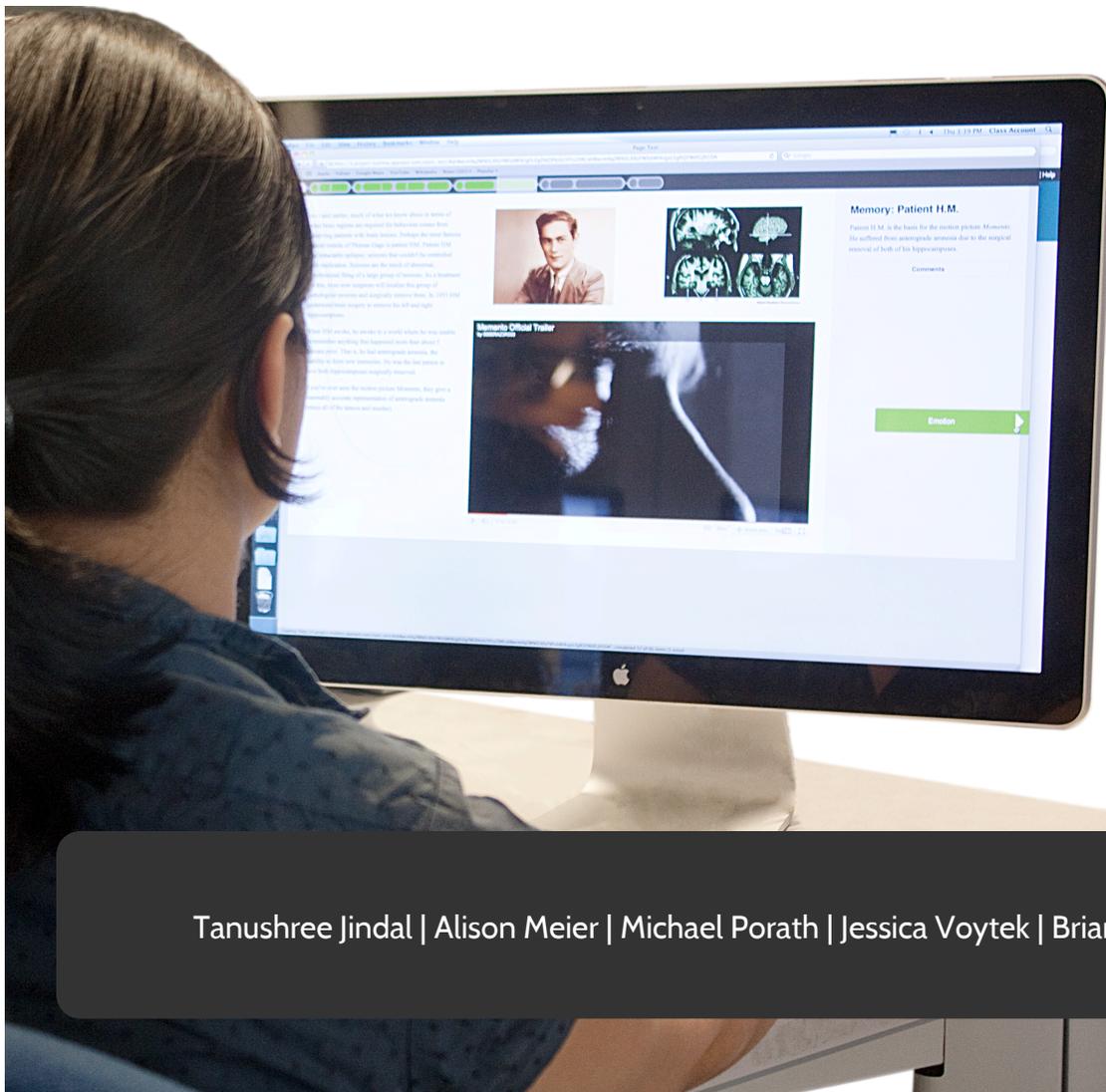




## Curating Rich Media for Online Education

www.trailmix.info

UC Berkeley School of Information  
Master's Final Project Report  
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Tanushree Jindal | Alison Meier | Michael Porath | Jessica Voytek | Brian Carver, Advisor

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## About *trailmix*

*trailmix* is a tool for curating and consuming rich media for online higher education. This highly functional prototype allows instructors to easily create educational narratives: collections of online resources—videos, images, and text—arranged in a way that allows students to explore topics in a logically ordered way rather than from a list of links. The tool guides instructors through the process of creating logical, cohesive, and attractive lessons that can replace or supplement existing course reading and lectures. Students can access the lessons online (even on an iPad), and experience a guided, unified learning experience.

*trailmix* addresses many common concerns of instructors and students in online learning environments: lack of student engagement, lack of guidance, and lack of interaction between instructors and students. *trailmix* leverages the recent abundance of compelling media such as videos and images in order to maintain student interest. At the same time, *trailmix* provides order and structure to this online content. Rather than wandering through links, students are guided through material embedded in an ordered lesson. In addition, instructors are encouraged to provide context for each piece of media using guiding text snippets. To give students and instructors a way to interact within the tool, there is a place for asking and answering questions alongside the content.

We named this project *trailmix* to emphasize the key elements of our system: the “trail” that connects learning resources to each other and guides students through the material and the “mix” of different media.

## Goals

Online higher education is becoming increasingly common (Fish & Wickersham, 2009). Educators are struggling to find the best way to teach geographically diverse students they may never have met, generally relying on methods that were designed for face-to-face classrooms. Online students strive to learn concepts, often solely through written lectures and other reading, without interaction with their classmates or instructor. Online reading often consists of traditional textbooks and articles, while lecture varies from a typed version of what an instructor would have said in person, to basic PowerPoint slides, to videos of face-to-face lectures. Textbooks and written content are structured and authoritative, but without the addition of face-to-face lectures, they fail to engage online students the way that they have in traditional classrooms. Meanwhile, a vast array of compelling media content is available online, but it is disjointed. Instructors occasionally point students to online resources and multimedia, but they underutilize the vast supply of rich content available online. Furthermore, students and instructors struggle with the lack of communication. Students want timely responses to questions, and instructors have little knowledge whether students are following the material.

Current distance learning systems typically used by online universities are not effectively addressing these issues of engagement, guidance, and interaction. Fish and Wickersham believe that delivery of content in online courses needs to undergo significant revision: “Effective online course delivery requires more than simply repackaging existing traditional course content by means such as placing

presentation slides and lecture notes into course management systems, which is frequently practiced by poorly trained faculty. Faculty must restructure how course content is delivered, which takes type of content, student ability and course sequence within curriculum into consideration” (2009). They suggest that rethinking distance learning requires using technology that is easy to use, enticing to students, and includes media resources: “Online technology should consist of user-friendly technology delivery systems, and software that appeals to learners. Furthermore, online course content should be easy to navigate and contain high quality images, graphics, video streaming, and links to electronic resources.”

We believe *trailmix* helps instructors create course content that is organized specifically for the online learner. We strive to meet students’ needs for engaging content, structured guidance, and interaction with instructors and peers. We endeavor to make this content extremely simple for instructors to produce. The interface for creating lessons guides instructors through finding and adding multimedia, selecting licensing options, structuring content using pedagogical and narrative frameworks, and following design principles.

## Online Courses

### Course Structure

There are many types of online courses. McFarland and Hamilton note the variety of online course delivery options, explaining that definitions range from “a course having materials delivered online that never meets synchronously, and the student learns completely independent of a live instructor” to “a course having materials delivered online that meets synchronously and regularly, perhaps in a chat room, moderated by the instructor” (2005). There are also online courses, often those outside of degree programs, in which students can start and end classes at any time, independent of a semester schedule. McFarland and Hamilton also recognize the existence of “blended” courses, in which large portions of courses are conducted online but with some face-to-face interaction.

Instructors we interviewed structured and administered their courses in a variety of ways. Here are three such possibilities:

**Course 1**—This online course consists of written lecture, supplementary reading (a textbook, articles, and video), and mandatory forum discussion. The instructor teaching the course is not the person who created the material that is being taught. This instructor primarily grades assignments, monitors discussion forums, and holds weekly online office hours to answer questions from students via instant message.

**Course 2**—The instructor teaching this course also created it. The instructor writes out lectures that are to be read weekly, and there are weekly readings from a textbook and articles. The instructor conducts two optional voice sessions per semester to discuss the assignments and course projects.

**Course 3** — For this online course, the instructor created a website and his own online textbook. Each week, students watch a recorded video lecture from a previous year (face-to-face instruction) and read from the online textbook. The textbook includes interactive demo

problems. Students can interact with teaching assistants throughout the week using chat via instant message.

Although we see value in using *trailmix* in many educational situations, we have focused primarily on a fully online degree program, much like the current pilot of the UC Online Instruction Pilot Program<sup>1</sup>. We envision a course in which students start and end the course on the same schedule but do not necessarily have synchronous class sessions. Like many online learning situations, students may be located in different time zones and have little opportunity to connect with peers or instructors in real time.

## Course Management Systems

Lessons created with *trailmix* will generally be one component of an existing online course management tool. Various online course management systems (also called learning management systems) are currently in use, such as Angel (by Blackboard), Elluminate, or Desire2Learn. Although each of these systems has some kind of authoring tool for creating course content, none provides creation tools similar to *trailmix*. These course management systems generally include functionality for class management, administering and grading assignments, and posting within forums, blogs, or wikis. We do not intend to serve as a complete course management system; *trailmix* is a tool that would integrate with existing systems.

## Process

Our process for creating *trailmix* can be divided into three components—research, design, and development—yet these pieces were conducted in an integrated and iterative manner rather than in distinct phases. Our approach was to first learn about online education, media curation, and learner engagement through user research, competitive analysis, and literature review. These findings informed our design of the tool and interfaces, supplemented with regular usability testing sessions in which we received feedback from instructors, students, and instructional designers. Our design dictated technologies and techniques for developing the working prototype, and additional usability testing helped refine the final artifact.

## Research Process

### User research

We interviewed individuals involved in the course creation process from both online and face-to-face teaching environments and students who are enrolled in online degree programs or who have taken online courses (a list of user research participants is available in the appendix of this report). We transcribed the interviews and then coded comments by category. We synthesized our research by sorting the notes by these categories and creating concept maps for each category. This process led us to key observations that we then further analyzed using affinity diagramming methods. We also created personas to capture the roles of different online instructors.

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<sup>1</sup> <http://groups.ischool.berkeley.edu/onlineeducation/home>

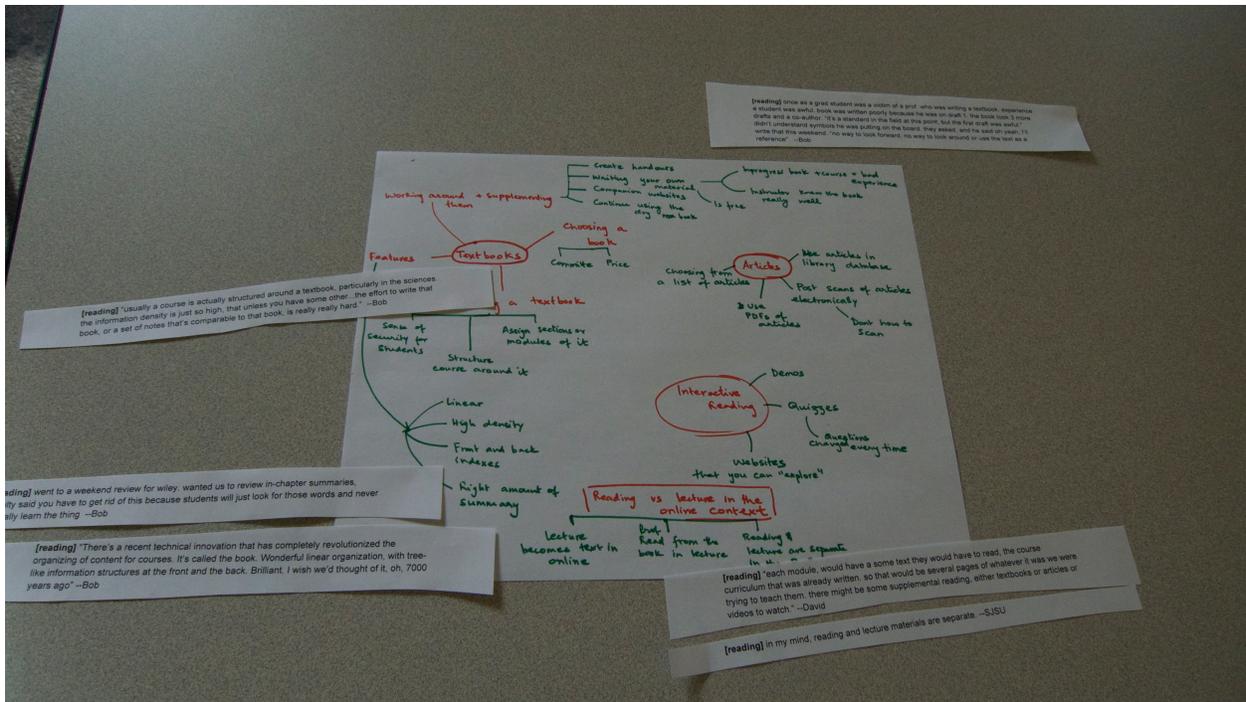


Figure 1 Concept map of one user research category

## Competitive analysis

We surveyed existing tools that fell in the categories of open educational resource repositories, educational content organizers, presentation tools, and visual search and curation tools.

While we found no tools that met our objectives exactly, we discovered inspiration in the successes and failures of existing services and applications. Some tools focused on organizing educational resources, such as the Xerte Online Toolkits, Omeka, Haiku, and Udemy, while others provided repositories for open educational resources, such as Open Learn, Connexions, and Merlot. Other tools presented a clean and simple interface for constructing narratives, such as Projqt, Storify, Keepstream, Storybird, though not geared toward an academic purpose. From still others we drew design ideas for presenting multimedia and guiding users, such as presentation tools like Prezi, Vuvox, Microsoft Research Digital Narratives, or visual search tools such as Qwiki.

A list of these resources is provided in the appendix.

## Literature review

We sought literature to help us understand online learning, multimedia in education, lesson plan design, and narrative structure (as a means to make content more compelling), both in terms of narrative in education and digital narratives.

Existing literature helped frame and inform our project; specific findings from this work are discussed throughout this report.

## Design Process

### Low fidelity prototypes

After our initial research, we continued the design process by sketching our ideas. These sketches helped us to refine the project and think through initial concepts.

Following a sketching phase, we each created a lesson: we each picked a topic and gathered materials related to an existing course and created a paper version of the lesson. The process of creating the content for the narratives was a learning experience for us. We realized first-hand that it is a very time consuming process and that educators' preferences in structuring the content in this manner can vary.

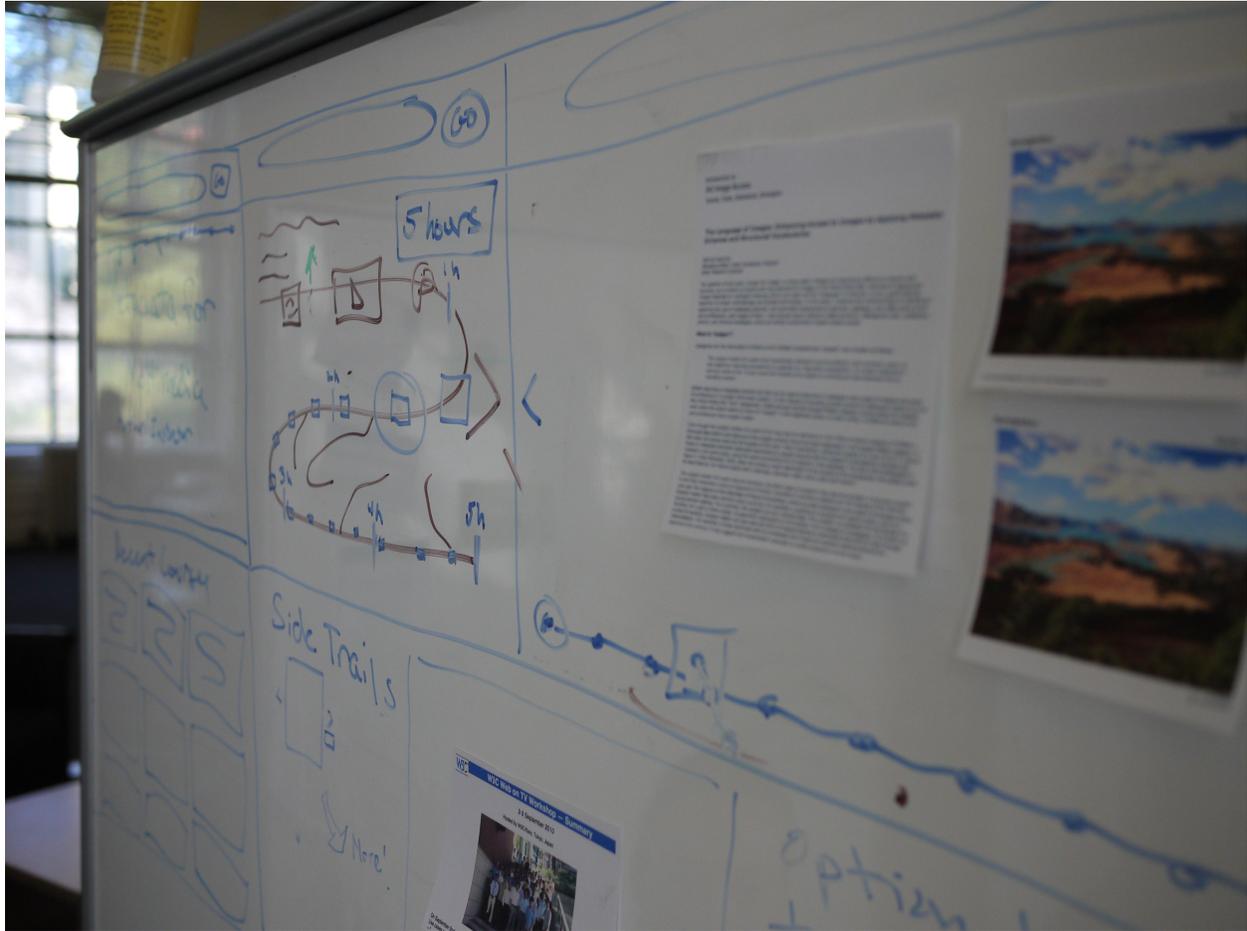


Figure 2 Sketching a sample lesson

We then selected one of the sample topics and designed four paper prototypes of the student interface, what we later named the Lesson Browser. The four versions helped us think through various design possibilities: We showed the paper prototypes to students and instructors to get feedback on the design.

To design the authoring platform, or Lesson Builder, we created sketches followed by several iterations of low-fidelity, clickable wireframes using a tool called Balsamiq. We used these interactive digital “sketches” for initial usability testing with instructors.

## High fidelity prototypes

Our end product is a highly functional prototype. This prototype contains much of the functionality that we would envision in a full product. Our development process for this prototype is discussed later in the Development Process section of this report.

We conducted usability testing in order to get feedback on the application and design, as well as to uncover problematic user interface elements. We conducted usability tests with online students, online instructors, and face-to-face instructors. During many of these sessions, we captured recordings of screen interactions including click activity, along with video of participants' faces and audio recordings. A few of the sessions were conducted remotely, using remote usability test methods such as screen sharing.

We tested the Lesson Browser with online students. These students tested an early version of working prototype and provided feedback that helped us revise the design. Instructors tested both low-fidelity Balsamiq interfaces and a working prototype of the Lesson Builder, as well as a working prototype of the Lesson Browser interface. Their feedback helped reinforce several design decisions and improve the application.

A list of usability test participants is available in the appendix.

## Development Process

To develop this prototype, we followed an iterative process of design, development, testing and redesign. Using this rapid iterative process, we were able to develop an entire web application including:

- a Lesson Browser where students can access course materials,
- a Lesson Builder where instructors can collect and organize educational materials into lessons,
- a browser “bookmarklet” for easily collecting content from the internet,
- a custom RESTful web service for getting and posting data asynchronously to and from pages on the site and the bookmarklet, and
- a basic authentication system.

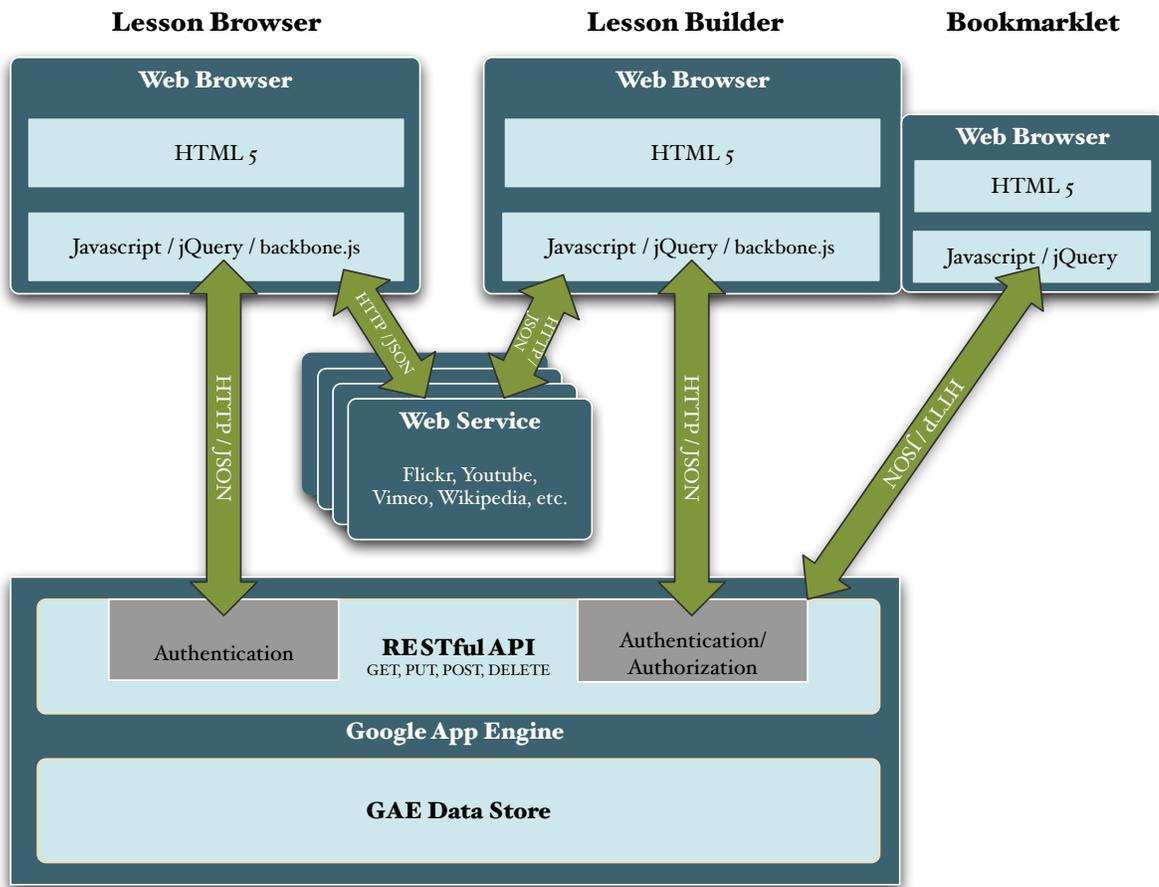


Figure 3 A diagram of technologies used in trailmix

We set out to design an application that can run on different platforms. Because of that and with more stable and mature current web technologies in the HTML5 stack, we decided to build a fully functional web application that runs in the user's browser. We chose commonly used and freely available software to quickly and inexpensively develop the features we had designed.

On the back-end, we developed on Google's App Engine framework (for Python). The main rationale was that App Engine makes it easy to collaboratively develop and deploy software, without having to maintain a server installation, separate database, web server or deployment framework. What is more, App Engine leverages WSGI<sup>2</sup>, which makes it straightforward to develop a RESTful service in Python. After beginning with an out-of-the-box package that implements a configurable RESTful service, we decided to develop our own implementation that is tailored to our needs and is more flexible allowing us to iterate our interaction and application design.

The front-end is realized with recent versions of HTML and CSS. All user interactions with the application, as well as interaction of the browser with the back-end are realized in JavaScript. We made use of popular JavaScript frameworks (*jQuery* plus plug-ins, *underscore.js*, and *RaphaelJS* for vector

<sup>2</sup> Web Server Gateway Interface

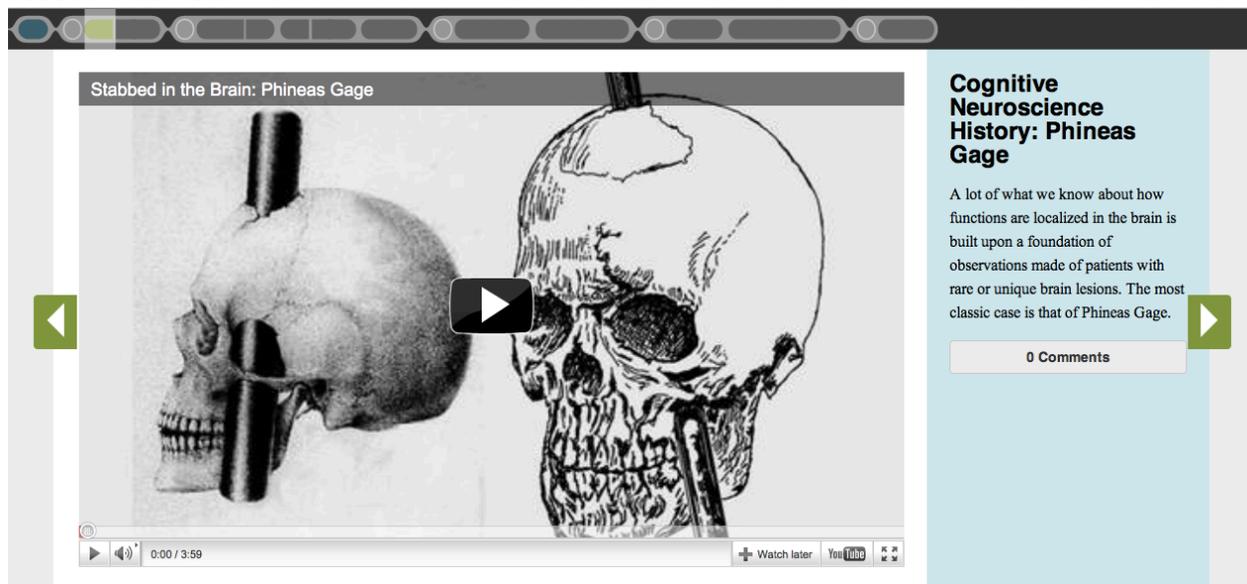
graphics). Because *trailmix* has a wide variety of functionality and carefully designed user interaction, we decided to implement it with *backbone.js*, a recently published open-source library that facilitates the separation of application logic, data, and user interaction. The framework indeed introduced a clearer code structure. More importantly, though, it provided the team with conventions for implementing the application. Normally, conventions have to be established in a team over time, but the framework sped up this process. With three team members working on the same features of the application at different times, this was essential.

The software is designed to run well on the latest versions of Firefox and Webkit-based browsers such as Google Chrome and Safari. Due to its prototypical nature, we did not optimize for other browsers such as Internet Explorer or Opera. By choosing to develop this prototype for a subset of similar browsers instead of all browsers, we were able to focus more on developing features than on cross-browser compatibility issues.

To enable educators to collect and use freely available educational materials posted online, the system is designed primarily to link or embed content from existing web sources. By linking and embedding content, there is little need to copy and store copyrighted material on the back-end. The back-end merely stores references to external materials in the form of URIs, short text snippets, thumbnail images, and metadata. This approach does have some drawbacks as the lessons can only be viewed in a web browser with an active connection to the internet. However, as connectivity becomes more ubiquitous, we believe these drawbacks are outweighed by instructors' enhanced ability to use content in ways that are considered fair use.

## Features

### Lesson Browser



The screenshot displays the Lesson Browser interface. At the top, there is a navigation bar with several circular icons. Below this, a video player is embedded, showing a skull with a metal rod passing through it. The video title is "Stabbed in the Brain: Phineas Gage". To the right of the video player is a sidebar with the title "Cognitive Neuroscience History: Phineas Gage". The sidebar contains a short paragraph of text: "A lot of what we know about how functions are localized in the brain is built upon a foundation of observations made of patients with rare or unique brain lesions. The most classic case is that of Phineas Gage." Below the text is a button that says "0 Comments". The video player has a play button in the center, a progress bar at the bottom showing "0:00 / 3:59", and a "Watch later" button.

Figure 4 Lesson Browser, a student's view of a lesson

## Content

### *Media from online sources*

One of our primary goals in building *trailmix* was to make it simple for instructors to integrate rich online media content in their teaching. We feel that online media resources are underutilized in favor of traditional textual materials, both in the form of written material from instructors and assigned reading material such as textbooks and articles. Integrating media content within the course material leverages rich resources available online and helps sustain student engagement.

Existing literature suggests that including media is an important component of online courses. As mentioned earlier, Fish and Wickersham state “online course content should be easy to navigate and contain high quality images, graphics, video streaming, and links to electronic resources” (2009). Likewise, Winkler-Prins explains, in designing online geography courses for Michigan State University, courses “tend to be graphics-intense rather than text-intense” because “we believe that this helps maintain student attention and interest and acknowledges the learning styles of today’s college student” (2007).

Some online education applications also provide methods for integrating rich content. Haiku includes an “embed the web” feature, and Xerte Online Toolkits allow for integration of a variety of media types. Udemy allows users to create online courses using videos, presentations, and text.

Instructors we interviewed who already included media in their lesson plans primarily mentioned pointing students to videos and noted that students tend to like videos. Others sent students to explore websites, while others found interactive applets and assessment exercises valuable.

### Availability of rich online media content

One reason to increase utilization of online media content is because of the recent proliferation of high quality educational materials readily available online. In addition to the vast collection of user-generated materials available in popular repositories such as YouTube and Flickr, there is also a growing movement to make high-quality educational resources available online and openly licensed, following the standards of open educational resources (OER)<sup>3</sup>. From the MIT Open Courseware initiative to OER repositories such as Connexions, OpenLearn, and Merlot, many resources exist with the goal of making high quality educational material accessible to all students regardless of enrollment in a course or ability to pay.

A report from the non-partisan research organization Committee for Economic Development contends that open resources are already transforming higher education: “The increasing use of digital media and the emergence of a new form of educational materials known as ‘open educational resources’ are raising the possibility of substantially changing the materials used in teaching and learning, the ways that they are created and utilized, and even the process of teaching and learning itself” (2009). In order for these resources to be fully utilized within online learning, instructors must be able to integrate media found online into their course materials in an easy manner.

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<sup>3</sup> <http://wiki.creativecommons.org/OER>

## Engagement

Student engagement is crucial for learning. As one professor noted during our user research, “I want them to actually learn this stuff. The best way to do that is to keep their brain in the game.” We believe that using a mix of media can help keep online students interested in their lessons.

While maintaining student engagement is a challenge in all learning settings, the challenge is augmented when students are learning outside of the classroom in solitary settings. Using a variety of media is one way to maintain attention. One online student noted during usability testing, “[Including media] is a really good idea. It’s so much more interesting than reading page after page after page ... As a student taking a class like this you are like ‘would you please give me something to look at that isn’t another paragraph!’” This student felt that using a variety of learning methods would have helped her to maintain focus. Likewise, the instructional designer at the commercial organization commented that he used videos extensively as he was aware that “student nowadays have a really, really high bar for what keeps their attention.”

## Embedded media

A key element of our design was to bring all of the content together in a unified view. We felt that most instructors who currently employ the use of online media rely on a list of links to outside sources. Links take you away from your current focus and remove the content from the context of the course. Students are likely to be distracted, overlook key points, or miss the opportunity to see the resource alongside other relevant course content. One professor summed up his frustration in sending students to visit outside links:

“Browsers let you go to a page, and there’s this thing called a back button that brings you back, but it doesn’t really pull you back...as a teacher I sort of want to control that interaction. I want to say this why you’re there, and this is what is going to happen next. And it’s not the link on that page, it’s this one. It’s almost like I want to refer you to a webpage, and not just the webpage, a specific part, a figure, a subpart of a figure, or a 3-paragraph narrative, and then I want you to come back.”

An online student confirmed this professor’s concerns about losing attention when following links. During a usability testing session, this student was excited to see that YouTube videos were contained within the lesson browser window:

“The more you send a student to a list of links to opening another window, especially going to YouTube, where you have you know all of the links for similar stories or similar clips, it’s really, really distracting. It can take a lot longer to actually finish a reading if you’re jumping around a lot...You’re working by yourself at home, or at a cafe, which I do quite a lot, and it’s really easy to get distracted, especially when the internet’s right there, and you are a curious soul.”

One online instructor commented during usability testing that she liked that *trailmix* combined content within one view instead of sending students to outside links: “I like being able to add things so easily rather than just provide a URL that someone has to click on and essentially leave to go see and then come back, so I think that’s a really nice feature of this.”

### **Limited Content on Each Page**

We strove to balance displaying related information together with limiting each page to information that is easily readable or viewable. There was a tradeoff between presenting all information about a topic on one screen and therefore giving students a big picture of how content was related—and spreading content out so that it is easily consumable. To explore these design choices, we created paper prototypes that illustrated four different options and tested them with students.



*Figure 5 Testing four paper prototype designs with students*

Based on our testing with students, we selected the card-based model that emphasized horizontal navigation and limited scrolling for text. One student commented that the layout reminded her of a traditional textbook: “It’s pretty much set up the way a lot of textbooks are, with information on both sides and then pictures, so I’m pretty used to it.” In order to accommodate this model, topics are spread out between multiple pages. In addition to illustrating a topic grouping in the trail, headlines in the right-hand column indicate continuity between topics.

### **Narrative**

Our original project concept focused on designing educational content using the principles of traditional narrative. Our goal was to create a tool for making it easy to create compelling lessons, and narratives have a long tradition of engaging audiences. We believe that educational material can leverage existing conventions of storytelling to increase engagement and improve learning outcomes. While we do not advocate creating educational content simply for entertainment, we do want to push educators to create a cohesive, logical experience that guides students to an understanding of key elements of a lesson and how content relates.

One professor explained that the textbook currently fills this role of creating a framework for learning about a topic. He noted, “We want these books to be read as a story. We want them to be read through...I want them to be read linearly.” This professor, who taught introductory physics, mentioned that all of the material that he teaches is available online, but not in an ordered fashion. He believes that his role of the teacher, and his use of a textbook, is a way to guide students through the concepts in a certain order to be able to grasp the patterns in the subject matter. We feel that *trailmix* can aid in this process. Instead of simply being a website that provides information, *trailmix* guides students through content in a logical fashion while at the same time incorporating digital media.

### **Definition of narrative**

A traditional definition of a narrative requires components such as setting, events in the form of a plot, and change (M.-L. Ryan, 2002). Philosopher Paul Ricoeur’s theory on narrative posits that narratives draw together disparate elements and make them cohesive (Dauenhauer, 2005).

### **Digital narrative**

Microsoft Research is currently developing its own tool for digitally creating narratives. Their tool creates an experience in which images, videos, and audio work in tandem to tell a story or communicate a concept. The tool allows users to stop the narrative at certain points to explore content in greater detail. Although their output differs significantly from *trailmix*, we found their definition of a narrative to be in line with our own: “A digital narrative is a narrative that takes advantage of multimedia and web technologies, providing the author with a new way to build and present a media-rich story, and simultaneously offering the viewer a new way to interact with the content.”<sup>4</sup>

### **Narrative in education**

Storytelling has been employed for teaching throughout history. Marie-Laure Ryan explains how narratives have been used to convey cultural knowledge. For example, *The Illiad* may have served the purpose of teaching the names of Greek tribes or the components of a warrior’s equipment (2002). Elliott Jane explains how the root of the word narrative comes from the Indo-European root “gna,” which translates as both “to know” and “to tell.” Jane finds that “narrative might well be considered a solution to a problem of general human concern, namely, the problem of how to translate knowing into telling” (2005). Likewise, teaching is fundamentally the sharing of knowledge.

More recent educational movements strive to incorporate narratives in educational settings. While this technique is occasionally employed in K–12 education (Banister & C. Ryan, 2001; Madej, 2009), others push for integration of narrative methods in higher education (Abrahamson, 1998). Abrahamson notes: “Instructors of higher education often have feelings of ambivalence about incorporating storytelling into their lectures and teaching method because they feel it is taking away from the actual delivery of factual course content. At the same time, there are a growing number of educators in higher education who feel the telling of stories is a powerful, perhaps indispensable, tool in teaching” (Abrahamson, 1998). We recommend that instructors leverage methods of narrative development to improve content delivery.

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<sup>4</sup> [www.digitalnarratives.net](http://www.digitalnarratives.net)

## Implementation of Narrative Elements

*trailmix* guides educators to implement two primary components of traditional narratives: narrative structure and guiding narration.

### Structure and Pedagogical Principles

As mentioned earlier, a key component of narrative is a sequence of events that make up a plot. A traditional plot structure is captured in Freytag's Pyramid<sup>5</sup>: a story begins with an exposition that sets the scene, conflict builds until reaching a climax, resolution occurs, and the story concludes with dénouement.

Likewise, a strong lesson plan includes similar components. Madeline Hunter's seminal lesson design formula includes a seven-part structure for designing lesson plans (Hunter, 1984). This structure includes "anticipatory set," in which the instructor prepares students for learning about the topic, "objective," to help students and instructors to focus on the main learning goal, and "input," in which students acquire learning." Additional phases include methods such as demonstrating learning and practice. Hunter states that each phase is not required for every lesson, and instructors must judge for themselves whether that element belongs in that particular lesson. Nonetheless, this model for lesson design is complex.

Andrew Johnson proposes a simplified implementation of Hunter's structure, explaining that "[Hunter's] format made planning difficult and often produced lessons that were not very effective. It was cumbersome, unwieldy, not applicable to every teaching situation, and, most importantly, it did not reflect the way teachers think as they go about designing learning experiences" (2000). Thus, he proposes a simplified format, which we have adapted for use in *trailmix*. Johnson's lesson plan format is as follows:

1. Objective: "This is a definition of what exactly you want students to know or be able to do as a result of your instruction. This is where the planning process begins. What is it exactly that you want to teach?"
2. Introduction: "This is a quick way to introduce students to the concept or ideas found in the lesson. An introduction links new ideas to known ideas, arouses curiosity, creates interest, and is relatively brief."
3. Input: "Learning involves the construction of knowledge as new information is given meaning in terms of prior knowledge."
4. Activity: "This involves the manipulation of the input."
5. Closure/Review: "It is generally a short review of the main ideas covered in a lesson."

*trailmix* encourages instructors to create lessons that include objective, introduction, body, and conclusion. Activity falls within the realm of assignment and assessment, which are not present in this version of *trailmix*. This could be an element of a future iteration of *trailmix*, however.

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<sup>5</sup> <http://oak.cats.ohiou.edu/~hartleyg/250/freytag.html>

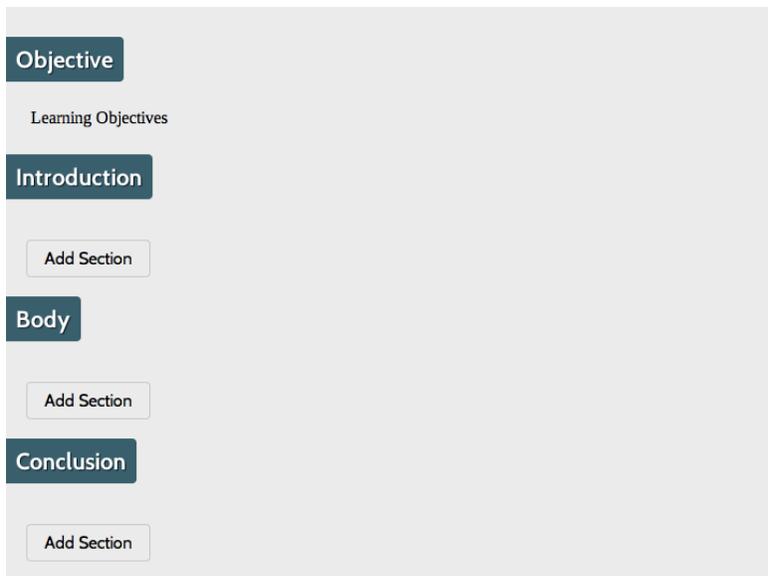


Figure 6 Lesson structure in outline

During usability testing, one online instructor responded to the built-in structure of objective, introduction, body, and conclusion with enthusiasm: “I think that’s excellent. I really like that.”

### Narration

The other narrative element present in *trailmix* is narration. Like a narrator in a story, *trailmix* makes it easy for the instructor to continually guide students throughout the lesson and emphasize key concepts and elements.

*trailmix* encourages instructors to include guiding narration alongside content elements. It is crucial that instructors be explicit about what students should focus on within a lesson and situate materials within a larger context. While face-to-face instructors have the opportunity to punctuate importance or connections through commentary or expressiveness, this is more complicated in an online scenario.

One online instructor expressed his attempt to tie content elements that he uses in courses back to the greater purpose of the lesson: “To always pose that question, like what is the value of that next thing that you are going to add, and how is it relevant to this thing you are trying to teach? If there was someone there who was always nagging you, OK, tie this back to your point. Why this video, why this image, why this text? That helps me a lot.” The *trailmix* guiding narration element not only pushes instructors to tie content to the overall lesson, but it makes this connection clear to the student as well.

### Trail

Another key component of the Lesson Browser of *trailmix* is the guiding trail that is visible at the top of every page. The trail provides both navigation functionality and an indication of progress through the lesson.



Figure 7 The trail provides one form of navigation and indicates progress

Within the trail, sections are indicated by pods, and topics are indicated by nodes within the pods. Divisions in the nodes indicate page divisions within topics, illustrating that pages are within the same topic even though they are on separate pages.

A translucent bar indicates where the student currently is in the lesson, and sections change color after students have accessed those pages. The section title and topic titles are visible when hovering over that section of the trail, and the student can navigate through the lesson by clicking on parts of the trail (in addition to navigating using the arrows on the right and left sides of the content).

### **Status indication**

The trail gives students an indication of how far along in the lesson they are and shows where they have been. Giving users information about their progress meets Jakob Nielsen's heuristic of "visibility of system status," which dictates "the system should always keep users informed about what is going on."<sup>6</sup>

In addition to wanting to give progress indications as a principle of good design, we felt that it was especially crucial to give online students a sense of how far they are in the lesson. Literature indicates that online students are continually pressed for time, especially because online students are likely to have even more constraints on their time than traditional face-to-face students (Quinlan, 2010). Having a sense of how much work they have completed and how much they have left to do gives students a tool with which to balance their workload.

During a paper prototyping session, one student mentioned that she liked when her assignments were divided into discrete chunks so that she knew how much work she had left to do. Another student built on this idea in usability testing by indicating that she wanted to not only see where she was in the assignment but how much she had done. Based on this feedback, the trail now indicates what pages students have visited by changing color.

Several existing tools that we analyzed utilize a progress bar indicator. Vuvox presents a timeline below the video content that shows how far you are in the material, but it does not give an indication of what the content actually is. Projeqt provides thumbnails of upcoming and recent pages of the narrative beneath the current page, though it does not show all of the pages at once. Qwiki shows thumbnail pictures of some of the images and videos presented, though because the pages are composites of various media, only a limited number of images are shown in the progress bar.

### **Connections between content**

The trail also gives students a quick view of how content fits together. The instructional designer of educational resources for a commercial company mentioned that he felt their current collection of videos and materials in their portal lacked any method for tying material together. This instructional designer wanted to design something that fulfilled the role of the trail in *trailmix*: "I wanted to build something that is a lot more interactive, gave a more consistent experience with the content and allowed people to see how things are linked with each other... [I want] to have a bit of path through the content in a way that allows you to quickly consume it too."

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<sup>6</sup> [http://www.useit.com/papers/heuristic/heuristic\\_list.html](http://www.useit.com/papers/heuristic/heuristic_list.html)

OpenLearn provides a different manner of seeing connections between content. Their knowledge maps<sup>7</sup> show how content is related but are not useful for actually progressing through the content contained in a lesson. The knowledge maps function more like mind maps—diagrams that demonstrate relationships between concepts—rather than a method for consuming material.

We also incorporated an outline view to provide the overall picture of a lesson to the student and instructor. The lesson outline is the traditional way of displaying the hierarchical structure and connections in a lesson—instructors are used to this convention. The outline translates into the more compact trail for a quick view of connections that is always present while viewing the lesson.

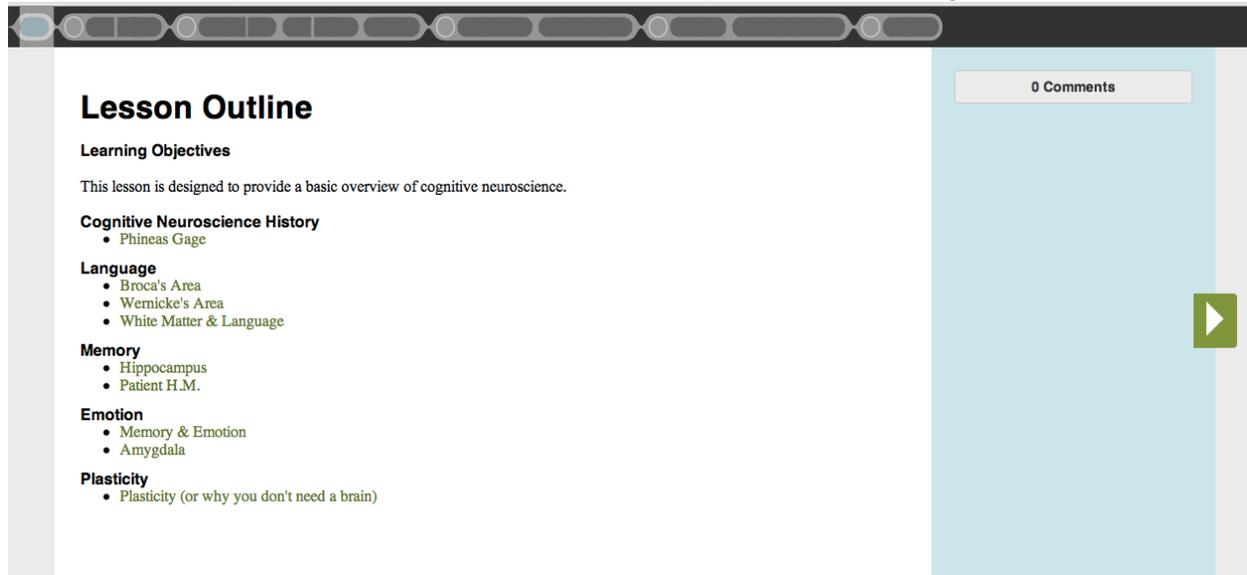


Figure 8 The Lesson Browser begins with a lesson outline.

### Easy navigation

The trail is useful for navigating through the content. Because it gives an indication of the content on pages by displaying the section and topic names and is clickable, the trail is useful for jumping between sections quickly. The arrows are suitable for progressing through the pages one-by-one, but the trail is ideal for surveying all of the material, jumping ahead, or jumping back to previously viewed content.

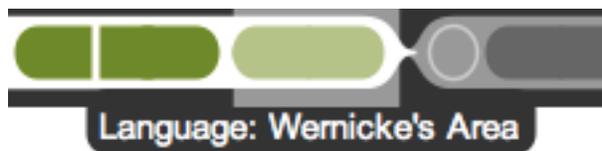


Figure 9 Section and topic titles are visible when hovering the trail

This pattern of navigation was confirmed in our usability testing. One student explained, “I think it’s useful to have [the trail] there. As an initial reference point, I found it appealing because I wanted to just

<sup>7</sup> <http://openlearn.open.ac.uk/course/view.php?id=2824>

mouse over it and read what all of these topics were coming up, without even going to them necessarily. For navigating more than a couple pages at a time, I would probably use it so I don't just hit [the arrow] over and over again. If I wanted to just go back to the page before, I would definitely use the arrows. Having the arrows to just go page to page is really helpful, but then to navigate farther, I would definitely use [the trail].”

### Changes in trail design

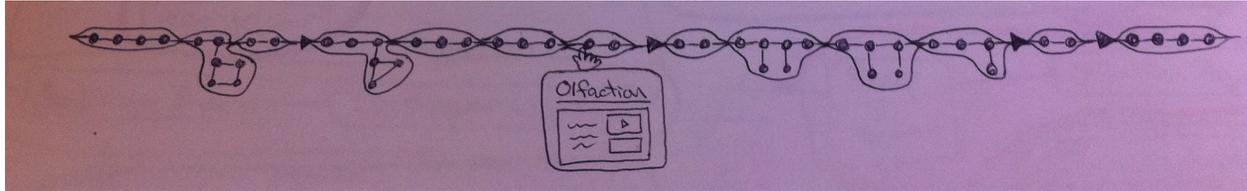


Figure 10 Early sketches of the trail

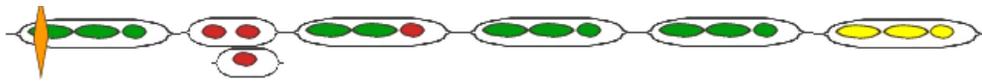


Figure 11 Low fidelity prototype of trail



Figure 12 Trail before feedback from usability testing



Figure 13 Final trail design

The trail underwent significant design changes throughout the project. One of our original concepts was to include the ability to create side trails: material that instructors designated as optional content that students could choose to pursue if interested. Although there was some instructor interest in giving students optional material, our research did not reveal a pressing need for this functionality. It also significantly complicated the interface for both creating and viewing the courses making it less usable and accessible.

We also redesigned the information presented in the trail and its design as a result of usability testing. The original trail indicated content on each page using colors for different media types. Students found this confusing, as they thought that the differently colored material indicated page transitions: “I can't tell what the difference between the green and the blue is, because I'm expecting there to be three pages there instead of the two. I'm wondering, what am I missing?” We also learned, from both instructors and students, that knowing the type of content was not particularly helpful, so we eliminated color as content type designation entirely.

Users were also confused by how we were indicating page changes. We originally used a black line to indicate a separation of a topic, but several users thought the line indicated content that they had already seen. We changed this design so that pages were indicated by breaks in the topic node.

The repeated expectation that lines indicated visited material told us that users were looking for a way to note where they had already been. We implemented color change in topics to indicate viewed pages.

Additional changes to the trail as a result of usability testing include increasing the size of the trail and topic nodes to make it both easier to see and easier to click.

## Q&A

The question and answer section on each page gives students the chance to ask questions about the material presented.

This element was not part of our original design; we added this functionality after repeated findings in both user research and literature of the difficulty of interaction between students and instructors, or students and other students in online classes.

All of the online instructors we interviewed stressed that interaction with students is difficult in the online setting. They expressed that interaction is important to help gauge student understanding, provide clarification and build concepts, encourage discussion and synthesis of topics, and to provide evaluation of the course. One online instructor mentioned that she has difficulty knowing whether students are understanding concepts. She thinks that they do not pick up on her tone from the lecture material; she said she does not know if they even get her jokes. She also finds it concerning that she cannot tell if students get the material, and they might not ask if they are unsure: “If they don’t get something, they need to ask right then because later in the class is going to build on it.”

Instructors often find that teaching online courses actually requires more time than face-to-face courses, particularly because of the limited social interaction with students (Fish & Wickersham, 2009). One online instructor we spoke to mentioned that he spent considerable time answering the same questions over again, particularly right before an assignment was due.

One usability testing participant suggested that we include a social aspect to the tool so that students can learn from each other: “I think it would be great if there was some sort of a social aspect of it, like commenting, or students interacting with each other, especially if it’s an online learning course, where you’re not necessarily getting that student interaction, because students learning from other students is really important.”

We wanted both students and instructors to be able to respond to questions based on information from one online student about how she currently uses forums to ask questions. This student found that other students are more helpful because instructors are often slow to respond. Furthermore, other students can reiterate or build upon her original question: “I feel like classmates are more responsive than the professors usually in an online forum. I’ll post a question just because I want clarification. And also it’s good...to know that your classmates have the same questions, because sometimes people won’t actually have an answer to the question but will post things saying ‘oh yeah, I was thinking about that too,’ and they’ll try to rephrase the question and add something else to the question, and maybe the professor will chime in or maybe other classmates.”

## Design of Q&A

We anticipate that *trailmix* will sit within existing course management systems that already have forums or blogs that are used for assignment-level synthesis and reflection. We did not want to replace these existing systems, so instead we focused on creating a place to ask questions in the context of the content itself. Furthermore, one online instructor told us that she does not want to read commentary posts; instead she wants to focus in on students' questions: "I don't want to read a hundred posts. I really like the discussion only when people post something that they want to ask."

We intend for the Q&A to be limited to students within the same class. This is both to protect student privacy and to limit questions and answers to things that make sense within the context of a class. Although there is some value to sharing and building on existing student discussion, there are significant student privacy concerns with storing student questions and making them public. Displaying questions publicly may also dissuade students from wanting to participate.

Furthermore, some of the students we interviewed noted that they thought that a commenting system limited to course members would be more valuable to them than an open system. One student explained that limiting a question and answer feature to students of the same class would be most useful "if it were all students from the same class so we knew the relevant things, we knew what we needed to take away from it, or there was an assignment everyone was working on so that we could say, this is the page we're all citing."

For the purposes of this prototype, we are using the cloud-based commenting service Disqus. A fully working product would require a custom Q&A feature. Because we are currently using this third-party tool, comments are not limited to members of a course.

## Lesson Builder

Our goal for the Lesson Builder of *trailmix* was to make it extremely easy for instructors to develop quality content that students would find compelling. Literature shows that instructors are reluctant to learn new technology for course presentation or development, even if it improves their teaching, because of the difficulty in learning new systems. Christie and Jurado find that "The potential to present course material in innovative and pedagogical ways is enormous with a learning management system but so is the learning curve required to realize such potential" (2009). Online students we interviewed confirmed this assertion. One online student—whose university had tried three different content management systems in three years—explained, "our professors are pretty much in the stone age... I feel like a lot of them are struggling right now since it's so new, and we've changed systems multiples times."

We recognize that reluctance to try new technology is a significant barrier to implementing new technology in education. We prioritized making *trailmix* as easy as possible to use so that non-technical instructors would feel comfortable creating lessons using the system. To that end, we employed user-friendly functionality such as a drag and drop and page layout templates. During usability testing, one online instructor commented, "I love the click and drag." Another online instructor said, "I could see myself using something like this very easily."

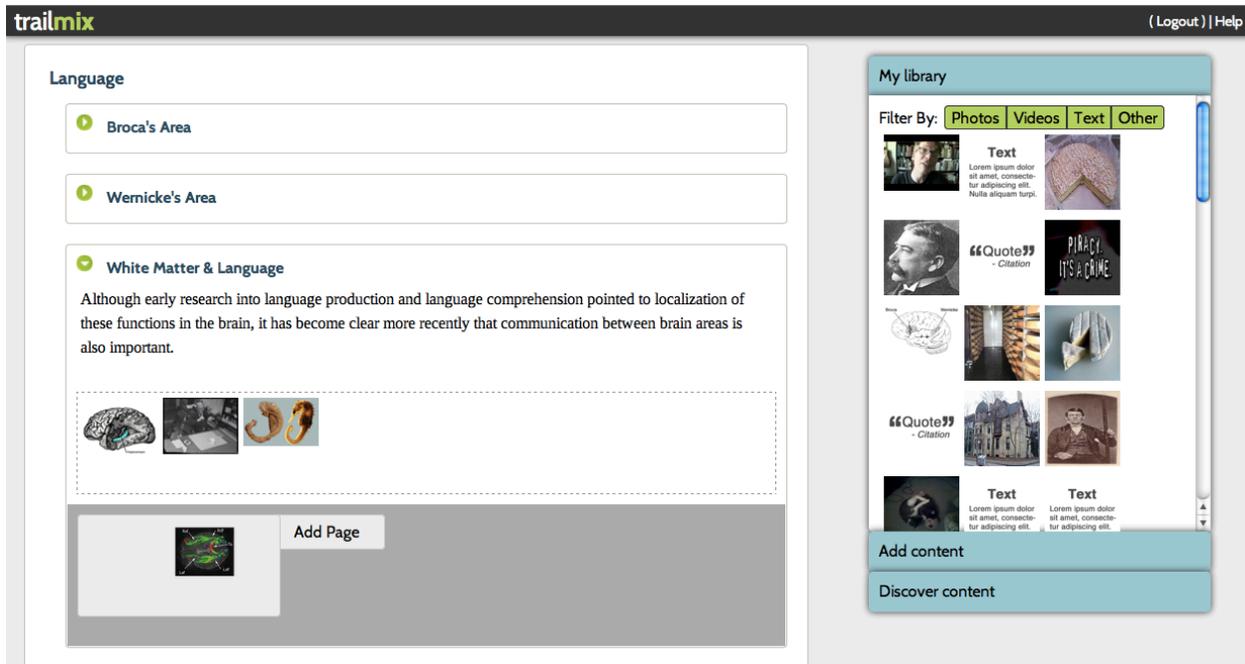


Figure 14 A lesson outline with content in a topic

### Content library and bookmarklet

We designed *trailmix* so that it would be easy to add content to the system throughout the course and lesson design process. As various instructors had different systems for organizing and finding content for their courses, we wanted to offer multiple ways to do this in *trailmix* as well.

Instructors we interviewed described their current systems for collecting materials for class. One instructor noted that she uses Evernote to save materials for class and tags content to indicate how she plans to use it. Another instructor compiles a Word document throughout the process of course design, in which she copies media and links and keeps careful track of source information.

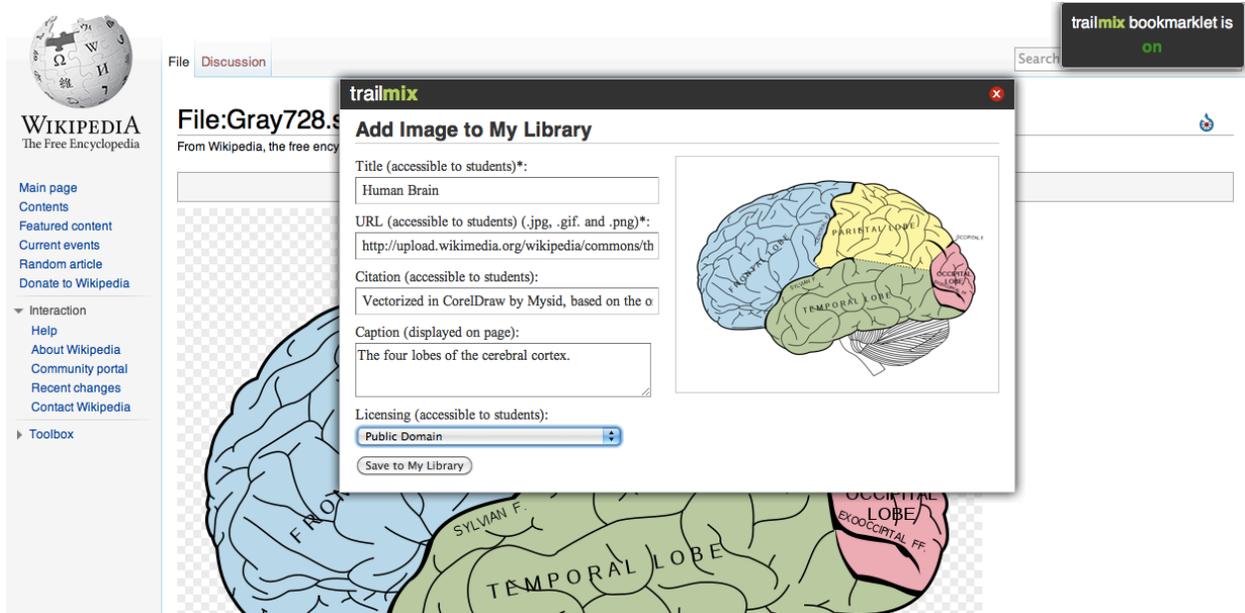


Figure 15 Using the bookmarklet to save an image in Wikipedia

The bookmarklet makes it easy to add content from a variety of websites—though most consistently with our suggested sites—while doing general web browsing from a browser. In usability testing, one online instructor found the bookmarklet extremely useful: “The bookmarklet is awesome, because that means that when I happen across something and think it would be really great for my class, it would be easy just to put it in and have it saved. That is really nice.”

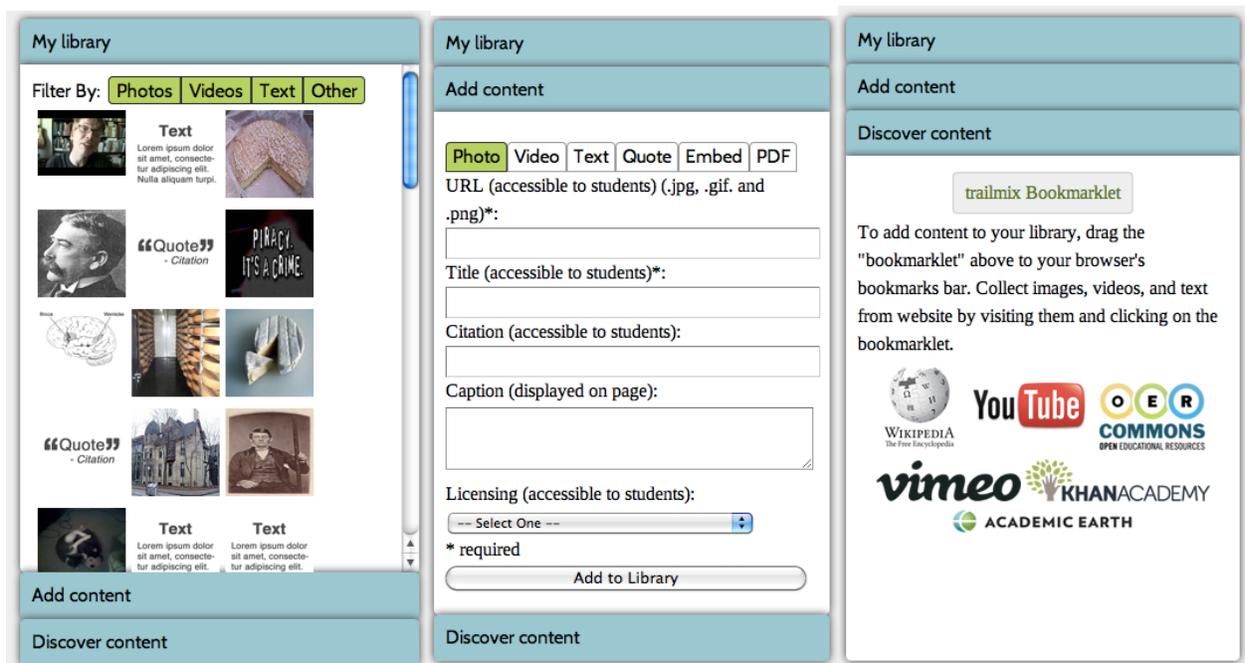


Figure 16 My Library, Add Content, and Discover Content sections

The My Library, Add Content, and Discover Content tools allow instructors to add content at any stage of the process.

My Library section stores content that has already been added to the system. Content can be dragged from the library and dropped onto a topic or a page. Instructors can access and modify metadata from the library (see more details in the metadata section below).

In the Add Content section, users can link to an image URL, embed videos, write text, insert a quote, embed HTML, or link to a PDF. While it is not possible to upload content in the current prototype, this would be essential in a fully functional system.

Within the Discover Content section, *trailmix* currently links to suggested popular content resources. A future version of *trailmix* should allow instructors to search within the tool itself. We particularly like Storify's interface for searching a limited number of sources for content and then being able to drag results directly into the story. We would like for instructors to not only be able to search outside repositories but also content added and used by other *trailmix* creators when the content owners have designated that content as public.

### Copyright

In our research, we found that instructors are uncertain about how copyright affects their use of media materials. Most instructors are not sure about the specifics of copyright law but feel like what they are doing is within the law. One online instructor described her lack of knowledge about copyright as an advantage: "I have the advantage of not knowing exactly what the law means."

Some instructors use password protection to avoid significant exposure to copyright infringement. One instructor felt that keeping materials password-protected was probably enough protection in case she was breaking copyright laws. This instructor does try to keep copyright in the back of her mind when she is choosing materials but feels like she does not know much about openly accessible materials online: "Knowing what, when, and where you might need permission to use something...that's something always on the back of my mind, I know so little about copyright materials and openly access materials."

One face-to-face instructor responded that he does not often upload content written by others on his website and so did not feel that it was an issue for him. He generally uploads handouts that he writes or links to external materials or websites. At times when he did upload published articles by other authors, he did not go out of his way to seek permission or confirm that it was within the law. He stated that, "It hasn't impacted me, yet. In principle, it's an issue."

When linking content within *trailmix*, we ask instructors to select a licensing option (though not required). Instructors can select a Creative Commons licensing option, public domain, their own copyright, someone else's copyright, or other. In a future iteration of *trailmix*, users will be able to upload their own content. In this situation, we will require users to select a licensing option as well as affirm that they have the right to upload this content.

In the current system, users can link to material that is only accessible using authenticated university system, but users who are outside of the library system or do not have a proxy set up will not be able to load that content. A future version of *trailmix* would have a more sophisticated method for authentication and notification to users about material that is only accessible with university authentication. Because universities employ a wide variety of authentication systems, this feature would need to be configured based for various authentication scenarios.

### **Metadata**

We feel it is important for instructors to have the option to add metadata to the content in their libraries, for the purposes of finding their own content, allowing their content to be found by others (in future version of the system), and for communicating to their students where the content came from.

*trailmix* imports metadata from the content source as much as possible, such as capturing the URL in the “source” field when content is added through the bookmarklet. We make it clear to the instructor how metadata will be displayed in the system. We decided to share licensing information with students at the suggestion of one online instructor: “[you should] build into the structure an awareness on the part of the students” so that students understand how copyright comes into play.”

### **Course and lesson administration**

We intend for *trailmix* to be used as one component of a course management system. Ideally *trailmix* would interoperate with existing class administration within these systems. We do not delve deeply into role administration for the purposes of this prototype, but we do provide functionality for creating courses within the system and lessons within those courses.

We envision that a course is a standard semester-long course associated with a class (students enrolled in that instance of the course). Within courses are lessons—the material that a student would follow to prepare for one session of the class. A lesson may be comparable to one week’s worth of work for a course that is structured by week.

Existing educational resource collections use various terminology to organize content groups. Connexions, for example, groups materials in self-contained modules. These modules can then be grouped into larger categories called collections.

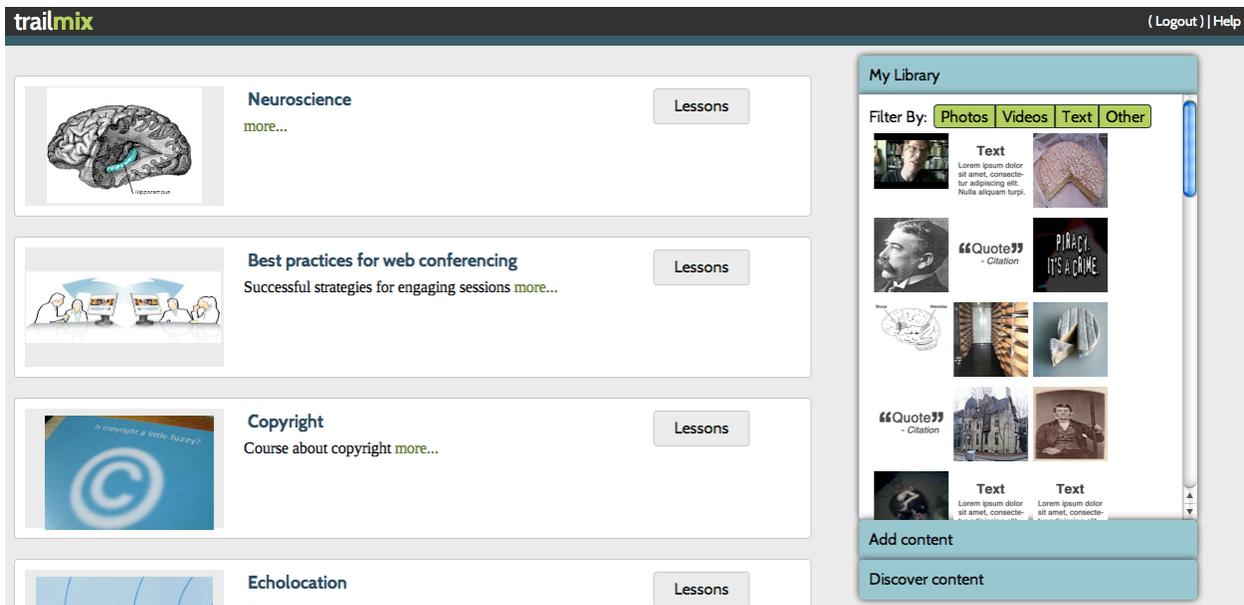


Figure 17 Sample course page

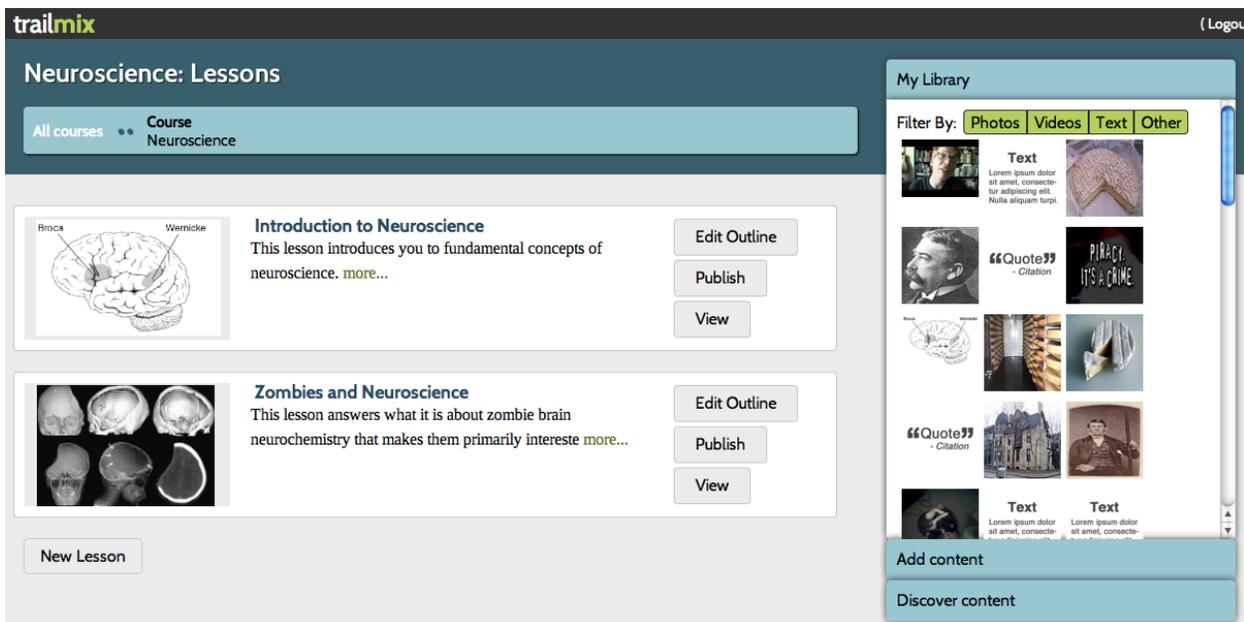


Figure 18 Sample lesson page

Each course and lesson has a title, description, tags, and contributors. The tags can be used by instructors themselves to describe their own courses, or in a future iteration of *trailmix*, for other instructors to discover courses on a particular topic. The contributor section attributes courses and lessons to those involved in its creation.

Connexions uses a similar model of attributing content to its creator. Although not built into the prototype, we envision that courses that are shared with a Creative Commons license can be copied and adapted by other instructors, and this functionality allows derivative authors to credit the original authors.

### *Openness of content*

Through our discussions with instructors, we have found that instructors want to be in control of not only whether their materials are shared, but also the granularity with which they are shared. We envision that in a future version of *trailmix*, courses and lessons would have the ability to be copied and remixed. This would give instructors a starting point to build from when designing lessons on similar topics as well as recommendations of content. We do recognize, however, that not all instructors want to share content that they have developed, so sharing would be “opt-in,” giving creators a choice between licensing options.

Some instructors indicated that they are happy to share their content. One instructor told us that she keeps her course materials online because she likes having access to others’ materials: “I like for my websites to be public, because I like for other people’s websites to be public. I like to be able to see what are people who are teaching something related to mine, what are they using, how are they doing it, what are their assignments, what are their readings, and I’m perfectly happy.”

Another professor mentioned that she occasionally uses materials posted on teaching websites but that she is protective about sharing her materials with other instructors at her institution. She particularly likes learning about how other instructors use media content in their classes such as how students reacted to specific videos, but she also finds “on the whole a lot of people tend to be pretty protective” of media because they are concerned that materials might be overused if they are shared within the institution.

Yet another professor told us that his website and course materials are public, but that he takes them down at the end of the semester. He avoids posting any solution sets online so that they do not become available to the general public and potentially future students.

This version of *trailmix* does not currently include the ability to administer who can and cannot see content, but a fully fleshed out product would include these elements.

## Outline

The screenshot shows the 'trailmix' interface for an 'Introduction to Neuroscience' course. At the top, there's a breadcrumb trail: 'All courses >> Course Neuroscience >> Lesson Introduction to Neuroscience'. Below this, the 'Objective' section contains the text: 'This lesson is designed to provide a basic overview of cognitive neuroscience.' The 'Introduction' section is titled 'Cognitive Neuroscience History' and features a list of topics, with 'Phineas Gage' added twice. An 'Add Topic' button is visible below the list. On the right side, there is a 'My Library' panel with a 'Filter By' menu (Photos, Videos, Text, Other) and a grid of content items including text, quotes, and images. At the bottom of the library panel are 'Add content' and 'Discover content' buttons.

Figure 19 Outline page

As mentioned above, we strive to encourage instructors to apply narrative-inspired pedagogical structures by suggesting a format of objective, introduction, body, and conclusion. Within these categories, *trailmix* allows educators to create two levels of hierarchy: sections and topics.

The design for the outline tool grew out of research with instructors about how they plan their courses. Two instructors we interviewed followed very different processes for building their course materials. One began by thinking about the course's learning objectives, then looking for textbooks and other materials to support those objectives, followed by creating a specific outline for the entire course. Occasionally she would look for new material while writing out the outline. Another instructor had a different process for creating courses; in fact, she commented that calling it "process is a little more formal than what it actually was." This instructor started by making a list of all of the things that she intended to include in the course, then researching new material published in the field and by professionals, then making a rough outline of the entire semester. She fleshes out lesson plans weekly during the semester. In fact, she likes online instruction because she has a flexible schedule for posting that week's material.

We designed the outline format to accommodate both methods of designing lessons. An instructor can spell out objectives first, then build out sections and topics, and then add content to each topic. Alternatively, an instructor can put content into blank sections and topics and play around with the order of content and design sections and topics around materials. In our usability testing sessions, we came across instructors with different preferences for building lessons. One instructor (whose courses use the blended learning format) mentioned that he was an "outline person" and built the outline for a lesson much before adding content or designing pages. Other online instructors showed an inclination to add media to the topics that they had added before continuing to build the outline. Our design aims to suitably accommodate both types of use.

We consider the outline tool, in conjunction with the page layout functionality, as a kind of template for creating a course. Other tools provide some kinds of templates for organizing material, such as Omega and Xerte Online toolkits. Prezi and Storify utilize drag and drop functionality for choosing content, which we adopted in this interface as well.

## Page layout

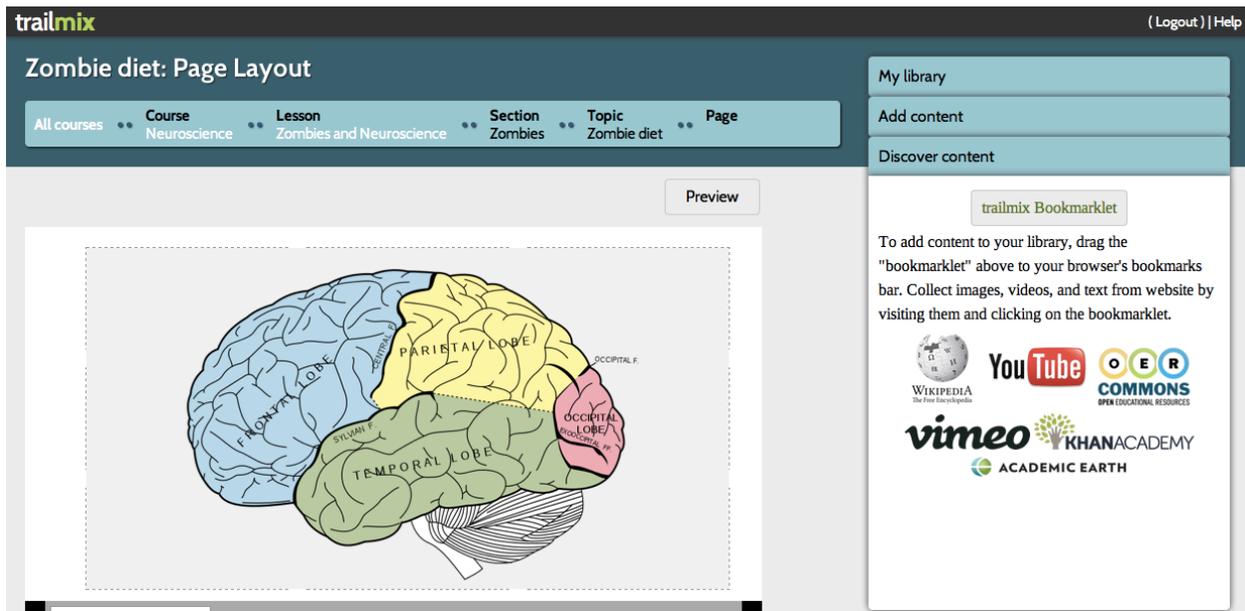


Figure 20 Page layout

For laying out actual content on pages, we strove to limit instructor's choices for the purpose of advocating strong design. Instead of offering color, font, and design choices that are often available (and abused) in presentation software, we present a pre-designed layout tool. The page is laid out using a 3x3 grid, and instructors simply drag content onto the page and select a size within the grid. The tool automatically sizes the content within the grid. This method takes away the instructor's need to make design choices and instead imposes a well-designed layout. Tools such as PowerPoint give instructors blank pages with unlimited options, and many instructors struggle to achieve the right visual design but end up squishing content on the page and using unreadable fonts that detract from the content itself. *trailmix* only asks instructors to decide what content goes on the page and what general size it should be. This allows the instructor to focus on organizing the content rather than acting as visual designers.

Learners find visual attractiveness of materials an important aspect of the online learning experience, but clarity and coherence are more crucial than content simply being pretty. Pomales-Garcia et al. comment, "In the context of learning, clarity is an important dimension as the information presented needs to be clear, simple, organized, accompanied with visuals, understandable and comprehensible, and grouped appropriately" (Pomales-Garcia, Lopez, & Liu, 2010). They also note that "that the way information is presented on a page does not just affect how pleasing it is to the eye but also affects the amount of time it takes to read it," which further supports our rationale for wanting content to be well designed. We aimed to follow this model of prioritizing well-organized content supplemented by visual design principles.

## Future Work

Because this version of *trailmix* is a highly functional prototype rather than a full product, there are many features that are desired but not built into the current system.

The current system does not include full role administration. Currently the system allows instructors to create usernames but not students. Eventually, this functionality would need to be created, particularly to implement various public and private desired functionality (see Privacy and Licensing details in the Appendix). Furthermore, we would like to limit Q&A participation to members of the same course. Again, this is not currently possible without being able to designate certain users as students.

Likewise, we would like to build our own commenting system so that we can implement it with all of the privacy features that we have designed. For the purposes of this prototype, we are using the third-party commenting tool Disqus; however, it does not provide the privacy and group functionality that we desire.

In a fully featured prototype, we also want to be able to insert additional content types, as well as functionality to modify content. We believe it would be useful to be able truncate videos and annotate images and videos.

We envision that a useful element of a fully functional prototype would be the ability to discover, build upon, and adapt other trailmix users' courses, lessons, and content. We believe that, for instructors who choose to share their materials using open licenses, there is significant value in being able to see how others have integrated multimedia in their lessons. Furthermore, we would consider implementing a rating system to make it easier for instructors to discover strong content within the system. The system could also suggest content that other instructors have used based on similar topics.

We considered whether it would be worthwhile to include analytics for instructors about how many (or which) students had viewed materials and how long they had spent on certain pages. Some existing online learning platforms include this feature, and some online instructors base participation grades on this information. In our user research, we heard from some instructors that this information is not particularly useful to them because of students' ability to game these systems. One professor commented, "I think it's not easy to make [analytics] reliable and easy... Students know those methods and game them rather severely." On the other hand, some instructors thought that these types of metrics could be used to refine courses over time, and to encourage instructors to make their courses available to more students. Favorable analytics could conceivably be an asset to professors attempting to gain tenure.

Several instructors did mention a desire to include some form of assessment such as quizzes—whether for self-assessment or graded assessment—within the lesson. We did not design for this within this version of *trailmix*, though this is worth considering for future versions.

Furthermore, we did not address accessibility standards or SCORM (Sharable Content Object Reference Model)<sup>8</sup> compliance in this prototype. These standards would need to be addressed before this tool can or should be used in educational courses. However, we lack the expertise or time to undertake compliance for the purposes of this prototype.

## Conclusion

Our original idea for *trailmix* was to make it easy for online instructors to arrange media content using a narrative structure. As we interacted with online instructors and students, read literature, and studied competitive products, our understanding of the challenges—and opportunities—within online education helped us refine our concept and design. This project allowed us to deepen our understanding of the needs of the end users and the context this tool would be used in, and these insights are reflected in our final prototype.

*trailmix* makes it easy for instructors to curate media and organize it into a cohesive learning path while guiding students to understand and link important concepts. Students can access unified content in a format that is simple to navigate and accessible from various devices. We believe that this tool meets many of the needs of both instructors and students and this growing learning environment.

One instructional designer, after playing with an early prototype, reported that he sees significant need for a tool like *trailmix*: “It seems like a really nice application of blending and remixing of stuff, and I don’t think that our current ways of consuming and creating media are quite caught up with that ... If you can make this easy, then I think this will really move the bar in that whole space.”

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<sup>8</sup> [www.adlnet.gov/technologies/scorm/scormdocuments/scorm%20resources/resources.aspx](http://www.adlnet.gov/technologies/scorm/scormdocuments/scorm%20resources/resources.aspx)

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## Appendix

### Participants

#### Participatory Design

We began with a participatory design session with four individuals—two graduate students with teaching assistant experience, one post-doctoral researcher with extensive teaching experience, and one tenure-track professor at a teaching university.

#### User Research

We conducted in-person or phone interviews with the following participants:

- three online instructors
- three face-to-face instructors who supplement courses with online tools
- one graduate student instructor of an online course
- an instructional designer from UC Berkeley Educational Technology Services
- an instructional designer who creates an educational portal and content for a commercial enterprise

- five students who are currently enrolled in online programs or have taken online courses

### Paper Prototype Testing

We created a paper prototype of the student interface. We tested this prototype with four face-to-face students, one online instructor, and one online teaching assistant.

### Usability Testing

We tested a working prototype of the student interface with three online students.

We tested the low-fidelity Lesson Builder with three face-to-face instructors and one instructional designer.

We then tested an early version of the highly functional prototype with three online instructors and one face-to-face instructor. Two of these sessions were conducted using remote usability testing methods.

### Personas

Elaine teaches a course for the UC Online Campus. She used to teach a similar course face-to-face at UC Berkeley. Elaine created the course herself and planned the content. The course takes place over the length of a semester. Each week, students read written “lecture” material and articles. The class meets online synchronously twice during the semester using voice chat through the learning management system.

Elaine thinks of lecture as distinct from reading assignments. The lecture material is what she would have said when teaching students in a classroom, but in written format. She thinks of herself as a good writer, so she thinks that she can communicate the key concepts. However, she doesn't feel like she can gauge student reaction or understanding of material because she doesn't see students as they read the lecture. Elaine doesn't use a lot of visual media in her course but would be willing to use more if someone suggested something to her. She sometimes points students to websites to look at if they are interested, but she doesn't require it because she knows her students are busy.

Mark teaches one course for the UC Online Campus. He didn't create the course content himself—the content was created earlier by a course author. The course was designed around a textbook, which was selected by a committee. The textbook is central to the course—it contains a lot of dense information that would be hard to replicate. In addition to weekly reading assignments, students also use the textbook as a reference source, using the glossary at the end to learn terms and the index to find information quickly.

Mark's role as teacher is to administer the forum discussion, grade assignments, and answer questions. Mark holds weekly online office hours, where students can ask questions over instant message. The course is the length of a semester, and there is one module per week. A module consists of a videotaped lecture (from an identical face-to-face class a previous semester) and reading from the textbook. Every week, students are required to write a post in response to a forum topic. These questions require some kind of synthesis of the reading material. The course never meets synchronously, so these forum assignments give Mark a chance to see if students are on target.

Mark doesn't have much flexibility to change the course content. The course is similar to a course that is taught face-to-face, and all of the content needs to be comparable. Occasionally Mark uses the discussion forums as a chance to bring in materials from the Internet like videos or blog posts to make

the material more relevant to current events. Mark finds it really time-consuming to look through all of the students' forum posts. He also has trouble figuring out students' personalities. Sometimes students seem rude during office hours, but this might be how they come across online.

## Competitive Analysis Resources

### Open Educational Resource Repositories

Connexions: <http://cnx.org/>

Merlot: <http://www.merlot.org/merlot/index.htm>

OpenLearn: <http://openlearn.open.ac.uk/>

### Organizing Educational Content

Haiku: <https://www.haikulearning.com/features/connect>

Omeka: <http://omeka.org/>

Udemy: <http://www.udemy.com/courses>

Xerte Online Toolkits: <http://www.nottingham.ac.uk/xerte/>

### Presentation Tools

Prezi: <http://prezi.com>

Viddix: <http://www.viddix.com/>

Vuvox: <http://www.vuvox.com/>

### Visual Search and Curation Tools

Keepstream: <http://keepstream.com/>

Microsoft Research Digital Narratives: <http://www.digitalnarratives.net/>

Projeqt: <http://projeqt.com/>

Qwiki: [www.qwiki.com](http://www.qwiki.com)

Storify: [www.storify.com](http://www.storify.com)

Storybird: <http://storybird.com/>

## Privacy and Licensing Guide

Although all of our desired privacy and licensing functionality is not present in the current prototype, we created a guide to how we envision privacy and licensing would work in a functional system.

### Philosophy

**Public or Private:** We believe that it should be easy to share courses, lessons, and content with other instructors and learners, but we also think it should be easy to limit access to your own class. We want to make it as easy as possible for others to discover and reuse your materials, but only if that's what you want.

**Private Class-Based Information:** We believe that student names and interactions should be limited to their own class. We believe that students will feel more comfortable, and receive more relevant responses, by asking their peers and their instructor questions rather than the general public.

**Content Licensing:** We aim to make it easy for instructors to make smart decisions about using content with various licenses. We want to encourage instructors to use openly licensed material (and contribute their own materials with open licenses), but we also make it possible to designate material under copyright, either the contributor's own copyright or someone else's. We believe that there are some instances in which using someone else's copyrighted material in the context of education falls under fair

use guidelines. However, we want users to follow all laws and regulations regarding copyright, so we ask users to confirm that they believe that their usage of copyrighted materials falls under fair use guidelines before publishing content publicly.

**Authenticated Resources:** We know that a lot of instructors use licensed materials that students can access only through their university's authentication system, so *trailmix* supports this functionality. These materials are only accessible to students who are using their university's authenticated system.

## Courses

### *Private or Public*

Private means that no one but you, fellow instructors, and students that you designate to have access to the course can view the course descriptions and list of lessons.

Public means that anyone visiting *trailmix* can view your course title, course description, and the titles, descriptions, and order of your lessons. Even if a course is public, class-based information (names of students, comments or questions in Q&A section) is never public.

### *Licensing*

You can select a licensing option for your course: All Rights Reserved or a Creative Commons license (Attribution, Attribution-ShareAlike, or Attribution-NoDerivs)<sup>9</sup>.

Only you and fellow instructors can make changes to your course or class information. If you select Creative Commons Attribution or Attribution-ShareAlike, others can make copies of your course that they can edit and share with their own classes, and your name will be listed as a contributor.

Selecting a license sets your lessons to default to that licensing option when published, though you can always change whether individual lessons are private or public when publishing. You can make an individual lesson private even if your course is public (and vice versa).

## Lessons

### *Private or Public*

Private means that no one but you, fellow instructors, and students that you designate to have access can view the content of that lesson.

Public means that anyone visiting *trailmix* can view the content of your lessons. Even if a lesson is public, class-based information (names of students, comments or questions in Q&A section) is never public.

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<sup>9</sup> We don't include non-commercial options for Creative Commons because there is debate whether many education institutions, such as private schools, fall under the non-commercial category (<http://www.oerafrica.org/copyright/CreativeCommonsLicense/CriticismsOfTheNonCommercialClause/tabid/1282/Default.aspx>)

## Licensing

You can select a licensing option: All Rights Reserved or a Creative Commons License (Attribution, Attribution-ShareAlike, or Attribution-NoDerivs).

If you have included content that is only available using your university's authentication process (such as a library proxy), those materials will only be available to people using the authenticated network.

Only you and fellow instructors can make changes to your lessons. If you select Creative Commons Attribution or Attribution-ShareAlike, others can make copies of your lesson that they can edit and share with their own classes, and your name will be listed as a contributor.

## Content Licensing

We attempt to capture as much licensing information as possible when content is saved in *trailmix*. The user can select between the following licensing options: Creative Commons (Attribution, Attribution-ShareAlike, or Attribution-NoDerivs, Attribution-NonCommercial, Attribution-NonCommercial-ShareAlike, Attribution-NonCommercial-NoDerivs), Public Domain, Copyright (mine), Copyright (someone else's), or Other.

When saving content using the bookmarklet, using an image URL, or embedding HTML, licensing information available in a machine-readable format is captured automatically. Users can manually select licensing information if it is not captured automatically. In this scenario, selecting licensing information is not required but encouraged because the content is simply linked or embedded and not stored within the system.

When uploading content, users must enter their own licensing information. *trailmix* requires the user to select a license in this case because content is being stored within our platform. Users must also affirmatively select "I believe that I have the right to upload and distribute this content."

For content created within the system, such as text material or narration, we do not require the user to affirmatively state that they have the right to use this content, though we do state that any material created within the system must be your own work within the terms of service. Furthermore, when a user publishes a lesson that will be public, the system asks the user to affirm that he or she believes that content used within the system confirms to fair use guidelines.