Vision 2030: Redesigning Education for the Future

Stephen Downes, October 28, 2014

In 2017 Maxime Jean-Louis asked me to look at the future of learning by posing the following challenge:

"With the automation of many of the functions employees currently perform, the emphasis will switch from answering simple queries to dealing with more complex problems that will require higher level of analysis, access to experts and greater autonomy."

My response was a 48-page document outlining what I called "quantum leaps we can expect from teaching and learning in the digital age: a roadmap". (Downes, Quantum leaps we can expect from teaching and learning in the digital age: a roadmap, 2017) In this document I talked about learning technologies such as learning analytics and artificial intelligence. And I talked about how changes in society impact education, and how changes in education impact society.

This work draws upon and expands on that previous work. It speaks to how these changes impact learning at a concrete and practical level by creating changes in the lives of individual learners. It looks at what learning will become and how we provide for that new kind of learning.

1. What Learning Will Become

Instead of describing the future of learning as a series of technological developments as in previous reports I want here to describe this future as a set of impacts on students directly. To that end, I describe learning in three ways:

1. *Relevant* - the learning you undertake matters to your work and your experience
2. *Engaging* - the learning draws you in, keeps you occupied, and helps you focus
3. *Personal* - you define what you need to learn and what counts as success

1.1 Relevant

By 'relevant' what we mean is that the learning matters to the learner. Something is relevant if it helps solve a problem, answers a pressing question, helps a person advance in their workplace, or satisfies their curiosity. By contrast, a learning experience is not relevant if it's something you won't ever use in the future, if it's something you already know, or if it won't help you.

There are many accounts describing how learning can be relevant. For example, Grafwallner talks about how to "keep learning real". (Grafwallner, 2017) She writes, "Give students an opportunity to learn about where they live by researching how culture, religion, and traditions have shaped their community and perhaps their lives as well." Discussions of relevance in learning have a long history; for example, Alexander points to the role of relevance as described by people like Whewell and Dewey (1913). (Alexander, 2017)

For our purposes, we can describe relevance in terms of four frames:

- Any Time/Any Place - the relevance of learning is increased if it is available when and where you need it.
- Ubiquitous - in a related manner, learning that can be delivered through any platform or service will be more immediately relevant that learning that demands you leave your existing environment and search elsewhere.
- Context-Aware - this describes many of the dimensions mentioned by both Graffwallner and Alexander. Learning that is related to the context in which it is sought. For example, learning designed for the operating system you currently use and the equipment you are currently repairing will be more relevant than general-purpose learning.
- Problem-focused - learning that addresses the matter of getting something done will be more relevant than learning designed for no specific purpose at all. We see this reflected in the development and use of problem-based learning.

Case studies highlighting the role of relevance can be found in the domain of mobile learning. Panday (Pandey, 2018) offers a good example from EI Design. "If these inputs (formal training/learning summaries/job-aids and so on) are available on smartphones, they will certainly be accessed and processed. This reality check is leading organizations to offer more pieces of training in the mobile learning format."

- *Access* - the importance of providing learning as you go supported on different services
- *Device* – the need to support not only smartphone but also tablets and laptops
- *Location* - the ability for learners can learn outside their home and office
- *Design* - designing adaptive web pages instead of content specifically designed for mobile

For example, the development of progressive web apps speaks to all four conditions. These enable a person to work with learning resources even when they are outside of wifi or mobile phone range. (LePage, 2018)

Another set of examples can be found in the domain of resource recommendation. As Long and Siemens report (Long & Siemens, 2011), recommendations draw on a wide range of contextual factors, including the following:

- Collaborative filtering - drawing data from multiple learners in the same environment
- Human cognitive modeling - developing a standard description of learning states
- Content analysis - modeling the domain being learned and the current data being used
- Self-assessment - enabling a person to report on their own progress and impressions
- Sensor & data analysis - using devices to provide objective tracking of environmental states

1.2 Engaging

There are two core aspects to learning that is engaging: it is learning that is immersive, and it is learning that is wanted. The idea is that learners must *want* to be in the learning scenario and will therefore have placed themselves into it voluntarily. And the learning in the scenario needs to be *believable*. Actual practice with the system or material being studies offers the most believability, but failing that, an immersive environment will offer the most authentic experience.

Usually when we think of something as immersive we think of extended reality (XR), which may include augmented and virtual reality. (Craig & Georgieva, 2018) But it is better to think of immersion as a *state of mind*. If you believe that something is real, then it doesn't matter what medium it is presented through; a voice on a telephone can be as immersive as a full-body experience.

This is explained by the concept of *presence*, introduced by Garrison, Anderson and Archer. The concept of 'presence' is essentially the ability to derive meaning from an environment and project ourselves into that environment, and for a teacher, to be able to organize resources supporting the making of meaning and the facilitation of social interaction. (Garrison, Anderson, & Archer, 2000) And if we look at contemporary conferencing applications such as Slack, Trello and Airtable, we see clear evidence of support for presence as defined here. This is what makes them immersive, and this is in turn what makes learning experiences using them relevant.

Presence is the idea that there is a real person at the other end of the application, whether it's a person on the telephone, the author of a book, a teacher or mentor, or an interface and content designer. It's the idea that we are engaged in an interaction with that person, that what they say and do matters to us, and in turn, what we say and do has an impact on them and on their world. The presence of that other person is what makes us believe the experience is real, and what makes it matter.

The development of engaging learning experiences can (and should) be thought of in terms of *affordances*. Kirschner (2002, p.14) offers a quick introduction to affordances in technology enhanced learning. He writes, "Educational affordances are those characteristics of an artifact (e.g., how a chosen educational paradigm is implemented) that determine if and how a particular learning behavior could possibly be enacted within a given context (e.g., project team, distributed learning community)." (Kirschner, 2002)

What sort of affordances would make a learning resource *wanted?* We might consider, from Laru (Laru, 2011), whether it's

- personal, spontaneous, opportunistic
- informal, pervasive, situated
- private, context-aware
- bite-sized, and portable

1.3 Personal

Relevance can be defined on the basis of whether the learning is *personal* or *personalized*. There is a good deal of literature on the concept of personalized learning; Patrick, Kennedy and Powell offer a good overview.

Teachers use technology daily to analyze and utilize real-time data to differentiate instruction, customize learning and to engage students in deeper learning. All students are responsible for their own learning and work at their own pace by demonstrating mastery of required concepts, resulting

in higher achievement and ensuring all students are prepared for both college and career. (Patrick, Kennedy, & Powell, 2013)

However, just as there is a distinction between 'custom' and 'customized', there is also a distinction between 'personal' and 'personalized'. When something is customized, it is created based on a standardized model, with additions and nuances added to create the individual experience. When something is 'custom', however, it is built from the ground up with the needs and intentions of the individual guiding the design from the start. Figure 1 illustrates the difference:

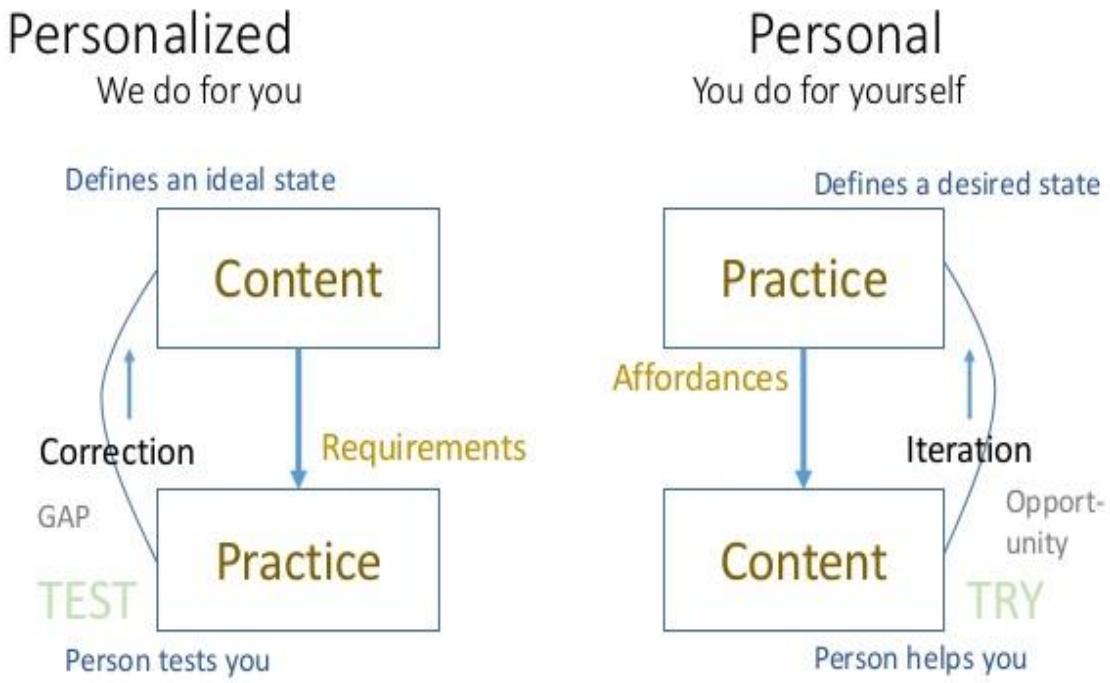

Figure 1 - Personalized vs Personal Learning

Personalized learning begins with what the learners will have in common: the content or skills to be learned, as defined by learning objectives or learning requirements. Students are tested against this common definition of content; what is individualized is the path they have taken to get to the tests, and the nature of instruction based on the gaps that result, rather than the learning itself.

By contrast, personal learning does not presume that all learners should acquire the same content. Each learner is regarded from the perspective of the distinct task or project they are undertaking, where the objective is defined as they result they are seeking to achieve. As the learner attempts to achieve this state he or she is aided by a helper who will provide resources and feedback as the learner works through successive attempts to achieve the outcome.

In personalized learning, the notion of *competence* is key, and as a result, numerous personalized learning programs are accompanied by competencies and skills systems defining the capabilities that should be achieved. However, the more advanced the learner becomes, the less capable an

institution is of defining the required competencies. In personal learning, the individual will need to determine for *themselves* what competencies are required.

Much professional and leadership learning looks a lot more like personal learning. It follows that to advance professionally, it will be important for learners to be able to define and manage their own learning. And the nature of the learning is transformed, changing from how to do something, to ways of doing things, to individual character as a person who does that thing.

For the personal learner, support rather than instruction is required. "Don't tell me, show me," writes Lowenthal.

- "show me how to think strategically"

- "show me how to reframe an issue"

- "show me how to deal with the ambiguity of the world right now" (Lowenthal, 2017)

We can see the difference between personal learning and personalized learning by looking at the affordances offered by different learning path applications. Can the learner set the objectives, define success, and manage the process? Here are some examples:

- Illuminate Education - data-based learning path
- FilterED Global Filter - specializes in rapid personal path creation
- MiCLUES - creates personal learning paths through museums and exhibits
- ItsLearning - learning platform
- Apereo OpenSSP - student success plan

2. How we Support It

Despite the prevalence of literature suggesting that success in learning depends on high-quality instructors. Notwithstanding the nuance this assertion has assumed over the years (Blazar & Kraft, 2017), in this new model of learning we see a different emphasis, an emphasis on high-quality learning *experiences* (about which there is considerably less research). An instructor becomes only one component of a wider picture, and there are scenarios in which instruction in the sense of a course or a class might not be required at all.

An educational experience can be described across any number of dimensions. For the purposes of this discussion, we focus on how we provide the following:

1. *Learning Resources* - content, applications, media and other material support for learning
2. *Environments* - the design and affordances of support systems and learning infrastructure
3. *Assessment* - systems and methods for evaluating learning outcomes

2.1 Learning Resources

In the case of traditional learning, learning resources typically consisted of standardized texts and curricula. In digital environments this might be supported with interactive applications, discussion forms or learning communities, and multimedia. Instructors would seek seek and use the highest-possible quality materials.

Thus we see for example it written that "the biggest barrier to adoption or selection of OER for course materials is the effort required to find and evaluate such materials." (Ontario Council of University Libraries, 2017) This was true of digital materials in general, and motivated the development of learning object metadata, to assist in the selection process, and of curation and quality assurance projects such as MERLOT (https://www.merlot.org/) and LORI (https://edutechwiki.unige.ch/en/Learning_Object_Review_Instrument).

In the new model, where learners select their own learning resource, the primary concern is *access*. Many of the resources used in traditional education were derived from commercial sources, and thus required payment or subscription, which is often unaffordable on an individual basis, especially if (as is typically the case) a larger number of resources will be consulted by the learner. Hence support for learning resources focuses on the following:

- Open Educational Resources
- Open Data and Data Books
- Personalized Learning Practices
- Performance Support

Open educational resources (OER) are materials used to support learning that can be freely accessed, used, modified, and shared by learners. A series of projects supporting OER have been undertaken over the last two decades, ranging from UNESCO initiatives to OpenStax at Rice University (https://openstax.org/) to MIT OpenCourseWare (OCW https://ocw.mit.edu/). To date most such initiatives have been institutionally focused and designed to support instruction. However, there is a more recent focus on open educational resources designed by and shared by individual learners directly with each other.

An example of this can be found in the domain of open data and data books. Open data consists of statistics and other structured resources offered as data sets and tables, rather than documents or publications. These are often updated on an ongoing basic (as, for example, weather data would be updated) and are presented in machine-readable form for they can be loaded and manipulated by computer programs. One adaptation of this is the 'data notebook', an individual learner resource that allows a user to update and manipulate the date using (for example) visualization algorithms. One such is the Jupyter Notebook (http://jupyter.org/), an open-source web application that allows you to create and share documents that contain live code.

In addition, learning resources are being developed that support personalized learning *practice* rather than instruction. These resources are often addressed toward classroom teachers and suggest methods of moving content broadcast out of the classroom, turning class time into contact time, and providing tutoring. As Feldman and Hill report, this newer approach to education

requires "…a delicate balance between student autonomy and instructor-led direction and scaffolding." (Feldstein & Hill, 2017)

An example of this sort of approach may be found in the support for inquiry-based learning. "Inquiry Based Learning places the responsibility for learning on the students, and encourages them to arrive at an understanding of concepts by themselves, following a process that can include:

- Determining what they need to learn
- Identifying resources and how best to learn from them
- Using resources and reporting their learning
- Assessing their progress in learning." (Centre for Innovation and Excellence in Learning, 2018)

Finally, there is a renewed emphasis on performance support. This is less a pedagogical strategy and reflects more an aspect of product design. A good example of this can bee seen in the tennis racquet called Babolat Play (https://en.babolatplay.com/). The racquet uses sensors to detect swing, impact, and other tennis-related factors, and interacts with a learning application on the player's mobile phone. By providing performance feedback, the racquet directly support's the player's improvement.

2.2 Learning Environments

In the last decade we have seen a gradual shift from the traditional learning management system (LMS), which was based on the idea of content management and teaching support, to the *learning platform*, which is intended to provide the learner with access to a variety of learning tools and applications. This is often facilitated through an IMS specification called Learning Tools Interoperability (LTI https://www.imsglobal.org/activity/learning-tools-interoperability). From the learning platform, the learner can 'launch' the external tool, and the tool in turn reports on progress and activities back to the learning platform.

One of the more interesting aspects of the learning environment as platform is the potential for integration into the internet of things (IoT). A number of projects have been developed using the idea of device-based activity support; here are three from the many cases that could be listed:

- Using an external interface in the same way the VorpX modification allows Grand Theft Auto users to run the game on the Oculus Rift Virtual Reality Headset (https://www.pcgamesn.com/grand-theft-auto-v/see-gta-v-through-the-eyes-of-the-oculus-rift-with-this-virtual-reality-mod)
- Tracking movements and enabling access to services and resources, the way Disney does with its MagicBand bracelet. (Estes, 2017)
- Context-aware mobile applications to detect movement and location (Troyer, 2011)

Among the most important environments being developed are those supporting social learning and interaction. These are based on the idea the learning can be created from interaction between

people looking at things from difference perspectives. Applications and environments in social learning include:

- collaborative (such as wiki-style document authoring)
- cooperative (such as social sharing of bookmarks and resources)
- competitive (such as games and contests) learning

In all cases, these environments depend to at least some degree on open networks and open standards, in order to facilitate communications between a variety of individuals, platforms, and applications. Mechanisms that support communication between different environments will be most useful, such as the wireless headphone Google developed to support real-time audio translation. (Balakrishnan, 2017)

In recent years, learners and educators have become more sceptical of centralized learning platforms, and especially social network services such as Facebook and Twitter, citing concerns about data ownership, privacy and commercialization. (Dijck & Poell, 2017) As a result, initiatives such as Tim Berners-Lee's Social Linked data (Solid https://solid.mit.edu/) initiative have begun development. In the educational sphere, developers have articulated the concept of the *personal learning environment* (PLE) as an alternative to centralized learning platforms. Indeed, most people have "some sort of informal PLE, a germ as Kaptelinin (2013) calls it, composed of different tools and platforms through which they mediate various activities that are related to both their social life, as well as their academic life." (Kuhn, 2017)

In a project we understood for the Canada School of Public service in 2017, we analyzed and evaluated the resources needed to support a distributed social learning environment in Canada's public service. (Downes, forthcoming) We identified a need for the following:

- Linkage - learning systems each with a tab or an icon on the other system
- Single signon - single unique identifier for all services
- Common Services – access to services from distinct environments
- Communications bus - to support user information and data exchange
- Support for learning tools interoperability or similar mechanism
- Full integration with other government platforms and services

It is also worth noting in this regard that just as schools and institutions have been migrating many of their essential infrastructure services to cloud service environments (such as Amazon Web Services or Google Cloud) access to the cloud has recently become accessible and affordable for individuals. In some cases, this is available through education-focused resellers, such as Reclaim Hosting (https://reclaimhosting.com/) or Edublogs (https://edublogs.org/), while in other cases individuals are managing applications on directly cloud services.

2.3 Assessment

Contemporary learning services are in the process of migrating through four major stages of assessment technology and support:

- Competencies and Skills
- Learning records
- Quantified Self / Dashboards
- Feed Forward

We mentioned competencies and skills above as an essential component in personalized learning systems. While observing that they play a lesser role in personal learning systems, some aspect of competencies and skills will be found in every type of next generation learning.

Work on competencies definitions has been underway for a number of years, with the result that there are numerous schemas available. They can be found everywhere from the Town of Oakville (https://www.oakville.ca/hr/competency-framework.html) to UNESCO (https://en.unesco.org/sites/default/files/competency_framework_e.pdf). Work is underway to develop an integrated Competencies and Skills Systems (CASS) framework at the U.S. Military's Advanced Distributed Learning lab, part of their Total Learning Architecture. (https://www.cassproject.org/) Related projects include initiatives in microlearning and digital credentials (for example, badges).

This represents a general shift in learning assessment - especially in corporate learning - from process to outcome. Instead of, for example, measuring the time spent in a classroom or the number of assignments completed, learning assessment and recognition is focusing on the demonstration of skills learning. This, however, increases the difficulty of assessment. Assessment criteria must be predefined and not *ad hoc*. Assessments should respect the candidates level of learning and cultural background. There need to be provisions for inclusive design in ethics. And the competencies measures must accurately reflect the competencies needed for a position. (Juneja, 2018)

As assessments and achievements become more fine-grained there is an increasing focus on learning records. We need something more detailed (and more reliable) than paper transcripts. Some developers are working on distributed ledger technologies for learning records. As Doug Belshaw writes, "If we used the blockchain for Open Badges then we could prove beyond reasonable doubt that the person receiving badge Y is the same person who created evidence X." (Belshaw, 2015)

Another trend in assessment and learning records is based on the idea of the quantified self. This involves the use of devices (such as a mobile phone or exercise tracker) to measure personal data and provide a dashboard or graphic of personal data analytics. (Rivera-Pelayo, Zacharias, Müller, & Braun, 2012) "Tracking strives to quantify (aspects of) a person's life in order to enable some objectivity in understanding it. Tracking facilitates reflective learning by collecting data on experiences and outcomes that can be used as objective basis in reflection and triggering."

In the realm of activity tracking ADL and other organizations have been developing a specification called the Experience API, or xAPI. Similar to the way applications launched using LTI report back to a learning management system, applications using xAPI report data back to an institutional learning record store (LRS). These records are then used for individual assessment or to create

longitudinal data sets from large numbers of individuals to support learning analytics. (Kevan & Ryan, 2015)

As with learning resources and learning environments, there is skepticism regarding the role of centralized platforms in this process. An increasingly popular theme in discussions of assessment systems is that of the *personal learning record*. We might think of this as a personal record store and LRS, containing our publications and other artifacts, and including databases of learning record activities gathered not only from institutional learning but also corporate and commercial providers. Research on this concept is limited, but it did form the basis of work in the recent NRC Learning and Performance Support Systems program. (Kondratova, Molyneaux, & Fournier, 2017)

The prospect of a personal learning record enables us to envision a much more detailed and nuanced set of records used for future assessments. They need not be limited to specific learning assessment activities undertaken in online courses. The data can include:

- Course commentary - comments on each other's works, ratings and evaluations, and commentary outside the domain of the course (for example, on published articles)
- User-generated content - including everything from blog posts, articles, multimedia and videos, and microcontent
- External content - including comments other people have made, records and data generated from 3rd party systems (such as online gaming results, YouTube views, etc.)
- Content curation - including a list of the content read (and for how long), content selected for reading, content recommended for other people
- Collaborative and cooperative learning - including things like contributions to Wikipedia pages, multi-author projects, works of art or music, etc.

When we view assessment in such a wide context it becomes apparent that it is very difficult to define a singe set of content, competencies or contributions a person could or should be required to make. Assessments themselves will become relevant not against some ideal standard of content acquisition or skills inventory, but with respect to the very specific needs of a position or project for which a learner is being considered, and the result of that assessment will not be a grade or certificate, it will be a job offer.

Concluding Remarks

In this paper we saw how recent developments in learning technology will have an impact on personal learning and development in the future, and we outlined some of the major areas of support and development for future learning, including learning resources, learning environments, and assessment.

Through this study we also saw some evidence of wider trends. In particular, there has been a gradual migration from a formal standards-based model of education based on common curriculum and assessment to an informal needs-driven model based on specific individual preferences as defined by tasks, projects or recognition.

This transition poses a difficult challenge for education systems and not all of them will progress toward a more decentralized and personal model of learning at an equal pace. Other factors, such as the need for safety, security and quality may well prevail in specific contexts, especially those were stakes are higher and a greater degree of professionalism is required. By the same token, however, it is being recognized that the grater the degree of professionalism in a discipline, the greater the degree of autonomy in decision-making is required, and this applies equally to decisions made about learning.

At any rate, it may turn out that the risks created by reliance on a centralized, formal and standards-based system of education are greater than the risks created by change. In an increasingly dynamic and chaotic world, the need to adapt may be greater than the need to stay the same.

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