Lifelong Learning in a Software and Services World

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January 2020
Abstract

Learning is becoming a lifelong endeavor. Traditional degree-based education, as well as the first generation of massive open online courses, are too monolithic, inflexible, and inefficient to serve the needs of lifelong learners. Technological innovations in the software and online services domain offer promising concepts for the creation of a new approach to lifelong learning that is personalized, adaptive, and cost-efficient. We propose an ecosystem for lifelong learning that leverages insights from diverse domains, including Object-Oriented Programming, Artificial Intelligence, Software-as-a-Service, on-demand marketplaces and blockchain technology. The ecosystem is described along the building blocks of a learning environment – design, selection, creation, delivery, and credentialing of learning content. We propose that a lifelong learning ecosystem should consist of learning objects that can be personalized through recommendation and topic aggregation engines and delivered as a subscription service with content sourced from open content marketplaces and certified with an immutable blockchain-based ledger. We define each element of the ecosystem by applying insights from software and online service providers to propose a disruptive vision for providing technology-enabled lifelong learning.

KEYWORDS: Lifelong learning, e-learning, SaaS, Artificial Intelligence, Learning as a Service.
"In a time where the half-life of any skill is about five years, leaders bear a responsibility to renew their perspective in order to secure the relevance of their organization."  

1. The Evolution of Learning

Lifelong learning has become one of the fundamental themes in a digital society. For decades, earning a post-baccalaureate, in post-experience or adult education, has allowed workers to secure an increase in wages and employment. However, given the fact that skills tend to have a half-life of about five years, learning does not end with an undergraduate or graduate degree. Although learners can augment degree-based education with on-campus executive education programs, traditional executive education programs do not offer the flexibility and personalization needed by employees and companies.

As a result, online education, in conjunction with certificates, is becoming a popular way for workers to continue their learning journey beyond degree-granting undergraduate or graduate programs. Online courses are more flexible and more convenient than campus-based programs. They can also be more customized as learners can choose courses that are relevant to their jobs. They are also less expensive and less time-consuming than campus-based programs. However, moving from a program-oriented degree to an online course-oriented certificate is not just a matter of transferring the educational content and structure to another medium. Consider the example of massive open online courses (MOOCs), a pedagogical innovation that aimed to democratize education by giving learners the ability to register for a wide range of courses from renowned universities. Several MOOC providers, including Coursera, EdX,
and Udacity, offer hundreds of online courses. However, MOOCs have not lived up to their promise. Empirical studies have shown that the drop-out rates in MOOCs are very high. Even though MOOCs offer choice and customization at a course level, this level of customization is still not enough as the courses themselves are largely one-size-fits-all. Several recent technological innovations offer the possibility of creating a personalized and adaptive lifelong learning experience. We propose five technological innovations for each building block of a learning environment - content design, selection, creation, delivery, and credentialing.

First, the design of learning content can be further disaggregated from the course level down to smaller chunks of independent **mini-modules**. In academia, this concept of independent mini-modules was developed in the early 2000th as "learning objects", inspired by the programming paradigm of object orientation, and then envisioned as intelligent, adaptive, scalable, and affordable web-based educational service architectures.

Second, these mini-modules can be adaptively combined to create a **customized learning journey** that focuses on the specific skills that are relevant for the learner’s context by applying artificial-intelligence based recommender systems to learning modules, along the lines of recommendation engines used by Netflix, Spotify or Amazon for content recommendations.

Third, the learning content can be sourced from open marketplaces that match content providers with learners, along the lines of on-demand marketplaces for ridesharing (Uber, Lyft) or video content (YouTube). Platform providers can match learners with content providers and mentors in a **multi-sided marketplace**, where consumers can take on the role of producers and vice versa.
Fourth, educational content can be delivered as an ongoing service by creating “Learning-as-a-Service”, along the lines of the “Software-as-a-Service” model that has transformed the software industry. This Learning-as-a-Service approach, as envisioned by Spaniol et al. (2008), can follow a subscription or pay-as-you-go model.\textsuperscript{11}

Finally, a transparent technology for digital certificates is needed to create an immutable record of the learning credentials that can be accessed by recruiters and human resource professionals to evaluate employees for specific job positions. Blockchain technology can be used to create and manage digital certificates. Such approaches have already been developed by MIT Media Labs and Knowledge Media Institute and commercialized by various companies.\textsuperscript{12}

These five themes in the evolution of lifelong learning are summarized in Table 1.

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Table 1. Five themes in the evolution of lifelong learning.

Technological innovations in software, content, and services provide the ingredients for designing a new paradigm for lifelong learning. However, these ingredients need to be adapted to the learning context, and they need to be
aggregated in a systemic way to create an integrated learning ecosystem. In the discussion that follows, we present a solution for lifelong learning in a software and services world that addresses the creation, organization, personalization, dissemination, and credentialing of learning content. We draw inspiration from best practices in a wide range of software and services contexts and discuss how these best practices can be adapted to the lifelong learning context. We begin with a discussion of the challenges in creating and delivering lifelong learning. We then define the elements of a lifelong learning solution that can effectively address these challenges. We conclude by identifying hurdles in implementing this vision and by discussing the managerial implications of these developments.

2. The Lifelong Learning Challenge

Lifelong learning refers to adult education and the idea that formal and informal training does not stop after college or university. The importance of lifelong learning in a digital society has been understood for a long time and has been addressed in various national innovation strategies. A recent OECD study on Future Ready Adult Learning Systems emphasizes that many countries have adult learning systems that are under-prepared to provide skills for the workforce of the future and these systems suffer from limitations like cost, lack of time, limited flexibility, lack of employer and family support and not meeting the minimum requirements to participate in courses. The skillsets demanded from 21st-century workers and leaders are broadening beyond pure domain knowledge and core skills of information literacy. Contextual skills such as flexibility, self-direction, ethical and cultural awareness, and the skill to continually improve one’s
Capabilities through lifelong learning are becoming a prerequisite to participate in the knowledge-based workforce.\(^{16}\)

Programs in adult education come in different form factors. They include full-time or part-time program degrees or onsite and online courses with academic or industry certificates, with more specialized of generalized learning tracks. The diversity in this field makes it difficult for employers and recruiters to make an objective comparison of the quality and depth of learning content. Recent trends in declining enrollments in graduate degree programs\(^ {17}\) and the rising cost of degree programs\(^ {18}\) suggest that traditional degree programs are not delivering on lifelong learning needs. The reasons include the lack of flexibility in time and content and the lack of personalization of programs to the individual needs of learners and companies.\(^ {19}\)

Meanwhile, the demand for e-learning is increasing. E-learning was estimated to have a global market potential of $398.15 billion by 2026 and a CAGR of 9.5%.\(^ {20}\) E-learning is defined as the use of information and computer technologies to create learning experiences. It is almost two decades old and has developed in many directions, including different media types, access types, and forms of interaction.\(^ {21}\)

Traditional universities have risen to the challenge of providing e-learning by participating in the creation of MOOCs. These online courses allow learners to advance their knowledge while accommodating constraints of work, family, and personal interests. Some courses are distributed via popular Learning platforms such as iTunes U. On other occasions, MIT and other universities created a MOOC platform called edX that provides courses from over 100 well-known universities. Other MOOCs are startup companies like Udacity and Coursera, set up as “supermarkets” of MOOC courses from a wide range of universities. However, MOOCs have largely not lived up to their promise.
In a recent study, Reich and Ruipérez-Valiente (2019) analyzed data from all courses taught at edX by MIT and Harvard from 2012 to 2018, covering 5.63 million learners in 12.67 million course registrations. They found that only 3.13% of participants completed their courses in 2017-18, down from about 6% in 2014-15. Completion rates have not improved despite six years of investment in course development and learning research.

MOOC completion rates are dismal for two main reasons: Lack of self-regulated learning capability, which leads to time mismanagement and demotivation, and unfulfilled expectations given the diversity of the audience. E-learning provides the student with a high degree of autonomy, which in turn requires the skill to manage the learning journey on their own. This means active goal-setting, monitoring, self-regulation, and reflection. A lack of this self-regulated learning capability leads to time management issues and results in student attrition. Unfulfilled expectations stem from the diversity of the audience. Each participant must assess for herself if the content is valuable by browsing through the introduction material. However, only during the actual course, do learners realize if the course is relevant to their needs. In addition, learners “cherry-pick” content and drop the course after they have learned the specific topics they were more interested in. Additional hurdles include the lack of financial and family support. Therefore, it is not enough to provide educational content in a more flexible way by leveraging video-content, online assignments, and online communities. A more customized and guided solution that includes goal setting, monitoring, motivating, and reflecting is needed. The OECD study calls for such a solution that adjusts to the constraints of an adult lifestyle, including family, work, and financial resources.

3. Towards a Personalized Lifelong Learning Ecosystem
An effective lifelong learning ecosystem needs to address the pain points of adult learners in online education that are not currently addressed either by on-campus continuing education or by MOOCs. A complete solution for effective lifelong learning needs to address the end-to-end process for designing, selecting, creating, delivering and credentialing of learning content.

To motivate the technology-enabled lifelong learning ecosystem, we look at how a hypothetical learner called “Amy” might use such an ecosystem to power her lifelong learning needs. Amy has been working as a software developer in a technology company. Recently, she was promoted into a product manager role, where she will be responsible for launching a new software product into the market. Although she is eager to take on the challenge, Amy is concerned that she does not have the necessary skills related to product marketing and business planning. Recently, she updated her LinkedIn profile to reflect her new job role. As she logs into her email, she sees a message from her “Lifelong Learning University” (LLU) virtual advisor with recommendations for new professional development content.

Amy sees that her virtual advisor has recommended three mini-modules based on the skills she needs to succeed in her new job. These mini-modules include a module on “influencing people without authority”, “implementing a go-to-market plan for a new product” and “developing positioning and messaging strategy for marketing a new product.” The first two modules are from leading business school professors, while the third module is from a practitioner who is an authority on product marketing. Amy also finds two offers from mentors who are willing to work with her one-on-one.

The learning modules and mentors were selected by an algorithm that matched Amy’s profile, learning needs, time availability, and learning preferences against a vast
repository of content modules and mentors. She can review the profiles and ratings of each module and mentor. After Amy completes the mini-modules, her lifelong learning record stored in a blockchain ledger is updated and automatically shared on her business profile as well as with her HR department. All this happens through her $99-a-month subscription to the LLU service, which her employer pays for.

This scenario demonstrates the application of several technological innovations in software, services, and content, and maps it to the design, selection, creation, delivery and credentialing of learning content (Figure 1).

![Figure 1: Mapping pain points of lifelong learning to technological solutions and elements of a learning environment.](image)

### 3.1 Content Design: From Monolithic to Modular

The first element of the lifelong learning ecosystem is the design of learning content. In traditional courses, the basic unit of learning is a “course.” Learners can only
customize their learning journey at the course level by choosing among available courses. In degree-based programs, as well as in continuing education, the smallest unit of learning remains a course. Even online learning, such as the MOOCs, are designed as courses with several modules that need to be taken in sequence. This monolithic design is inflexible and inefficient for the learner as well as for the instructor. The learner must take the entire course, whether or not all the modules in the course are relevant for them. The learner might be scared off because she thinks she lacks the prerequisite knowledge for the entire course. Instructors at different institutions create virtually identical generic course content, a massive duplication of effort.

Consider how Amy would choose learning content in the current model of course-based learning. She could take a one-week classroom-based course at a business school, costing $10,000. Alternatively, she could enroll in an eight-week online course on product management for $2,000. In both cases, she has to sit through content on product development that she already knows. This is akin to asking Amy to pay $29.99 for an “all-you-can-eat” buffet at a restaurant when she only wants a $2.99 cup of coffee! Like the buffet, a course is a “one-size-fits-all” product that cannot respond to the varying needs of learners. A one-size-fits-all approach may work for undergraduate degree education because most students have similar learning needs. However, it does not work for lifelong learning, as learners in the workforce have a greater need to match learning to the specific skills needed for them to impact their job performance or their job prospects positively. Lifelong learners do not have the patience to learn content that does not directly produce an immediate Return of Investment for them in their jobs.

For lifelong learning to become more customizable, it must be designed using a smaller unit of learning called the “learning object” (LO), a concept developed by Wiley
(2000) and extensively discussed in McGreal (2004). The LO concept draws inspiration from the object-oriented paradigm for designing and developing software. The core insight lies in disaggregating content into small, modular learning objects that are associated with metadata so that they can be automatically combined into larger, customized lessons. This is analogous to object-oriented programming; the overall problem is decomposed into smaller sub-problems. A computer program consists of a set of interacting objects representing the subproblems. Instead of a lengthy flow of instructions, like in procedural programming, the program manages the communication between the objects via a standardized interface to solve the overall problem.

The concept of an LO as a "representation designed to afford uses in different educational contexts" has been implemented in various industry standards such as CISCO RLO/RIO, IEEE Learning Object Metadata or the Learnativity LO Model. Regardless of the actual LO implementation, it should possess four characteristics: being self-contained, reusable in multiple contexts, aggregable into a larger lesson and tagged with metadata for information retrieval and machine processing. This ensures that courses can be decoupled into smaller units - and the smaller the unit, the better it can be assembled into a customized whole.

Let us see how the LO concept would come to life in the case of Amy’s learning needs for product management. Instead of creating a course consisting of ten modules designed to be taught sequentially, we could create a more granular design with hundreds of LOs for product management topics—each self-contained in terms of content, exercises, and assessments. For instance, if Amy wants to learn how to assess a new product innovation, she would be forced to take courses in product management, intellectual property, and financial risk management to capture all relevant content for
assessing innovations. In our proposed approach, Amy could be presented with learning objects for specific tools and frameworks for assessing product innovations, such as the “Product versus Market Opportunity Matrix”, “Jobs-to-be-Done Analysis”, “Three-Dimensions of Product Fit”, “Framework for Scoring of Opportunities”, “Solution Resume” and the “Vision Press Release”. If Amy lacks the prerequisite knowledge for specific LOs, additionally LOs, customized to her learning success, will be loaded automatically. Each of these LOs can be implemented as a digital entity (following the IEEE LOM model) consisting of metadata including Title, Language, Keywords, Abstract, Level of Difficulty, Length, Price, Versioning, Requirements, Learning Objectives, Content (Video, Documents, Assignments), Pedagogical data (Type of learning, assessment) and Copyrights. All these LOs would be stored in a repository. The properties of LOs would be matched with objective measures of Amy’s preferences such as financial resources, time commitment (e.g., 10 hours per week), as well as her prior knowledge and the level of mastery she seeks over the content related to Product innovation. The matching of LOs could also include subjective measures such as Amy’s preferred learning styles (audio, visual, semantic) and content form factors. This is similar to Spotify’s approach to labeling audiotracks. Audiotracks are categorized in terms of mood (danceability, energy), context (liveness, acoustics) segments, beats, pitches.

With the contextual knowledge of Amy’s preferred learning style, the system searches the LO repository, retrieves the most relevant LOs and aggregate them to create a personalized learning plan for her. This process is depicted in Figure 2. The recommendation system creates a learning plan based on Amy’s needs and past behavior. The LO Retrieval System fetches the necessary learning objects from the repository. If necessary, it augments these objects with additional learning objects if
prerequisites are not matched (step 2 and 3). The retrieved LOs are aggregated and sorted by topics and their dependencies to create sets of objects (step 4 and 5). The result of this aggregation is a structured set of learning objects (mini-modules) to access the knowledge in a guided and meaningful way. At the next level of abstraction, the learning journey is created by wrapping the mini-modules into a storyline consisting of introductory content, main content and summarizing content (step 6 and 7). As a result several learning plans are recommended to Amy (step 8 and 9).

Our LO-based aggregation approach turns the existing deductive teaching styles on its head. Instead of focusing on a set of skills that can be applied to multiple problems, the learning system begins with the problem as the starting point for designing the learning journey – working backwards from the learner’s problem and the “jobs to be done” by the learning to identify the frameworks, tools and exercises from a
comprehensive repository of LOs. This problem-driven approach would also allow learning systems to transcend silos of learning. For instance, if the system determines that Amy needs to develop skills for NPV calculations, it could seamlessly pull additional learning objects on NPV calculations and introduce them in the course aggregation stage. In this scenario, Amy would not have to take an entire course on financial analysis to learn how to do NPV calculations. The relevant LOs would simply be incorporated into her Product Innovation learning journey.

3.2 Content Selection: From Predefined to Emergent

In the current online education model, learners must decide their learning agenda by choosing the courses they should take to continue to enhance their knowledge. However, asking learners to decide their learning agenda places an undue burden on the learner. After all, learners don’t know what they don’t know! It takes experience to set goals, to monitor and reflect on the learning progress, and to keep oneself continuously motivated. In addition to being forced to choose courses without knowing the content, learners can only customize their learning agenda at the level of the course instead of being able to match learning content to their specific learning needs. While self-paced online learning comes with the advantage of time and location flexibility, the downside is the requirement of self-regulated learning skills.42

Once the learning has been deconstructed into modular LOs described by a set of attributes, they can be matched with the needs and constraints of learners in an emergent fashion, without the need for learners to proactively choose learning content. This automated approach to recommendations is widely used in social networks, entertainment, and online marketplaces. More than 80 percent of TV shows people
watch on Netflix are discovered through the platform’s recommendation system. Netflix uses machine learning and algorithms to find shows that they might not have proactively chosen. The system consists of three elements: Netflix subscribers who consume TV shows and rate their enjoyment of TV shows; Netflix “taggers” who label each TV show on a set of attributes; and machine learning algorithms that match content with subscribers.

We can adapt this recommendation engine approach to the lifelong learning context by developing a “Netflix for Learning.” The automated learning recommendation system would consist of four elements: The user-defined in terms of her needs and constraints, the recommendation engine that captures the user behavior and uses this knowledge to retrieve relevant LOs from the repository, and the LO aggregator engine, a set of AI-based natural language processing and generation and visual cognition algorithms which automatically stack the LOs to high-level mini-modules structures to create an ontology for the learning topic. However, just stacking these objects together is not enough. Du et al. (2008) emphasize that the usage of LO as a teaching vehicle is only meaningful if it is embedded in an appropriate context. Building a storyline has a crucial impact on knowledge absorption.

Automating the process of creating a customized learning journey requires a semantic understanding of the LOs and the needs of the learner. On both sides, data is available in structured and unstructured formats, which requires AI-based technologies to process them. Again, the innovations are already present. Recently the Goethe-University in Frankfurt, Germany, developed an AI-based approach to scan 52,000 scientific documents of a specific topic and to automatically create a readable literature review, which was published under the name of the algorithm: Beta Writer.
The process consisted of several steps of data retrieval, data preprocessing, Data structuring, and content aggregation as visualized in Figure 3.

**Figure 3:** Comparing Beta Writer’s process of creating a literature review with the process of creating a storyline from learning objects using AI-based technologies.

Drawing inspiration from the problem of using machine learning based technologies to create an automatic literature review, we propose the following steps for creating a customized learning agenda from individual learning objects:

**Data Retrieval**

The recommendation engine matches the learning objects to the learner’s needs. Learning objects are tagged and categorized based on hard measures (content, applicability for specific job roles, industries, costs, ratings, or seniority levels) as well as soft measures (teaching style, voice style. The learner’s profile is described in terms of variables like their seniority, company, industry, job role, learning credentials, geography and past learning behavior.
Preprocessing

Based on cognitive computing techniques (visual perception, text understanding), image, video, audio footage, and text is semantically annotated and linguistically analyzed. Characteristics such as the voice of the instructor, color schema, video style or vocabulary are extracted, similar to Spotify’s analysis of audio records.

Structuring

The characteristics of a LO (metadata and cognitive characteristics) are used to create a topic map. A topic map describes the knowledge of a specific domain and links it to existing information resources. Topic modeling algorithms help to extract semantic information from structured and unstructured data such as documents, images, or videos. The topic map is the basis of the learning storyline. It is used to create a meaningful flow of learning objects. As a result, the LOs can be hierarchically and sequentially structured into mini-modules (Figure 4).

Generation

The mini-modules are wrapped into baskets of introductory content, main content, summarizing content building a storyline or learning plan. Such a design, using a beginning, middle, and end, provides the necessary context to foster the knowledge absorption. A set of learning plans will be compiled by ranking the different mini-modules within each basket of the story. LOs might come in different shapes, such as images, text or video, and different length using various examples and from different institutes. Thus, multiple LOs may cover the same content. A page rank algorithm can be used to pick the mini-modules with the LOs that best fit the learner’s need for each basket of the storyline.
In Amy’s case, assume she wants to learn Product Innovation Assessment, which is a subset of Product Management. Therefore, she is not interested in Marketing but needs elements of Intellectual Property and Financial Risk Analysis, which are also associated with Product Innovation Assessment. Similar to Netflix or Spotify recommendations, the learning system would retrieve a set of LOs from the LO repository based on the quality, time, difficulty level, and relevance to the learner’s needs. It would then create a topic map (Figure 4) and various learning plans consisting of: (1) Introduction: Opportunity Brief, (2) Excursus: Patent Description and NPV calculation, and (3) Summary: Scoring of Opportunity Tables. Each learning plan is evaluated and assigned a score matching Amy’s preferences. Some LOs on Patent Description are more expensive, but explain the content as a video, while others are cheaper but text-oriented. Only by compiling the final learning plan, a score can be assigned and recommended to Amy.
Figure 4: A topic map on Product Innovation. Rectangles are Learning objects. Rounded rectangles are topics. Straight lines represent information resources relevant to a topic. Dotted lines denote associations among topics.

Amy’s learning journey could be further enhanced by integrating the learning ecosystem with her social networks. As soon as she updated her profile on LinkedIn with her new job in product management, the algorithm would adapt to her learning needs with a different set of recommendations for learning. If Amy were to change industries—say, from technology to financial services—her learning recommendations would instantly adapt. Any change in job role, industry, or a promotion—whether vertical, lateral, or outside the industry—would trigger recommendations to new learning suggestions.
Throughout the process, discoverability becomes implicit, as user profiles are updated continuously, and the recommendation engine gets more feedback from users. As a result, learners do not need to proactively search for content, just as Netflix subscribers get TV show recommendations without searching for them.

3.3 Content Creation: From Closed to Open Marketplaces

Learners currently have to choose a specific learning provider – a university or a private learning provider. The content is proprietary and unique to each learning provider. Not all faculty at an institution are equally skilled teachers. However, when learners choose an institution, they have to take the good with the not-so-good faculty. A similar limitation in the choice of instructors and content carries over to conventional e-learning courses, where learning providers offer proprietary courses taught by faculty to captive students. The same limitation on captive content also applies to customized B2B learning solutions such as Degreed, Cornerstone, Docebo, or Axonify.

This assumption of captive content from specific providers can be turned on its head in the future by lifelong learning providers who can create and sell content in open marketplaces. Just as ridesharing services like Uber match riders with drivers in an open marketplace, freelance learning providers can offer learning objects in an “Uberized” marketplace for learning content. As a subscriber to the learning platform, learners can access learning objects from highly rated providers who best match the needs and interests of learners. The learning platform can function as a two-sided marketplace, matching content from a diverse set of learning providers with learners seeking specific learning objects. In this learning marketplace, it would quickly become apparent which
learning objects are rated as most relevant and popular—just like Uber drivers with five-star ratings.

The “best of the best” in terms of content and instructors would rise to the top, allowing learners everywhere to access superior instruction—not just those who attend a particular institution. This is already occurring with online education platforms such as Emeritus, which offers content from MIT Sloan, Columbia Business School, Northwestern’s Kellogg School of Management and Dartmouth’s Tuck School of Business.⁴⁹

As more third-party learning platforms emerge, faculty “stars” will no longer be confined by the walls of their institutions. They will be able to reach students anywhere around the world. Learners would also be able to “buy” office hours from faculty when they need one-on-one mentoring or instructions. In the open marketplace world, every educational institution will not need to create its own proprietary content. A few leading institutions can create content that can be licensed by second-tier and third-tier institutions, who can complement world-class content with high-touch instructors and teaching assistants. Such as a platform model brings consumers and producers together.⁵⁰ Customers consume a “learning object” and compensate the producer of the “learning object”. The platform operator facilitates payments, ensures the quality of the delivered product (the learning object) or service (1-to-1 mentoring) and matches the content to learners.

To assure the quality of content, it may not be enough to use learner ratings, comments, and likes. Content producers may compensate authorized institutions to audit and certify their learning object or service. Therefore, the content marketplace consists of two inter-related processes – the “matching” process that assigns content to learners and a “certification” process that evaluates the quality of the learning content.
These two processes are depicted in Figure 5. Therefore, the production is partly crowdsourced when it comes to content because everyone can provide learning objects and interact or mentor students. Dedicated authorities are only involved in quality assurance for the content. The human in this automated loop takes on a new role. Instead of being a knowledge synthesizer or content aggregator, the human becomes a facilitator, mentor, and motivator assisting the learner in her journey and balancing a potential lack in self-regulated learning. This high-touch mentoring and facilitation can greatly reduce the high dropout rates that plague the first-generation MOOCs offered by Coursera, Udacity, and Udemy. Perceived satisfaction with online learning courses for adults is driven by the online presence of the instructor and its role as a supporter, mentor, and motivator and by active communication with peers.

Figure 5. The lifelong learning platform skill matching, curriculum integration, and quality assurance of learning objects. Inspired by Moazed and Johnson (2016).
3.4 Content Delivery: From Episodic to Ongoing

Learning today is delivered episodically – learners get a degree and then they are “done” for several years until they decide to get a “knowledge upgrade” by enrolling in a continuing education course. This is very similar to the traditional premise-based model for delivering software. In the past, software users bought a product such as Microsoft Office 2013, paying a one-time fee for a perpetual license that gave access to software updates and “bug fixes,” but no enhancements. After a few years, they would upgrade to a newer version of the software. The software industry has transformed rapidly into a different model for delivering and paying for software – the model of software as a service (SaaS). Today, Microsoft sells Office 365 for a monthly subscription fee, which enables users to receive continuous improvements with new features and enhancements. This ensures that users always have the latest software.

As learning becomes a lifelong endeavor, the episodic delivery model is no longer workable. Learning needs to be continuous so that learners can upgrade their skills and knowledge to keep pace with the rapidly changing world. As early as 2004, Rory McGreal highlighted this in his concept of Online Education using LOs: “We need accessible and affordable learning”. This approach has been further developed by Spaniol et al. (2008) to the “Learning-as-a-service” framework and partially commercialized by a patent.

Participants like Amy would “subscribe” to a lifelong learning service in the same way that users buy Microsoft Office 365 as a subscription service. With a lifelong learning subscription, Amy will receive a continuous feed of updated content. This annuity-based model can be very lucrative for educational institutions. Consider a university that has 50,000 alumni. If 50% of these alumni could be convinced to subscribe to a lifelong
learning service priced at $99/month on an ongoing basis, the university could generate $25 million in subscription revenues at very attractive gross margins. By giving alumni a “lifelong learning passport” instead of a one-time degree, universities can also increase alumni engagement, which would increase alumni satisfaction, alumni donations and overall capture more of the learner (customer) lifetime value.

3.5 Content Credentialing: From Degrees to Micro-Certificates

As Amy completes learning modules, she needs an immutable and verifiable record of what she has learned so that she can prove her credentials to potential employers. Today, this is done with her college degree and the list of courses Amy took in college and beyond. However, the diploma or list of courses, just like current course design, is too monolithic for lifelong learning. In a learning model based on granular learning objects, certification can also be made granular by creating micro- or nano-certification for each successfully completed learning object. These micro-certificates can be stored in a blockchain ledger, which is immutable and can allow for selective access by potential employers to cater for a transparent proof of learned skills.

Blockchain technology is already being used for certification, with MIT Media Labs offering Blockcerts in partnership with Learning Machine and the Knowledge Media Institute (KMT) in the U.K. While the MIT solution is based on cryptographically signed and shareable credentials the KMT solution is based on smart contracts. Both providers adhere to the Groningen Declaration to create a solution for storing student data in a way that allows for free movement of students and skilled workers. Such blockchain ledgers allow learners to amass a record of the learning objects completed and to provide access to verify learning credentials, regardless of national boundaries.
Amy can also upload “badges” for relevant learning modules to her LinkedIn profile. These visual updates enhance her portfolio of lifelong learning and can become a resume of her knowledge and skill mastery. Prospective employers could search for candidates like Amy by matching their job requirements with the learning objects that are considered relevant for the job. Here again, machine learning algorithms could be used to match granular job requirements with learning objects, to uncover patterns that determine the skills and knowledge that are most important for success in the job (Figure 6).

Figure 6. Matching skills published as certificates with jobs in a public blockchain.
4. Implementation Challenges

There are several conceptual and institutional challenges in bringing the lifelong learning system to life. We outline a few of these challenges in the discussion that follows:

**Design:** The concept of the modular learning object is compelling, but what is the best level of granularity of a LO? The smaller the size of an LO, the more customized the learning journey can be. However, smaller LOs will be more challenging to integrate and reuse in a different context, especially if the LO and associated examples are based on a specific domain. More abstract LOs capturing a broader level of applications will lead to less practical applications. Balancing the granularity and degree of context for a particular problem instance is a major challenge.

**Selection:** The content personalization by an algorithm assumes an intelligent approach to sequence one learning object after another. How can a consistent flow of LOs be ensured? Current courses are designed in a uniform educational, and visual style, which means formulas, concepts, and visuals are used in a consistent manner. If an AI-based system pools LOs from different providers, it would be challenging to maintain consistency in pedagogical and visual style. For instance, a learner could see a five-minute introductory video talking about a discounted cashflow formula where \( n \) denotes the number of years in the formula and a subsequent assignment video where \( t \) represents the number of years. Sanitizing the content and creating a meaningful storyline, cannot be done by an algorithm from scratch without being trained on data. Thus, a two-sided market business model where consumers are also producers could be an approach to gather experience.

Another issue in content selection is path dependency. If the LO recommendation process only looks at the past, how can one create new-to-the-world content? This is a
typical bias in recommendation systems. Once the system adapts to the customer’s taste it narrows the world view. By tailoring the recommendations too much to the individual, out-of-the-box thinking would be discouraged.

**Creation:** How can the platform-based model create the critical mass needed for the success of a two-sided marketplace? How would the platform attract learners and providers in the early stages until the network effects kick in? How should learners and providers be subsidized in the early stages of development of the two-sided market, just as Uber offered subsidies to drivers as well as riders to join the platform?

As a producer, one has the incentive to create deliberately easy learning objects and advertise them to be consumed by a large audience. These easy learning objects might not go deep enough into underlying concepts, but they may still be rated as popular learning objects. How can the rigor of a learning object be calibrated and factored into the recommendation engine?

How can one ensure that the assessment is taken by the individual and not someone else? Solutions like ProctorU are proposing solutions for proctoring online exams using a combination of AI-based behavior analysis augmented by human proctors. Are such proctoring solutions viable, scalable, and customizable for specific clients and learning domains?

**Delivery:** The platform-based marketplace, in combination with a Software-as-a-Service approach, challenges incumbent universities and their brands. By offering an affordable subscription-based membership, the exclusivity of a brand might get diluted. Should everyone get a micro-certificate from an elite university? How will challengers create e-learning brands that rival elite universities? Such a platform model is a typical
“the-winner-takes-it-all” model, and there is only a niche market for the competition. Are universities able to still capture their value similar to the “Intel Inside” campaign? 65

**Credentialing:** A blockchain-based certification process ensures that learning is legitimate. However, to be fully trustless and transparent to firms, the blockchain must be an open blockchain, which means that the educational efforts are publicly traceable. This could create a new dimension of peer pressure and an arms race to collect “nano degrees” just as people like to collect clicks and likes on social networks. Moreover, if the customer opts to hide his efforts, this might turn into a disadvantage during the job hunt, especially if assessment failures are also tracked. How can such a solution ensure the “right to be forgotten” with respect to privacy concerns of digital data traces?

5. **Likely Players**

Who are the likely actors that will compete to create a lifelong learning ecosystem? Will it be incumbent universities, technology companies like Microsoft or Google or disruptive startup companies? We consider three possibilities - a startup, a big technology platform company, and a university. We highlight the strengths and weaknesses of each type of actor in actualizing the vision of adaptive lifelong learning.

**Startups** excel in combining existing innovations to solutions for new problems. “Cloud and AI-native” startup companies will be in the best position to combine state-of-the-art AI technologies with the Software as a Service (SaaS) model and blockchain-based credentialing. However, startup companies lack the brand name of established universities and they may also lack the academic expertise to create content in specialized domains. They will need to partner with research universities and world-class faculty to source subject-matter expertise and brand-name credentialing.
Technology Companies like Microsoft, Amazon, and Google have developed powerful platforms for AI-based recommendation systems. Some of them also have deep relationships with universities. They could use their cloud technology platforms and their AI and Machine Learning expertise to create the platform for storing and retrieving the Learning Objects. They could also develop the learning journey recommendation engines by using components from their AI platforms. Like the startup companies, however, the large technology companies lack the subject matter expertise to create world-class content. These companies would also be viewed with suspicion in terms of using personally identifiable information to create learning platforms. In recent years, regulators have been scrutinizing the market power and the potential violations of privacy laws by Amazon and Google, so there may be a pushback from privacy activists if these companies announced a lifelong learning solution that needs to know a lot about learners and their credentials.

Universities or educational institutes own the brand names and the subject matter expertise to create content. While the relevance of content is important in lifelong learning, brand names still matter in credentialing. In addition, universities are already experimenting with virtual learning and MOOC platforms like Coursera and edX. They could go one step further by disaggregating their online courses into smaller pieces and awarding micro-certificates which are traceable using blockchain-based technology. However, universities are incumbents. They are slow, bureaucratic and resistant to change. To make things worse, the lifelong learning model is a disruptive development that may be perceived as diluting the brands of universities, potentially cannibalizing degree-based programs, and undermining one of their core strengths of providing a community with personal relationships. How can universities, in this scenario, transfer the
community aspect, which is firmly based on sharing the learning experience with peers along the program journey, to the online world?

In practice, the most likely outcome is a partnership between universities who will provide content and innovative startups who will provide the platform, the AI expertise and will be responsible for marketing the lifelong learning service. This model is already emerging in the non-degree executive education market, where providers like Emeritus and GetSmarter are “white-labeling” executive education courses from leading business schools. In this arrangement, the content and the brand name are provided by universities while the platform, hosting, marketing and course administration services are provided by the technology startup.

6. Conclusion and Managerial Implications

Learning is becoming a lifelong endeavor and should be designed and delivered as such. Drawing from the inspirations of intelligent, adaptive, scalable, and affordable web-based educational service architectures,66 lifelong learning systems should be composed of learning objects that can be personalized through recommendation and topic aggregation engines and delivered as a subscription service with content that is sourced from the best providers or crowdsourced from a large audience and certified with an immutable record. This future of learning is already visible in the software and online services world, where Uber, Netflix, Spotify, Microsoft, and many other players are disrupting the monolithic, expensive, and captive paradigm of software development and delivery to a subscription-based, flexible, and open marketplace paradigm.

This vision of lifelong learning poses urgent questions for educational institutions and employers. How will universities adapt their content development and delivery
models while being burdened by their legacy models and organizations? Will disruptive startups be created to build the “Netflix” or “Uber” for learning? Will employers create customized learning journeys for their employees that combine externally sourced learning objects with content from internal subject matter experts?

The vision raises also fundamental questions about learning in general. Would an excessive focus on acquiring directly applicable skills be the opposite of the Humboldtian model of higher education that focuses on providing holistic education and developing versatile learners? Would we run the risk of “overfitting” learning the learners’ context, reducing them to skill-adopters who know a lot about what they are supposed to do on the job, but very little about everything else? In the search for efficiency and relevance, would we make learning myopic? Would the proposed lifelong learning approach bias learning towards hard skills and operational roles as opposed to soft skills and roles that demand creativity? On the other hand, how relevant is the Humboldtian model of higher education in its pure sense to the requirements of post-degree education?

These are only a few of the questions that need to be addressed in the journey to create an adaptive lifelong learning ecosystem. While it is not clear how exactly this journey will play out or who the winners and losers will be, what is clear is that lifelong learning will look very different in the near future. The advances of technology, software, and online services are too compelling to ignore. There is tremendous value waiting to be unlocked for learners as well as for educational content providers.

Notes


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