# Typology of Free Web-based Learning Technologies (2020)

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## Abstract

The Typology of Free Web-based Learning Technologies (2020) provides educators with a list of 226 technologies arranged into 40 types and 15 clusters that can be used via a browser to promote more productive and interactive learning. The 2020 Typology constitutes an update to the previously published Typology of Web 2.0 Learning Technologies (Bower, 2015), which was also based on a systematic search and categorical analysis (see Bower, 2016, for methodology). This 2020 Typology of Free Web-based Learning Technologies returns to the original analysis to remove tools that are no longer available and add new tools and categories that have entered the online learning ecosystem. Based on these emerging tools, new categorical types and clusters have also been added. Brief descriptions, example tools and pedagogical uses were provided for each category, in order to support ease of conceptualization and application. The analysis makes it possible to gauge trends in online learning technologies over the last five years, for instance the unsustainability of many smaller tools, the marketisation of many others, the trend towards more integrated platforms of tools, and greater dominance by larger providers. The paper concludes by inferring future trends in the online learning technology landscape.

## Introduction

The term "Web 2.0" was used early this century to characterize a new breed of simple-to-use web-based technologies that enabled users to collectively contribute and share with one another (O'Reilly, 2007). The revolution of Web 2.0 technologies compared to their more static predecessors was that they allowed large numbers of people to contribute typically small amounts of content in a way that was openly accessible and could be flexibly arranged (Hew & Cheung, 2013). These days it is taken for granted that free online technologies will serve our every interactive purpose, so "Web 2.0" has become a largely historical term.

Yet, the distinguishing characteristics of Web 2.0 technologies are still relevant and important today, insofar as educators are often looking for free, browser-based, interactive, tools that can be used to foster creativity and sharing. Being able to access software via a browser and store information in the cloud enables educators to seamlessly facilitate

constructive and collaborative learning (Leow & Neo, 2015), at the same time as reducing financial, hardware and maintenance overheads of physically installing software. Thus, it is still useful for teachers to understand the sorts of freely available online interactive tools at their disposal, and how and why they might choose to use each.

The 2020 Typology of Free Web-based Learning Technologies provides an update to the 2015 Typology of Web 2.0 Learning Technologies, with the change in name reflecting the diffusion of "Web 2.0" characteristics into contemporary technological assumptions. To perform the update, the currency of each of the tools from the 2015 Typology was inspected, with discontinued or commercialized technologies removed. Next, tools that had been observed and noted since the 2015 typology were reviewed and classified. Following this step, a search for freely available online tools was performed, and tools that met the criteria for inclusion were categorized and added. As a result of this process, three additional clusters of tools were added into the typology: 3D Modelling tools, Coding tools and Learning Management Systems. The category "Timeline tools" was reclassified from being a cluster in its own right to being a technology type in the "Knowledge organisation and sharing" cluster. The 3D modelling tools cluster is comprised of two types of technologies – 3D model repositories and 3D model creation. Otherwise, the types of technologies remained generally the same, noting some small adjustments to the names of the clusters and tool types. The 2020 Typology of Free Web-based Learning Technologies is shown in Figure 1 below, with clusters presented in the inner radius and any sub-categories of tool types presented in the outer radius.
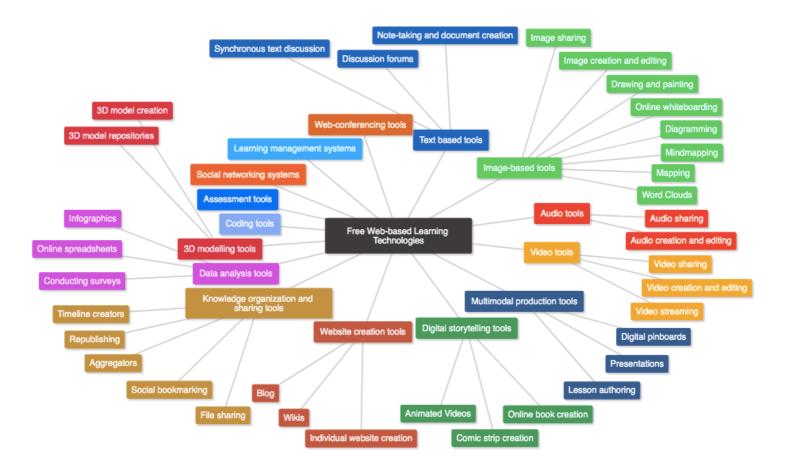


**Figure 1. Typology of Free Web-based Learning Technologies**

In order to have been included in the 2020 Typology of Free Web-based Learning Technologies, the tools must:

1.  be freely available, or at least offer a free version that can be used in continuity (not just a free trial)
2.  be openly accessible via a standard web-browser
3.  enable people to contribute and share content
4.  be educationally applicable (so, for instance, marketing tools were not included).

These criteria correspond directly with those used to form the original Typology (Bower, 2016). This consistency in process enables reliable characterization of changes to the technological landscape over the last 5 years. As part of the openness criteria, only those sites that could be used via popular browsers (e.g. Firefox, Chrome, Safari) were considered. That is to say, sites that required proprietary extensions or plugins for certain browsers were excluded, to avoid conditional inclusions in the Typology.

The categories of free online learning technologies, their descriptions, pedagogical uses and updated example tools for each category are described below, arranged according to the clusters. Throughout the descriptions the term 'users' rather than 'teachers' is often applied because students may learn more from being designers with the technology than from teachers preparing and disseminating activities, and 'users' encapsulates both of these cohorts. In reviewing the Typology educators are strongly encouraged to consider the age permissions and suitability of each site, as some might not be appropriate for primary school or even high school students.

# The 2020 Typology of Free Web-based Learning Technologies

## Text based tools

### Synchronous text discussion

Synchronous text discussion tools enable users to exchange text-based comments in real-time. These can be used for synchronous interaction between groups of learners to form a backchannel during a live presentation, or for instance to facilitate remote troubleshooting support. Twitter (http://twitter.com) is the most well known of these tools providing the ability to post short public text comments, and Plurk (http://plurk.com) provides an alternative. Chatzy (http://chatzy.com) and Backchannel Chat (http://backchannelchat.com) enable users to create private web-based chat streams that can be shared via URL. Slack (https://slack.com) offers synchronous text-based collaboration tools enable groups of users to synchronously instant message, plan and share artefacts online in order to promote effective team collaboration. Fleep (https://fleep.io) provides an alternative with text chat channels and file sharing.

### Discussion forums

Discussion forums facilitate asynchronous text discussions between groups of users, organising contributions according to discussion threads. This can be useful for more reflective text conversations where real-time interaction is not required. ProBoards (http://proboards.com) is an example. ReadUps (http://readups.com) is a social reading platform where people can read a book together by placing text-based comments around the pages within the browser (which can also be used in synchronous mode by virtue of the

inbuilt Twitter integration). Stand-alone discussion forums are less prevelant than previously as they are now integrated into broader suites of tools (for instance Learning Management Systems).

### Note-taking and document creation

Note-taking and document creation tools enables groups of users to collaborative author documents in real-time and see each other's changes. Evernote (http://evernote.com) provides a sophisticated web interface for note-taking including image insertion and file management but with view-only sharing rather than collaborative writing capabilities. Google Keep (https://keep.google.com) is a note-taking service, including texts, lists, images and audio, accessed through a Google account. Microsoft Word Online (https://www.office.com/launch/word) allows traditional desktop publishing of creating, editing, sharing and collaboration of Word documents via OneDrive. Google Docs (http://docs.google.com) enables simultaneous contributions to a document by multiple users with many of the features of Microsoft Word (including the ability to embed images). Zoho Writer (http://zoho.com/docs) is an alternative to Google Docs. Canva (https://www.canva.com) provides user-friendly, layer-based image manipulation functionality to design and create interesting documents.

## Image based tools

### Image sharing

Image sharing sites are designed to facilitate asynchronous public sharing of images. Users can utilize these to source and share image resources. Flickr (http://flickr.com) provides a large repository of publicly shared photos (and more recently, videos) that people can use or share using Creative Commons Licenses. Instagram (http://instagram.com) also facilitates photo (and video) sharing through individual postings. Other sites support sharing of images via open repository, for instance Pics4Learning (http://www.pics4learning.com), Burst (https://burst.shopify.com), Pexels (https://www.pexels.com), Unsplash (https://unsplash.com) and Pixabay (https://pixabay.com) provide archives of pictures that can be used for education, Openclipart (http://openclipart.org) offers general purpose clip-art, and Wikimedia Commons (http://commons.wikimedia.org) incorporates images (and videos) that can be reused under Creative Commons licenses.

### Image creation and editing

Image creation and editing sites enable users to individually create and edit images as well as add effects (e.g. on photos), and then share images via URL. This can be useful when users need to produce and disseminate an image, for instance to represent a concept. Befunky (http://befunky.com) provides a simple online photo editing tool with cropping, resizing, colour mixing, exposure and sharpening adjustments as well as filters. Pixlr (http://pixlr.com), Sumopaint (http://sumopaint.com) and DeviantArt (http://muro.deviantart.com) provide more powerful image creation and editing facilities with layers and effects much like proprietary commercial software, yet available directly through a web browser. It should be noted that there is also a range of free image creation and editing tools that are available as a software download, for instance the popular Gimp program. There are also several image creation and editing tools that can be operated via some browsers via installation of proprietary extensions or plugins.

### Drawing and painting

Drawing tools allow users to use their mouse as a pen to create a picture and share it via a URL. This can be useful for sketching and illustrating purposes. Sketchpad

(https://sketch.io/sketchpad) offers a user-friendly platform to create, share, print and export artworks using a variety of drawing tools. Slimber (http://slimber.com) enables individual users to replay their creation at speed to see how the image was constructed. Flockdraw (http://flockdraw.com) enables multiple users to enter a free-form collaborative drawing session through their browser with integrated text chat.

### Online whiteboarding

Online whiteboarding tools differ from drawing tools in so far as they include line, shape and text tools (and in some cases other features) to structure the illustrative process. A Web Whiteboard (http://awwapp.com) provides a simple whiteboard for real-time collaborative whiteboarding activities. Google Drawing (http://docs.google.com/drawings) and Board800 (http://board800.com) provide more fully featured whiteboarding with live collaboration. CoSketch (http://cosketch.com) incorporates text-chat to support live collaboration. Twidlla (http://twiddla.com) and Autodraw (https://www.autodraw.com) facilitates both free drawing using a variety of tools and AI assisted creations, which can be exported as a PDF file.

### Diagramming

Diagramming tools impose more structure to the drawing process by offering a range of templates for creating diagrams and flowcharts. This can be useful if users need to quickly develop a procedural schematic diagram. Examples include, Gliffy (http://gliffy.com), Lucidchart (http://lucidchart.com), and Draw.Io (http://draw.io). Creately (http://creately.com) and Cacoo (http://cacoo.com) enable collaborative diagram creation, including flowcharts.

### Mindmapping

Mindmapping tools support the development of images to represent interrelated concepts in the form of a visual knowledge network that can be shared via URL. This can be used to represent conceptual and even metacognitive understanding. Bubblus (http://bubbl.us) and Mindomo (http://mindomo.com) provide simple text based mindmapping with the ability to save and disseminate maps via URL. Wisemapping (http://wisemapping.com) provides a large range of editing and formatting features including the ability to embed images, while Mindmup (http://mindmup.com) also allows documents and videos to be attached. Popplet (http://popplet.com) allows images, text and freestyle drawing to be organized and linked. For collaborative mindmapping, Mind42 (http://mind42.com), Mindmeister (http://mindmeister.com) and Slatebox (http://slatebox.com) have advanced formatting capabilities, image insertion, and also allow real-time collaborative authoring. Coggle (http://coggle.it) provides real-time collaborative authoring and the ability to track back through versions of the mindmap to see who has made changes at various points in time. Debategraph (http://debategraph.org) provides groups of users with the ability to visualise a network of documented ideas with features to view the knowledge networks in different ways including as trees, radial graphs, nested and content boxes.

### Mapping

Mapping tools support the creation of custom maps by marking up publicly available mapping information, which can then be shared by link or by embedding within another site. This can be useful for representing a travel path or a series of related sites. Google Maps (http://maps.google.com) allows users to pin text, images, and videos to maps that can then be shared by URL. Scribblemaps (http://scribblemaps.com) allows image, text and marker placement on Google maps. The relatively recent Google Tours platform (https://www.google.com/earth/education/tools/tour-builder) enables text, images and videos to be integrated to build a 3D virtual excursion experience.

### Word clouds

Word cloud tools enable users to create and share image arrangements of keywords of a text based on the file, text or URL provided by users. This offers educators a visually appealing way to represent a literary composition and also enables lightweight analysis based on the words that are more frequent and thus occur in larger text. Examples include WordClouds.com (http://wordclouds.com), Tagcrowd (https://tagcrowd.com) and Word Art (https://wordart.com/).

## Audio tools

### Audio sharing

Audio sharing sites enable users to upload and share their audio recordings (for instance, podcasts) via open repositories. This can be useful for sourcing disciplinary information and also sounds to be used for remixing. Examples include Soundcloud (http://soundcloud.com), Audioboom (http://audioboom.com), Freesound (http://freesound.org), Chirbit (http://chirbit.com) and SoundBible (http://soundbible.com).

### Audio creation and editing

Audio creation and editing sites enable individuals to record audio directly through their browser. Vocaroo (http://vocaroo.com) allows simple online audio recording directly through a web-browser. Soundation (http://soundation.com) offers users more sophisticated audio recording and editing functionality including the ability to mix different audio tracks and combine them with a library of free sound effects. Note that the popular Audacity audio editing software is only available as a software download, though can be operated via some browsers via installation of a proprietary extension or plugin.

## Video tools

### Video sharing

Video sharing sites enable users to share video content via public repositories. This enables teachers and students to source video content for knowledge acquisition or remixing purposes, as well as disseminate their own video. YouTube (http://youtube.com) and Vimeo (http://vimeo.com) are well renown generalist video sharing sites. Teachertube (http://teachertube.com) specializes in the sharing of educational videos.

### Video creation and editing

Video editing tools allow individual users to create and edit videos through their browser. This enables teachers and students to create video content for instructional or assessment purposes. The YouTube Video Editor (http://youtube.com/editor) can combine videos, trim, add images, audio tracks, transitions and text, and includes feature to adjust brightness, contrast and so on. Another tool in this space is Video Toolbox (http://videotoolbox.com). Kizoa (http://kizoa.com) and Muvee (http://muvee.com) specialise in videos and slideshows based on images, multimedia, text, and music, incorporating transitions and a range of other effects. Flipgrid (https://info.flipgrid.com) allows multiple participants to record, edit and share their created video, which can be viewed by all participants. Screencast-o-matic (http://screencast-o-matic.com) provides users with the ability to create a video recording of their screen via direct operation through their browser.

### Video streaming

Video streaming services allow users to publicly broadcast a live video stream from their video camera or webcam. This is useful for providing remote access to live events (such as presentations) or creating a student-driven television broadcast. Live streaming on YouTube (http://youtube.com) provides a free video streaming service integrated into YouTube. Another alternative includes YouNow (http://younow.com), which uses advertising to support their free plans.

## Multimodal production tools

### Digital pinboards

Digital pinboards allow groups of users to organise and share a range of resources such as web pages, files, photos, and notes by adding them to a freeform canvas. This is useful for collaborative brainstorming sessions. Examples include Pearltrees (http://pearltrees.com), Padlet (http://padlet.com), Stormboard (http://stormboard.com), Lino (http://en.linoit.com) and Conceptboard (https://conceptboard.com). Miro (https://miro.com) is a more fully featured example include collaborative whiteboarding, marking up documents, collaborative writing and discussions via text.

### Presentations

Presentation tools enable users to sequence multimodal content so as to support or deliver an instructional narrative. Products are shareable via URL and public repositories. Presentation tools are useful for any situation where teachers or students are required to share or demonstrate their understanding. Prezi (http://prezi.com) provides users with an open and zoomable canvas for embedding video, images and text, and supports recording, real-time collaboration, and sharing via a public repository of presentations. Microsoft PowerPoint Online (https://www.office.com/launch/powerpoint) is a browser-based version of the popular presentation creation program, supporting sharing and collaboration via OneDrive. Google Slides (http://www.google.com/slides/about) supports real-time collaborative authoring of PowerPoint style slides directly through the browser, with presentation and sharing via a URL. Haikudeck (http://haikudeck.com) provides simple web-based slide creation software that searches for appealing image backgrounds based on keywords. Photopeach (http://photopeach.com) and Photosnack (http://photosnack.com) enable the creation of slideshows based on image upload (though without audio annotation). Vcasmo (http://vcasmo.com) specialises in adding audio-visual narration to slide presentations. Slideshare (http://slideshare.net) and Authorstream (http://authorstream.com) enable users to share their desktop presentations via public repository, and include the ability to add audio narration to uploaded slides. Spark (https://spark.adobe.com) offers a basic free account with upgradable plan models and is a popular tool to create graphics, pages or videos using customizable templates and images.

### Lesson authoring

A range of Web 2.0 lesson authoring tools have emerged that enable users to sequence content into learning modules and often add interactive elements. These can be used by teachers to create learning sequences, and also by students in tasks that require them to teach their peers. Example tools include LAMS (https://www.lessonlams.com), BlendSpace (http://blendspace.com), SoftChalk (http://softchalk.com), EasyGenerator (http://easygenerator.com), Nearpod (http://nearpod.com) and Udutu (http://udutu.com). Composica (https://composica.com) has been designed to support collaborative authoring via the web. Many of these tools have a free trial period before charging for services.

Edpuzzle ([http://edpuzzle.com](http://edpuzzle.com)) provides users with the ability to synchronise images, text, and interactive quiz elements to Youtube and other video clips.

# Digital storytelling tools

## Online book creation

Online book creation sites enable individual users to create a story based on pictures and text, and share them via URL or repository. These can allow adults to publish and distribute their work in book form, and there are also a range of tools that support story composition by younger students. StoryJumper ([http://www.storyjumper.com](http://www.storyjumper.com)) and Tikatok ([http://tikatok.com](http://tikatok.com)) allow students to create and publish e-books by uploading their images and text. StoryBird ([http://storybird.com](http://storybird.com)) provides a wide variety of artistic theme-based templates and graphics to enhance and structure story creation. Mixbook ([http://mixbook.com](http://mixbook.com)) is a well-renowned site for creating books based on uploaded photos than enables collaborative authoring and sharing (including in print form). Book Creator ([https://bookcreator.com](https://bookcreator.com)) provides a user-friendly interface to combine text, images, audio and video to create, read or publish books.

## Comic strip creation

Comic strip creation sites allow users to drag and drop characters and backgrounds into templates and then overlaying individualized images and text. Comics are often used as elementary yet motivating ways to summarize scenarios or demonstrate processes. Examples include Storyboard That ([http://storyboardthat.com](http://storyboardthat.com)), MakebeliefsComix ([http://makebeliefscomix.com](http://makebeliefscomix.com)), and Pixton ([http://pixton.com](http://pixton.com)). WittyComics ([http://wittycomics.com](http://wittycomics.com)) provides an adult genre for their comics.

## Animated videos

Animated video sites enable creation and sharing of animated videos and presentations through drag-and-drop interfaces with a large variety of elements, styles and templates. This is useful for creating videos without the need to shoot footage. Examples include Powtoons ([http://powtoon.com)](http://powtoon.com)), Moovly ([http://moovly.com](http://moovly.com)) and DigitalFilms ([http://digitalfilms.com](http://digitalfilms.com)). Voki ([https://www.voki.com](https://www.voki.com)) creates customisable animated speaking avatars from written text, that can be shared to a range of platforms.

# Website creation tools

## Individual website creation

Individual website creation tools enable single users to create websites from customisable templates through a point-and-click interface (no coding required). Examples include Google Sites ([https://sites.google.com/new](https://sites.google.com/new)), Tripod ([http://tripod.lycos.com](http://tripod.lycos.com)), Wix ([http://wix.com](http://wix.com)), Jimdo ([http://jimdo.com](http://jimdo.com)), and Moonfruit ([http://moonfruit.com](http://moonfruit.com)). Note that many of these have basic free plans with fees for premium services. Weebly ([http://weebly.com](http://weebly.com)) also integrates a blog tool. For single page websites Glogster ([http://glogster.com](http://glogster.com)) provides a simple to use interface for creating visually appealing posters that can be made available as a URL.

## Wikis

Wikis enable multiple users to create, edit and link multi-page websites through their web-browser, making them ideal for project workspaces or collaborative knowledge bases and for project workspaces. PBworks ([http://pbworks.com](http://pbworks.com)) is a frequently used wiki that is free for education. Recently there has been a decline in the number of freely available served

wikis, though there are still platforms that are offered with a limited users, or postings, or advertising including Confluence (https://www.atlassian.com/software/confluence), Nuclino (https://www.nuclino.com), Zoho Wiki (https://www.zoho.com/wiki) and Wikidot (https://www.wikidot.com).

### Blogs

Blogs differ from wikis in that they organise website posts in chronological order. This makes making the suitable for teachers and students to represent and track evolving thinking over time. Wordpress (https://wordpress.com) includes multimedia libraries, numerous templates and a host of wigets to enhance the functionality of their blogs. Edublogs (http://edublogs.org) is based upon the Wordpress platform and offers teachers the capacity to create and administer an entire class of blogs through a secure portal. The Tumblr (http://tumblr.com) blog has an easy to use interface and simple resharing facilities. Blogger (http://blogger.com) is another well renown blogging site now owned by Google. Paper.li (http://paper.li) and RebelMouse (https://rebelmouse.com) provide online newsletter publishing tools with a commercial agenda but do allow free use for individuals. Penzu (http://penzu.com) allows students to create private notebook entries and embed images, with a range of classroom management, tracking and assessment tools for teachers.

## Knowledge organization and sharing tools

### File sharing

File sharing sites enable users to share their documents, images, audio files and videos via the web. Whereas other types of tools enable users to view and often manipulate those files, file sharing sites typically only provide a directory or 'folder' system where permissions can be set to determine who can access the files. This is useful for sharing files within classes and between groups. Popular examples include Dropbox (http://dropbox.com), MediaFire (http://mediafire.com), 4shared (http://4shared.com), and OneDrive (http://onedrive.live.com). Google Drive (http://google.com/drive) differentiates itself by integrating its online office tools (Docs, Sheets, Slides, Forms and Drawings) with file storage so that users can view and edit files through their browser.

### Social bookmarking

Social bookmarking sites enable users the capacity to store, organise, annotate, and share links to websites online. This is useful for creating sets of links amongst a community of practice or team. An example is Diigo (http://diigo.com), which allow users to create groups and online presentations. Other social bookmarking tools include Icyte (http://icyte.com) and Memonic (http://memonic.com), each have their own slightly different features and target audiences. Edshelf (https://edshelf.com) is specifically designed to help share collections of resources for educational purposes, and Wakelet (https://wakelet.com) and Participate (previously known as Educlipper) (https://explore.participate.com/educlipper) extend this by serving to create learning and teaching networks for educators and students.

### Aggregators

Aggregators use Really Simple Syndication (RSS) harvest web-based information into one place. This allows users to organise, save and share content on topics that is important to them. Examples include Flipboard (http://flipboard.com) and Feedly (http://feedly.com). Bloglines (http://www.bloglines.com) specializes in aggregation of blog content.

### Republishing

Republishing tools extend beyond aggregation tools to enable individuals and groups of users to not only scrape content from the web but also comment upon and republish it. This

can be used by students and teachers to share interpretations of the resources that they find. ScoopIt (http://scoop.it) is designed for individual user republishing. Pinterest (http://pinterest.com) enables groups of users to collect, markup and republish content around a common topic of interest. LiveBinders (http://livebinders.com) allows users to collect links and organise content into virtual shareable folders about topics.

### Timeline creators

Timeline tools allow users to organise text and images on a single page according to when they occurred. This is useful for representing historical events. Timetoast (http://timetoast.com) and Preceden (https://www.preceden.com) are basic examples. Tiki-Toki (http://tiki-toki.com) allows users to make timelines in three dimensions so that different themes can be seen alongside one another. There are also other tools available such as Office Timeline Online (https://online.officetimeline.com), that do not natively allow image insertion.

## Data analysis tools

### Conducting surveys

Online survey tools that enable collection of data via web forms. This enables students and teachers to source data to use in subsequent analysis. Examples include Survey Monkey (http://surveymonkey.com), Crowdsignal (https://crowdsignal.com/), SurveyGizmo (http://surveygizmo.com), Slido (https://www.sli.do), Strawpoll (https://www.strawpoll.me), Addpoll (http://www.addpoll.com), Mentimetre (https://www.mentimeter.com) and FluidSurveys (http://fluidsurveys.com). The Google Forms platform (http://www.google.com/forms/about) provides the capacity for multiple users to collaboratively author surveys, with integration into the Google spreadsheet application for data analysis. Similarly, Microsoft Forms (https://forms.office.com) facilitates surveys, quizzes and polls, collects data in real-time and provides visual, exportable results. Poll Everywhere (http://polleverywhere.com) differentiates itself from other survey tools by offering SMS as well as web-based voting and real-time broadcasting of responses as controlled by the teacher. Answer Garden (https://answergarden.ch) is a simple feedback-gathering tool for presenters arranged as a word cloud.

### Online spreadsheets

Online spreadsheets provide the ability for users to collaboratively edit spreadsheets that are shared via a URL. This means teachers and students can conduct collaborative data analysis. Google Sheets (http://www.google.com/sheets/about) and Microsoft Excel Online (https://www.office.com/launch/excel) are popular online spreadsheets. Alternatives include Zoho's Spreadsheet tool (http://www.zoho.com/docs), Live Documents spreadsheet (http://www.live-documents.com/live_spreadsheets.html) and Ethercalc (http://ethercalc.net). Smartsheet (http://smartsheet.com) is an online spreadsheet with extra organizational features such as additional views as calendars and Gannt charts.

### Infographics

Infographics provide online tools and templates for representing numerical data that can in turn be shared via URL. Infogram (http://infogr.am), amCharts visual editor (https://live.amcharts.com), Venngage (https://venngage.com) and Google chart tools (https://developers.google.com/chart) provide interactive charts and data tools, with the ability to import Excel or CSV files to create different types of charts that can be published online. Easelly (http://www.easel.ly) and Piktochart (http://piktochart.com) moves beyond chart data to create poster-style template-based data representations. ChartsBin

([http://chartsbin.com](http://chartsbin.com)) creates interactive visualisations of data, including interactive maps that can be exported and embedded in presentations, blogs or websites. Figma ([https://figma.com](https://figma.com)) allows customisable, collaborative image editing, arrangement and creation.

## 3D Modelling tools

### 3D model repositories
There are numerous online communities that promote sharing and usage of 3D models, which have supported the rise of the 3D printing and the maker movement. Examples include GrabCAD ([https://grabcad.com](https://grabcad.com)), Rapables ([https://repables.com](https://repables.com)), 3D Warehouse ([https://3dwarehouse.sketchup.com](https://3dwarehouse.sketchup.com)) and Print Me a Sheep ([http://www.printmeasheep.com](http://www.printmeasheep.com)). Thingiverse ([https://www.thingiverse.com](https://www.thingiverse.com)) and Pinshape ([https://pinshape.com](https://pinshape.com)) also offer tutorials and lesson plans in subject areas for educators.

### 3D model creation
3D modeling tools enable users to create, save and share three-dimensional Computer Aided Design (CAD) models through their web-browser. Shapeshifter ([http://shapeshifter.io](http://shapeshifter.io)) enables quick creation and manipulation of 3D objects that can be downloaded for printing and shared by hyperlink. Tinkercad ([http://tinkercad.com](http://tinkercad.com)) provides browser-based CAD design, which supports import and has socially formed gallery of creations. Slash ([https://www.3dslash.net](https://www.3dslash.net)) offers an easy-to-use, clean intuitive interface for 3D model creation supported by tutorials and a shared gallery. Sketchup ([https://www.sketchup.com](https://www.sketchup.com)) is a popular and powerful 3D modelling program.

## Coding tools
The focus on developing computational thinking and computer programming (coding) capabilities has led to the rise of numerous visual programming tools, which enable students to create and share, stories, animations and games by dragging and dropping blocks of code. Possibly the most well renowned example is Scratch 3.0 ([https://scratch.mit.edu](https://scratch.mit.edu)), which is used by tens of millions of students worldwide. Code.org ([http://code.org](http://code.org)) also enables students to create and share programming projects online, and includes numerous small programming challenges. Gamefroot ([https://make.gamefroot.com](https://make.gamefroot.com)) provides an alternative that is specifically designed to support game development. Some sites offer coding experiences through integrated tutorials, including Code Academy ([https://www.codecademy.com](https://www.codecademy.com)), Free Code Camp ([https://www.freecodecamp.org](https://www.freecodecamp.org)) and Khan Academy ([https://www.khanacademy.org/computing/computer-programming](https://www.khanacademy.org/computing/computer-programming)), with the latter two platforms focusing on text-based coding. The Australian Computer Academy ([https://aca.edu.au](https://aca.edu.au)) and Makecode ([https://www.microsoft.com/en-au/makecode](https://www.microsoft.com/en-au/makecode)) offer interactive tutorials and simulators for learning to code in a range of languages.

## Assessment tools
Assessment tools typically enable users to create online quizzes using a range of question types (such as allows users to create multiple choice, fill in the blank, matching, short answer, and true/false questions) with automatic grading and feedback as well as performance tracking. Epitomic examples include Quizstar ([http://quizstar.4teachers.org](http://quizstar.4teachers.org)), ProProfs Quizmaker ([http://proprofs.com/quiz-school](http://proprofs.com/quiz-school)) and Class Marker ([https://www.classmarker.com](https://www.classmarker.com)). Quizlet ([http://quizlet.com](http://quizlet.com)), Cram ([http://cram.com](http://cram.com)) and CoboCards ([http://cobocards.com](http://cobocards.com)) also allow creation of flashcards and various forms of testing (for instance multiple choice, true false, matching, written answer) as well as

memorization tasks and games, with a public repository of user creations. EasyTestMaker (http://easytestmaker.com) is more print and summative assessment oriented, but with sophisticated features for tracking student performance. Peerwise (http://peerwise.cs.auckland.ac.nz) offers a platform for students to create multiple choice questions that their peers can answer and provide feedback upon, all in a gamified badge and leaderboard environment. Socrative (http://socrative.com) is specifically designed for real-time monitoring of quiz results for formative assessment purposes. Kahoot (https://kahoot.com) is a games-based platform enabling both custom-made and ready-made multiple-choice quizzes. GoSoapBox (https://www.gosoapbox.com) allows presenters to embed comprehension checks to engage their audience.

## Social networking systems

Social networking systems enable users to sharing photos and videos, post text-thoughts and run polls via their personalized profile pages. They can be used to help students share content, provide feedback and trouble-shooting support to one another, and harvest perceptions via comments and voting activities. Facebook (http://facebook.com) is obviously the most well-renowned social networking site. Class Dojo (https://www.classdojo.com) offers a safe and education oriented social networking platform that includes parents and administrators. Fakebook (http://www.classtools.net/FB/home-page) and Twiducate (http://twiducate.com) provide other educational alternatives. There are other social networking tools that are built around specific communities of practice. For instance, Research Gate (http://researchgate.net) and Academia (http://academia.edu) support social networking and information sharing for academics.

## Learning Management Systems

Learning Management Systems (LMSs) facilitate the delivery of courses, rather than singular lessons. Additional to delivering content, the features of a LMS include the ability to prescribe tasks, set assessments, track student performance, report and document data, as well as having control of the administration associated with the course. Edmodo (http://edmodo.com) and Seesaw (https://web.seesaw.me) are popular LMS platforms that are pitched towards younger-aged students. Google Classroom (https://classroom.google.com) provides a reliable platform that is popular in primary and high schools. There are several other platforms that offer a "freemium" model, including platforms such as Moodle Cloud (https://moodlecloud.com), Latitude Learning (http://www.latitudelearning.com), Myicourse (http://myicourse.com), Schoology (http://www.schoology.com), ATutor (https://atutor.github.io) and FormaLMS (http://www.formalms.org).

## Web-conferencing tools

Synchronous multimedia collaboration tools, otherwise known as web-conferencing or video conferencing, enable participants to see and hear each other as well as use other real-time collaboration features such as screen sharing.  Zoom (http://zoom.us) allows web conferencing for up to 40 minutes for free, and comes with a range of powerful features including screen sharing, whiteboard, text-chat and breakout rooms, which can all operate directly through a browser. Google Meet (https://apps.google.com/meet) offers free web-based video-conferencing for up to 100 people for up to 1 hour at a time. Skype Online (https://web.skype.com) facilitates voice and video calls, messaging, screen sharing with end-to-end encryption security. Discord (https://discordapp.com) offers a voice, video or text communication platform, allowing up to 10 users to share their screens simultaneously.

# Discussion and Conclusion

The 2020 Typology of Free Web-based Learning Technologies presented in this article was based upon an original systematic review of Web 2.0 tools conducted in 2015, and updated to reflect shifts in the learning technology landscape over the last 5 years. It is by no means claimed that all free online learning technologies have been incorporated. However, many have, and these can be immediately deployed by teachers to enhance the learning outcomes and experiences of their students. More importantly, the Typology provides a framework for educators to conceptualise available technologies so that they can make purposeful decisions about the types of tools they deploy. The Typology also provides a valuable timestamp with which to compare and track the nature of the change in the online technology landscape.

In particular, of the 212 tools used in the 2015 Typology, 150 were retained and 62 were deleted. The decision to delete tools was made based on the following reasons: 1) the site being unavailable or discontinued; 2) the service being commercialized and no longer free for the user; or 3) the service changed to no longer constitute an educational purpose. There were 76 new sites added to the Typology, many in the newly added clusters of Learning Management Systems, 3D Modelling tools and Coding tools. The emergence of platforms offering a range of integrated learning and assessment tools resulted in the formation of the Learning Management Systems cluster. The increased importance placed on the development computational and design thinking capabilities over the past five years corresponds with the inclusion of new clusters of tools relating to Coding and 3D modelling.

The growth of approximately 7% from 2015 to 2020 in the number of freely available web-based tools included in the typology is in some ways surprisingly low, and may be a mark of the increasing maturity of the field as competition and sustainability exert greater influence on the domain. It should be noted that there has been a marked increase in the number of extensions and plugins that are offered through individual browsers (for instance Google Chrome and Mozilla Firefox) that enable users to complete productivity tasks and share content. While these were not included in the list because they were proprietary to a particular browser, they have further increased the sorts of educational tasks that can be completed for free online, and educators are encouraged to explore these options when searching for the right web-based tools.

It was interesting that the original framework of the Typology remained relevant for the categorization of the majority of the freely available online technologies. The fact that there were still technologies available in all of the categories of the original Typology implies that none of the technology types had become entirely obsolete. Large providers, such as Google and Microsoft, have permeated many of the categories in the Typology, a noticeable growth since the publication of the 2015 version. For instance, as well as its YouTube brand, including video editing, music mixing, live streaming and video watching, Google offers infographics, mapping (including Google Maps, Google Earth, tour building and excursions), Hangouts, Google Classroom, Sketchup, Sheets (assessment) and website creation. These powerful, free tools have apparently impacted on the sustainability of smaller providers. Similarly, the reduction in the number of small, stand-alone tools in clusters such as wikis, discussion forums and online whiteboarding could potentially be attributed to this, with these features now routinely offered in larger integrated platforms.

It appears from the research literature into online learning and anecdotal observation of educator practice that only a narrow subset of tools available are being utilized and

investigated by educators and educational researchers (see Bower, 2017). Thus, there is considerable potential to further explore and examine how the various affordances of different online technologies with their different modalities and information structures can be incorporated into learning designs and impact upon learning processes. The Typology presented herein offers a touchstone for educators and researchers, by raising awareness of the large variety of technologies available and how they can be differentiated in terms of modalities, synchronicity, structure of information, and sharing. However, if educators are to fully capitalize on the pedagogical potentials of free online technologies they need to do more than simply understand the nature of the tools – they must also understand how the action potentials or 'affordances' of technologies can be used to help achieve the requirements of the learning tasks they are designing in accordance with the specific contextual needs of their students (see Bower, 2008, 2010).

There is no doubt in the future that online technologies will continue to change. Several implications for the future of web-based tools can be drawn by extrapolating the trends observed over the last 5 years. Firstly, we would expect that smaller tools without a significant differentiation or business case will either discontinue, marketize, or be taken over. Secondly, it would appear that larger players in the online technology ecosystem will continue to crowd-out smaller players, as their suites of tools become more ubiquitous and integrate greater functionality. We can expect that the built-in intelligence of tools will continue to increase as the machine learning and learning analytics fields become more mature. As a final observation, the business models and motivations of these free online technology providers should be continually scrutinized by the education field, in an effort to ensure appropriate data security and privacy of students and teachers.

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