology lifespans and obsolescence change and technologies that might have otherwise appeared obsolete become relevant again.

INNOVATION, NOSTALGIA, AND THE LIGHTBULB

Technology innovation and distance learning systems have greatly benefited from ingenuity, competition, and markets that drive the design and production of new technology solutions. The innovations of the past decade, particularly e-learning and mobile learning, have transformed and reinvented the field of distance education (Balch, 2014). The expansion of mobile technology, the introduction of cheaper, more powerful, and more nimble devices, the broad and far reaching infrastructure and networks that bring Internet and cellular signals to the far reaches of the globe, and the explosion of ways to introduce, package, and fuel content and knowledge creation means that learning at a distance is no longer just an alternative for those who were unable to complete education through the traditional routes (Simonson, Smaldino, & Zvacek, 2015). Indeed it is a standard and anticipated component of most learning environments. In richer connected countries, we now interact virtually to teach, learn, create, and deliver content, and flip classrooms from a distance. Analog technologies have ceded their everyday utility to digital ones, and the words *film* and a*lbum* evoke a sense of nostalgia as we remember a time when life moved more slowly and "distance" referred to places that were far away and hard to reach. But as we feel the draw of a tacit consensus that new technologies are inclined to be better and brighter and more appropriate to solve today's problems, don't forget about learning environments that rely on more traditional methods and technologies. And don't forget about the light bulb.

DEFINITIONS OF TECHNOLOGY TRANSIENCE AND OBSOLESCENCE

Definitions of technology obsolescence are often driven by factors unrelated to whether the technology application is still useful (National Center for Families Learning, 2008). The light bulb is an interesting and iconic reference point; the power of the commercial light bulb is undisputable. Like the Internet or the radio or the printing press, there is little doubt that the invention of the commercial light bulb changed lives (cf. Krajewski, 2014). It not only brought light and productivity to the darkness, it also helped catalyze an age of electrification and a ripple of lifestyle changes that were irreversible. But technologies, like the light bulb, are born into complex worlds where decision-making and problem solving are part of large and competing agendas. There are at least two reasons why the introduction of the commercial light bulb helps us to understand technology lifespans and obsolescence in distance learning today: first, decisions about technology choices are driven as much by markets and perceptions as they are by the problems that the distance learning technology might solve (Pulizzi & Rosenblum, 2008). In other words, older technologies and distance education solutions may be discounted well before their time. Second, distant learning technologies that may at first appear to be obsolete may offer a bridge to newer or more robust technology systems or be useful in a different context. This is especially true in the contexts of the developing world today.

The conclusions that people draw about technology lifespans may be tainted by assumptions that access to the Internet and cell technology are almost universal and most learners at a distance can connect over the Internet, even if the connection may be slower or "clunkier." But in much of the world much of the time this is still not the case. Radio, telephone, and other older technologies still provide valuable access to educational materials and interaction to learners around the world (Fortune, Chungong, & Kessinger, 2011).

LIGHT BULBS, MARKETS, AND OBSOLESCENCE BY DESIGN

Before presenting examples where older technologies are still relevant to distance education, let's analyze perceptions of obsolescence through the prism of the light bulb. The history of the people and companies competing to invent and market the incandescent light bulb are filled with stories of intrigue. Even those that remain controversial have interesting lessons. According to researcher Markus Krajewski (2014), the original design of a commercially viable incandescent light bulb was heartier and longer lasting than the one brought to market. The story goes that in December 1924 powerful companies from around the world invested in the production and sales of light bulbs, including Osram, Philips, Tungsram, and General Electric, met in Geneva and founded the Phoebus Cartel (Reich, 1992). The cartel was organized specifically to control markets and lower costs through the standardization of the life expectancy of light bulbs. The members made a pact to produce incandescent light bulbs with dramatically shorter life spans than was necessary in order to increase sales. While it was possible to produce light bulbs that would last from 1,500 to 2,000 hours, the companies of the Phoebus cartel agreed to manufacture and sell light bulbs that would last only 1,000 hours, thereby making it necessary to replace them more often. At that time, they claimed that a longer life expectancy would waste electricity; however, the consolidated move positioned companies within the cartel to sell more light bulbs and to artificially inflate prices. This example of companies designing for product obsolescence and influencing public perception is seen as one of the first attempts at controlling a global economy. The agreement was exposed and diffused in 1939 and, while some historians downplay the cartel's motivations, the lessons remain: obsolescence is a powerful concept that contributes to decisions with behavioral and economic outcomes and it can be manipulated (Krajewski, 2014).

In developing countries and places with poor infrastructure due to crisis, technologies such as radio and telephone are still vital to building the communication bridges that enable learning to take place. The following two examples demonstrate how the telephone and radio continue to stretch their technology lifespan and relevance to distance education: (1) the integration of telephone technology to expand blending learning in higher education institutions in Indonesia where the Internet is not reliable (HELM, 2014), and (2) the use of radio instruction in Liberia during the ebola crisis (Wallace, 2014).

BLENDED LEARNING FOR HIGHER EDUCATION IN INDONESIA: BRIDGING OLD AND NEW TO INCREASE PARTICIPATION

While online learning is expanding educational opportunities around the world, the Internet has been slow to transform higher education in Indonesia. The number of higher education institutions in Indonesia has exploded since the government passed the Higher Education Reform Act in July 2012 (Global Business Guide Indonesia, 2013), a set of reforms meant to encourage competitiveness and systems of quality control across the 900 populated islands and more than 3,000 institutions of higher education in Indonesia. The Higher Education Reform Act made it possible for universities, polytechnics, and community colleges to have greater control over their internal systems and budgets, to form partnerships with both Indonesian and foreign entities, and to be responsible for new, more stringent standards of accreditation. However, many higher education institutions serving populations across this vast island country do not have many of the attributes that other universities regard as standard: adequate infrastructure, solid professional development systems and networks, and access to peer review.

Indonesia is the fourth most populous country in the world and Internet is considered an increasingly important method to expand access to and increase quality of higher education. The Indonesian Association of Internet Service Users (Asosiasi Pengguna Jasa Internet Indonesia, 2015) estimated that there were 139 million people using the Internet in 2015 (about half the population), with five companies providing Internet services. However, the infrastructure and services are not evenly distributed across this island country and, while most higher education institutions on the western islands of Java, Sumatra, and Bali have basic access to Internet, the universities on the less wealthy eastern islands of Kalimantan, Sulawesi, Maluku and Papua have unreliable or lack Internet service entirely. Internet service providers, backed up by government, have not yet invested in the infrastructure in these locations to the same extent. Only three major universities, all on the island on Java, are recognized as integrated web based services into teaching and learning: University of Gadjah Mada, Bogor Agricultural University, and Bandung Institute of Technology. Several universities on the islands of Sulawesi and Sumatra are expanding access slowly. The culture, networks, and infrastructures are simply not ready to support a more broad use of web-based interaction at the higher education level.

The HELM (2014) project, funded by the U.S. Agency for International Development in Indonesia, was designed to support the Indonesian government to implement reforms, strengthen leadership and management in 50 higher education institutions across Indonesia, and introduce special initiatives and innovations that demonstrate how to increase higher education performance. The project provides extensive face-to-face training to the 50 universities in order to build capacity in four core areas: administration and leadership, financial management, quality assurance, and collaboration with external stakeholders. After three years of intensive work and more than 2,000 leaders and managers trained, it remained clear that Indonesian higher education institutions would benefit from much stronger professional networks, concentrated follow-up support, training and interaction that did not rely on travel, and greater integration of technology systems in teaching and learning. Without these added systems, most institutions of higher education would not be globally connected or globally competitive.

In June 2014, leading university Universitas Gadjah Mada (UGM) made a proposal to USAID HELM to codesign a virtual approach to provide intensive and regular follow-up to the face-to-face training and launch executive networks for professionals in higher education management. Launched as a HELM special initiative, this HELM UGM blended learning approach set up four 3-month interactive courses in the four core areas of the project. Each would include a weekly live session that would take place over a webinar format and would encourage faculty members to present their projects and interact. Despite the known obstacles to Internet connectivity, the idea was to experiment with a blended approach to training and networking to better understand what could be done, and measure demand, participation, and learning.

The four month blended course in accreditation and quality assurance best demonstrate the results of the experiment. The HELM UGM Blended Learning Program provided a 3-month blended learning course that integrated webinars/live connection and virtual mentoring from January to March 2015. The HELM team and UGM's department of higher education and management invited experts in the field to create materials such as videotapes and presentations, which were uploaded to the UGM website and sent via e-mail to participants. In addition, staff at the 50 HELM partner higher education institutions, who had previously attended HELM training and were tasked with accreditation and quality assurance, were invited to register for the webinars. Table 1 demonstrates the demand and participation in the webinars by faculty members who had previously attended training. Over the 3-month period, 777 participants from 28 of

TABLE 1
Participants by Region and Gender for Quality Assurance Webinars, January–March 2015

	Kick-Off		*Webinar 1*		*Webinar 2*		*Webinar 3*		*Closing*	
Date	*15-Jan-15*		*29-Jan-15*		*18-Feb-15*		*12-Mar-15*		*26-Mar-15*	
Sex	*Male*	*Female*	*Male*	*Female*	*Male*	*Female*	*Male*	*Female*	*Male*	*Female*
West	19	21	11	10	9	8	17	26	25	31
East	22	6	23	7	22	8	24	10	26	9
Group Learning	14	12	32	32	43	40	57	47	96	70
Total	55	39	66	49	74	56	98	83	147	110
Subtotal	94		115		130		181		257	
Grand Total	777									

Source: MMPT-UGM (2015).

the 50 higher education institutions successfully registered and participated in live webinar sessions from both the western and eastern regions of Indonesia. This means that representatives from 56% of the HELM partner institutions joined a live session.

The composition of participants was also somewhat different than in the face-to-face training. While face-to-face HELM training sessions had been consistently dominated by males in both regions and on average approximately 70% of attendants had been male, the percentage decreased to 56% male across the board in the webinar sessions, suggesting that a far greater proportion of females were participating. The real difference occurred in the west. As the data show, the proportion of males participating in the eastern region of Indonesia was approximately 75% male, which was roughly equivalent to face-to-face trainings (these data do not include the group learning participants). In contrast, 46% of the participants in the west were male, representing a much lower proportion of participants (HELM, 2014). We concluded that the virtual approach enabled many more females to participate in the sessions in many of the higher education institutions.

Given the lack of Internet in many areas in the east, when we questioned how participants connected, we found that many of the faculty members working in the eastern part of Indonesian uploaded and downloaded the training materials on their mobile phones, not through their computers. Dr. Partino, Head of the Quality Assurance Center at Cenderawasih University on the island of Papua, stated this was the norm (R. Partino, personal communication, 2015). He said more than 60% of their faculty members use smartphones instead of the Internet. They can actually access data faster. Adel Hard, vice dean at the College of Mathematics and Science at the State University of Papua confirmed this, saying "teachers have unstable Internet connection on our campus and cannot access images and voices at the same time. They prefer to use mobile phones for uploading and downloading data for teaching and learning and texting with [their] students" (A. Hard, personal communication, 2015).

The researchers at HELM found that many of the participants in the 22 higher education institutions were accessing the materials via their phone, but were not planning to connect to the live session, which was promoted as a webinar. To accommodate this preference, UGM added a feature to the webinar system to enable calling into a live session with either a mobile or landline phone. While the participants using landline phones would not be able to see others in the live session, they would be

able to hear the presentations and discussions and be heard if they chose to contribute.

Among those participants who registered for a live session, many participants chose this option and called in through their phones. This choice was important because while the landline phone might be considered obsolete as a primary vehicle for interacting in a live webinar session, for those interested faculty members without stable Internet or reliable cellular signal, the landline technology was not only relevant, it was the only way to connect. In a small sample survey of 19 participants, nine of whom were participating by landline, seven participants said the voice clarity was good or very good and was adequate to participate. Two were still not able to connect adequately.

Another finding of interest to the HELM project was the unanticipated demand among the 28 higher education institutions and the strategies that emerged to expand participation through group learning. In the beginning, UGM provided a quota of 30 participants who could register and interact live. With more than 60 participants registered for the first session, HELM sent out protocols of interaction and a recommendation that institutions use their multimedia centers, computer laboratories, and speakerphones for groups of participants who would then work together on their accreditation projects. UGM and HELM supported two basic learning services: live participation and group learning. Following this recommendation, Universitas Muhammadiyah Malang used their teleconference room to connect in the first webinar session. Starting with the second webinar session, at least 12 higher education institutions did the same, with five of them in the east and seven in the west. Larger numbers of the quality assurance staff began to register through UGM for the group learning approach and rooms full of staff convened to listen and plan out their own applications for accreditation for individual institutional study programs.

Table 2 shows how the numbers of individuals registered increased through the group learning approach. At the first live session, 68 of the 94 registered participants joined as individual users. Over time, that number decreased and the numbers participating as group learners increased.

RADIO IS NOT OBSOLETE IN LIBERIA

Radio technology is far from obsolete as a distance learning technology in Africa and nothing drives this message home more than a crisis. In March 2014, the first known case of Ebola was diagnosed in Liberia. Over the next few months, what started as one case in a border town grew exponentially until by June 30th there were 90 reported cases (Centers for Disease Control, 2015). Nearly all the counties in Liberia were affected, including the populous capital of Monrovia. The government put in place stringent measures to curb the spread of the disease, such as closing all but three land border entry points, instituting new security screening measures, and banning large public gatherings. On July 30, 2014, the government announced the closure of all schools until fur-

TABLE 2
Trend of Interacting and Group Distance Learning Participants

Connection Service	*Live 1 HEQAS*	*Live 2- Module 1*	*Live 3- Module 2*	*Live 4- Module 3*	*Live 5- Evaluation*
Interacting participants (from Table 1)	68	51	47	77	91
Group distance learning participants	26	64	83	104	166
Total	94	115	130	181	257

Source: MMPT-UGM (2015).

ther notice. This affected both private and public educational institutions at all levels: preprimary, primary, high school, university, adult education programs, and technical–vocational schools.

September, typically the start of the new academic year in Liberia, came and went. It was uncertain when the Ebola outbreak would be contained, and consequently, when the government would determine it was safe for schools to reopen. The Liberian Ministry of Education and its development partners were engaged in emergency response planning to determine how they could continue to offer educational services during the crisis.

One alternative education program turned to radio broadcasting. The Advancing Youth Project, funded by the U.S. Agency for International Development and implemented by Education Development Center, had worked with the Liberian Ministry of Education to develop a 3-year basic education curriculum focused on literacy, numeracy, work readiness, and life skills for out-of-school youth (United States Agency for International Development., 2014). In addition to printed lesson plans in a teacher's guide and an accompanying learner workbook, there were over 200 audio programs designed to complement and reinforce key learning objectives in the print curriculum. Each of the literacy lessons for the first year of the program included an audio component, which focused on phonics, listening comprehension, and writing. The other content areas had audio programs for selected lessons that were particularly challenging for facilitators or learners. The audio programs were designed to be used by a facilitator in the classroom, and were played on solar-powered MP3 players. The audio program guided the facilitator and learners through a series of learning activities for approximately 20 minutes, after which they continued with the printed lesson plan. Classes were usually held in public primary schools three nights a week in the late evening hours, after youth had finished their day jobs.

Like formal schools, alternative night classes for youth had also been suspended in July. At the time, classes were ending and about a third of the over 12,000 learners enrolled in the program had already taken end of the year exams (UNICEF, 2014). There was concern that as the hiatus in classes dragged on, students would lose some of the learning they had gained during the year. This was of particular concern for the first-year learners, most of whom had never attended school before and already had difficulties successfully completing the curriculum. Attendance in the entry-level classes was more irregular, and learners were more likely not to persist than learners in higher levels. Classes were an important means of peer support and community cohesion, with students gaining both confidence and respect within the community for their educational attainment. Therefore learners were anxious to resume classes as soon as possible.

In October 2014, the Ministry of Education, USAID, and project management agreed to broadcast the literacy and numeracy audio programs on 10 community radio stations that covered the communities where learners were enrolled. The project sent out text messages to facilitators and youth leaders to announce the broadcasts. Learners could listen to the broadcasts with a "study partner" and follow along in their workbooks. This way they could review lesson content with some support from a trusted friend or relative, but not risk contravening the government ban on public gatherings. The audio lessons were broadcast twice a day, every weekday from October to April.

Radio stations began to get calls, not only from learners enrolled in the program but also from parents of primary school children wanting additional information about the program. Program staff heard from some students that they were pairing up with learners from higher level classes, or with more educated relatives who acted as study partners. Others complained that the timing of the broadcasts was during the day, when they were busy trying to make a living by farming or selling in the market.

During the Ebola crisis, project staff members were not allowed to travel to communities, and any feedback gathered on the radio programs had to be done through mobile phone calls. Lists of learner mobile numbers were incomplete, and youth often changed numbers or used borrowed phones, so it was difficult to create a survey-sampling framework. Phone surveys with young people with low literacy levels are also more complex, as text-based surveys are not possible and survey questions require thorough field-testing in order to ensure they are worded appropriately and surveyors have standard clarifications. So, rather than trying to conduct a rigorous survey over the phone, the project decided to gather general feedback by calling facilitators and youth leaders in the community. It was by this method that they learned about complaints about the timing or clarity of the broadcasts in different areas, and listenership. When classes resumed in April 2015, just over 3,000 youth came to be tested and register for night classes. This is much lower than the year before, when over 12,000 youth were enrolled. Registering learners were asked if they had listened to the radio broadcasts during the ebola crisis. Of the 3,283 learners who chose to take the completion test or register for classes, only 12% reported having listened to the programs (M. Sanoe, personal communication, 2015). Although the programs were promoted via text messages to facilitators and youth leaders, it appears that these efforts were not sufficient to mitigate the effect of school closures.

APPLICATIONS OF THIS STRATEGY TO OTHER EMERGENCY EDUCATION SITUATIONS

The circumstances of the ebola crisis in Liberia were unique and may not be readily replicable. It took nearly a year to develop, test, and finalize the 200 audio programs and materials before they were ready. The production process began with the development of the scope and sequence of the audio program, linked to the Liberian basic education curriculum. Then the standard program format was developed, which included how the program models learning activities, as well as how teachers and students interact directly with the audio program, with each other, and with their peers in pair or group activities. A team of four scriptwriters and two editors, with support from an educational technology expert, drafted the scripts and then recorded them with a stable of approximately 15 actors. Each program was field tested in a classroom, and adjusted according to feedback from facilitators, learners, and observers. The final program was then rerecorded and edited.

This thorough approach yielded high quality and effective programs. Evaluation results from a sample of learners in the 2012/13 school year showed statistically significant gains for learners in schools using the audio program in addition to the print curriculum. On an out-of-school literacy assessment that measures some aspects of phonics, word recognition (decoding), oral reading fluency, comprehension, and some real-world literacy skills, learners in schools with audio programs had a significant improvement in their overall scores, moving from 17.5% correct across all out-of-school literacy assessment subtests at baseline to 23% correct at the endline. Urban learners who had the added audio intervention, with its focus on phonics and decoding skills, showed the most improvement in letter sounds with a six percentage point gain. Of all the learners, they also showed the most improvement in reading words in a connected text, more than doubling their results at endline compared to baseline. At endline, these urban learners who received audio instruction were able to read 53% of the words in a story correctly. In the context of a structured learning environment, the programs were successful in improving learning gains.

One advantage for learners during the Ebola crisis was that they were using the radio programs to review and reinforce content that they had already covered during the school year. They already had the accompanying

learner workbooks, and had already been exposed to the audio lessons in class. So they would have been familiar with the approach and content. However, listeners who had not been enrolled in the program the year before would not have had an orientation in how to follow the programs and would not have had access to the learner workbooks. They may still have been able to follow some of the activities, but would not have had the same level of inputs as the advancing youth learners. The radio broadcasts were therefore more likely to be effective for learners who had been enrolled in the program before.

During the ebola outbreak, there was considerable interest in the use of radio broadcasting for education, and the Ministry of Education formed a working group to develop programming. There were discussions about how to adapt the out-of-school youth audio programs for an early grade audience by removing references to learner workbooks and adding learning activities appropriate for young children. The adaptation process started, but programs were never aired due to delays in planning, production, and approval of programs. At the same time, under pressure to demonstrate progress, the ministry produced a handful of lecture-style radio programs on a variety of subjects including math and career counseling that were aired repeatedly. However, the programs were not linked to an instructional scope and sequence with clear learning objectives for a defined grade level.

Certainly, radio has not outlived its lifespan for distance learning in Liberia. A 2011 survey found that radio listenership among women in Liberia is 81% and that all of them listened to community radio stations (Fortune et al., 2011). This statistic is particularly relevant for first year advancing youth learners, 80% of whom are women. And for some educational purposes, such as teaching phonics to beginning learners, audio is more effective than print curriculum. But to be effective as a teaching tool, radio broadcasts must be embedded within a supportive institutional structure, used in an appropriate learning context with clear and obtainable objectives, and adhere to sound instructional principles.

REASSESSING TECHNOLOGY LIFESPANS AND OBSOLESCENCE

Distance learning has benefited from innovators and educators trying to find any channel possible that can deliver quality education and interaction to people at a distance. It is the problem-solving nature of the beast that has produced some of the most interesting and effective systems and technologies used in distance learning. The Indonesia example demonstrated that the demand among higher education professionals to connect to the webinar training sessions was strong and many participants were able to overcome infrastructure challenges by using their mobile or landline phones to connect to the live webinar sessions and participate. The combination of technologies to access information and participate depended on the environment. While the goal was to participate as fully as possible in a webinar environment, the landline was still a relevant option. The second case demonstrates that radio technology had an invaluable role to play during the Ebola crisis in Liberia and highlights how important these distance education systems are in developing countries.

Technologies are upgraded and replaced and we move to newer and better versions to solve our problems. But as we think about the goals of higher education reform in Indonesia or the crises that break down education systems in Liberia and the many other educational environments that exist around the world, it is hard to consider technology systems as completely irrelevant. As we attempt to define technology obsolescence and lifespans, don't forget about learning environments that are still largely off the grid. And do not forget about the light bulb.

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