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A Usability Assessment of the Engineering Pathway Educational Digital Library

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A USABILITY ASSESSMENT OF THE ENGINEERING PATHWAY EDUCATIONAL DIGITAL LIBRARY

By

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Executive Summary

The Engineering Pathway digital library, www.engineeringpathway.com, is a portal to high-quality teaching and learning resources in engineering, applied science and math, computer science/information technology, and engineering technology. The website is designed for use by K-12 teachers, university educators, and students. Engineering Pathway is a combined effort of NEEDS.org and TeachEngineering.com to provide a more complete digital library of engineering education materials for all education levels.

The TeachEngineering digital library, www.teachengineering.com, provides teacher-tested, standards-based engineering content for K-12 teachers to use in science and math classrooms. Engineering lessons connect real-world experiences with curricular content already taught in K-12 classrooms. Mapped to educational content standards, TeachEngineering's comprehensive curricula are hands-on, inexpensive, and relevant to children's daily lives.

The goals of this study were to:
- Assess needs of K-12 teachers
- Assess usability of K-12 portion of Engineering Pathway website
- Assess usability of TeachEngineering website

Four methods were used to conduct this study. A competitive analysis was done to identify the key competitors of Engineering Pathway and to compare them to the website. A heuristic evaluation was done as an initial assessment of the usability of the Engineering Pathway website. In order to assess the needs of K-12 teachers, interviews were conducted. Lastly, usability testing was employed to evaluate the usability of the Engineering Pathway and TeachEngineering websites, in order to assess the users' overall experience and impressions of the websites.

This report focuses on the usability testing portion of the study. Several recommendations are made at the conclusion of this report to improve the navigation, search functionality, and organization of the Engineering Pathway and TeachEngineering websites to better suit the needs of K-12 teachers. In addition, several recommendations and improvements that can be quickly addressed are listed on page 35.

Introduction to Study

Engineering Pathway and TeachEngineering

Engineering Pathway is a portal to high-quality teaching and learning resources in engineering, applied science and math, computer science/information technology, and engineering technology for all levels (K-gray). K-gray includes K-12 education, higher education, and continuing education (education outreach and professional societies). Engineering Pathway's goal is to provide resources that help teachers, parents, faculty, and practicing engineers to inspire more of today's students to follow an engineering path as their way to understand and improve the world. Engineering Pathway is sponsored by the National Science Digital Library (NSDL). This project is funded by a grant from the National Science Foundation (NSF) to establish a digital library containing engineering education resources. The collection contains about 25,000 cataloged entries and went live in November of 2005.

Engineering Pathway is a combined effort of NEEDS.org and TeachEngineering.com to provide a more complete digital library of engineering education materials for all education levels.

TeachEngineering's vision is to use engineering as a vehicle to integrate science and math in K-12 classrooms through inquiry-based curricula and hands-on activities that demonstrate the creativity of engineering and are relevant to the lives of youth. TeachEngineering is the K-12 sister site to Engineering Pathway. When searching the K-12 portion of Engineering Pathway, many of the resources found are contained in the TeachEngineering collection.

Goals of Study

The goals of this study were to improve the K-12 component of the Engineering Pathway website. A needs assessment of K-12 teachers was conducted in order to understand how Engineering Pathway and TeachEngineering could best meet those needs. The usability of the K-12 component of the Engineering Pathway website as well as the usability of the TeachEngineering website was also \investigated.

Methods

The four methods used for this study are described below:

- **Competitive Analysis**
  The goal of the competitive analysis was to identify the key competitors of Engineering Pathway, determine the key attributes, and then compare them to each other as well as the Engineering Pathway website.

- **Heuristic Evaluation**
  The goal of the heuristic evaluation was to assess the usability of the Engineering Pathway website. From this assessment, potential usability problems were discovered.

- **Interviews**

  The purpose of the interviews was to understand the needs of K-12 teachers. The interviews focused on what resources teachers use, where they find those resources, how they share resources, and how they evaluate the resources.

- **Usability Testing**

  The purpose of this method was to assess the usability of the Engineering Pathway and TeachEngineering websites. During the usability testing users searched, submitted, and viewed resources. The users' overall experience and impressions of the websites was also addressed during the testing.

The competitive analysis and heuristic evaluation have been previously conducted (I214 final report: S. Robinson, J. Mangold, and A. Favor). The interviews have also been previously conducted (J. Mangold: Masters Report May 2008). The following report discusses the usability testing conducted during this study, the goals, and the findings.

Layout of Report

Throughout the report user quotes are italicized and boxed for easy reference. At the end of the report recommendations are outlined as well as suggestions for further study.

Usability Testing

Goals
The main goal of the usability testing was to assess the usability of both the Engineering Pathway and TeachEngineering websites. The specific topics that were addressed in the usability testing are related to each user's personal real-time experience on the website. The goal of the testing was to find out how useful the website was and how easy to use and understand it was. By assessing the usability of the websites, this would help to make recommendations to the Engineering Pathway group so that they can create a website that is specific to the needs of K-12 teachers.

Participants
Usability testing was conducted with six K-12 teachers in the Bay Area, more specifically middle and high school teachers (grades 6-12) currently teaching math, science, or computer classes. These teachers curriculum is more relevant to engineering education resources than those in elementary school. Usability testing was also conducted with graduate students in the school of education and Graduate Student Instructors (GSIs) in the computer science department; both groups from the University of California, Berkeley. The education students all had K-12 teaching experience; mainly in math, science, and the liberal arts and had a low-to-medium computer proficiency level. The GSIs did not have any K-12 teaching experience, but had teaching experience in the computer science department at the undergraduate level and had a high computer proficiency level. Prior to the usability testing, all test participants had never heard of Engineering Pathway or TeachEngineering before. A description of the usability testing participants can be found in Appendix A.

Process and Topics Covered
Each usability test lasted for about 30-45 minutes. The usability test was videotaped to record any facial expressions and audio from the user and CamStudio was used to record the computer screen navigation. Two team members participated in each usability test, one person administered the usability test and the other member took notes. The usability tests were conducted at a location convenient to the participant. The following topics were covered during the usability testing and the usability testing guide can be found in Appendix B.

For the usability testing, the users did a think-aloud as they walked through the websites. To begin the test, users were given a scenario that a colleague had just e-mailed them the link to the Engineering Pathway and TeachEngineering websites. They were then asked to express their initial impressions of the Engineering Pathway and TeachEngineering homepages (e.g. what they thought the website was about and what they thought they would find there). Next users were asked to create an account and log into the site. The participants were then asked to conduct a passionate search (e.g. search for something that they would need for a lesson that they were creating for their class). The next task was for users to manage and add a

resource to "My Workspace." To conclude the test, users were asked to submit a resource to the Engineering Pathway website as well as the TeachEngineering website and logout.

Analysis

In order to analyze the usability testing data, coding methods were used to find themes and key findings throughout the usability testing notes and videos. The coding and analysis of the usability testing data can be found in Appendix C. These themes were used to develop the findings and recommendations. These findings and recommendations are discussed in the sections to follow.

Successes and Mixed Successes

Successes

Overall Impressions

Engineering Pathway – Is a high quality site
Users believed that Engineering Pathway was a credible website because of the sponsor logos that are displayed at the bottom of the homepage. Knowing that the site was sponsored by a reputable organization made them feel that they would find reputable material on the website. This also made users feel good about the overall quality of the site.

> **User #2:** *Supported by NSF – that looks good. I had more faith in it and less suspicion and higher quality than Joe Schmoe.*
>
> **User #5:** *I see the NSDL so I know that is a good thing, but I forget what it stands for, but I know it is a science thing.*

TeachEngineering – Is consistent
Users were excited about several aspects of the TeachEngineering website. Several users liked the standardized format for each lesson. Users also liked all of the information that was given about particular lessons, such as the time required, cost, grade level, and group size.

> **User #3:** *Wow, there is a lot of good stuff here. This is all printer-friendly so I can print resources out the way they are.*
>
> **User #4:** *So if you took them all and they were standardized, so they are all set up the same way, so I know where to look, so I don't have to search, I don't have to take as much time to figure how to navigate it.*
>
> **User #4:** *It's standard, so you look at it once and you know how to do it.*

Mixed Successes

What is Engineering Pathway?

Most users understood the general idea of Engineering Pathway (that it provided resources to bring engineering into the classroom), but they are unsure how it relates to them or how it can fit into their classroom since they do not teach engineering.

> **User #4:** *I think it is all physical science, because it says engineering instead of science pathway, but I guess it is also math, so math and physical science.*
>
> **User #1:** *I see education and K-12 a lot. I see the little kid. So I think it is a way to bring engineering into the classroom.*
>
> **User #2:** *Resources for kids and, wait, no, resources for educators, maybe?*
>
> **User #5:** *This is for engineering and I'm life sciences, so I wouldn't expect to find anything here. I don't teach engineering.*

Pictures

Engineering Pathway
Users had mixed reactions to the changing pictures on the Engineering Pathway homepage. Some users thought that the pictures were cool. Other users thought that the changing pictures were distracting.

> **User #3:** *Cool pictures*
>
> **User #2:** *I don't like that the picture changes every 3 seconds*

A lot of text

Engineering Pathway
Some users thought that the amount of text on the homepage was overwhelming and confusing. They also thought that it was a lot to digest. On the other hand, one user thought that the amount of information presented on the homepage meant that the website was promising and that it had a lot to offer.

Comments & Reviews

Engineering Pathway

Participants were very interested in seeing comments and reviews from fellow users. However, they could not find many resources that had populated comments or reviews.

For example: one user searched for slope, clicked on a search result, looked at a resource display page, saw "1 comment and 0 reviews", questioned how new the website was, saw "publication date: 1998" and thought that it was the publication date of the website when it was really the publication date of the resource.

Findings and Recommendations

Terminology

Engineering Pathway & TeachEngineering

Findings

- Users were not sure what several of the terms meant that were used throughout the website. Some of these are shown in the screenshots below.

Example Terminology on Engineering Pathway Homepage

Example Terminology on Engineering Pathway Homepage

Example Terminology on TeachEngineering "Resource Display" page

Recommendations

- Use terms that K-12 teachers would be more familiar with, and provide definitions for terms that may be ambiguous.

> ***User #1:*** *So research findings, is that like studies you've done?*
>
> ***User #2:*** *I don't know what broadening participation is.*
>
> ***User #5****: I don't know what these are AEE, IJEE [papers].*
>
> ***User #6:*** *What does lesson dependency mean?*

Navigation

Engineering Pathway

Findings

- Almost every user had trouble searching for K-12 resources.
  - Several users scrolled over the "K-12 Resources" button on the left navigation bar and then clicked on "Curricular Resources". The "Curricular Resources" page displays other websites that provide K-12 resources. Users expected to be able to search for curricular resources, but instead were provided with alternate websites. This also added to the confusion about what the purpose of the website is; one user assumed that it just recommended other websites that have K-12 resources.

  - One user was unsure of how to search for K-12 resources and went to the site map. After viewing he was still unsure and decided to just use the "Quick Search" box in the upper right hand corner of the homepage.

Navigation options on Engineering Pathway Homepage

"Curricular Resources" page on Engineering Pathway

K-12 homepage on Engineering Pathway

Recommendations

- Make it easier to search K-12 resources.
  - For example, on the K-12 homepage move the "Search K-12 Curricula" box higher up on the page. (See above)

- Keep users on the Engineering Pathway website.
  - The "Curricular Resources" page currently contains links to other websites that have K-12 engineering resources. This page should have the K-12 search field as the main focus and the suggested websites should be provided under a "favorite's" page.

> **User #1:** All these are buttons? [on the left side navigation bar]
>
> **User #2:** So I went to a site map which for me is easier. Often I go to quick search then I find it isn't the right place to go.
>
> **User #5:** I would probably go to K-12 resources and then to curricular resources. Being life science, I probably wouldn't click on NASA or engineering, or the Robo lab. My class isn't really about building or engineering, so that probably wouldn't be applicable to me.

TeachEngineering

Findings

- On the TeachEngineering homepage, several users used the "Browse" link to see what types of resources were in the collection. The "Browse" link on the bottom of the homepage is linked to the "Browse Standards" page (not the "Browse Curriculum" page). Users spent an average of three minutes trying to determine what page they were on and how they got there.

"Browse" link on TeachEngineering Homepage

"Browse Standards" page on TeachEngineering

Recommendations
- Make the "Browse" link direct users to the "Browse Curriculum" page

> *User #5:* I guess I am looking at the standards; that is a little misleading.
>
> *User #6:* How would I, oh these are all standards though, these aren't lessons. Hmmm… this isn't lessons; I thought it was going to be looking for activities.

Search

Engineering Pathway

Findings
- When users searched for resources, the "Search Results" display page showed resources that were not relevant to the subject that the user was looking for.

- o For example, one user "quick searched" for cells as a 7th grade life science topic and some of the top hits were fuel cells and cell phones.

- On the "Search Results" display page, users were unclear how the search results were ranked.

- Users did not know how many total search results there were after completing a search.
  - o For example, on the "Search Results" display page, users assumed that the number of search results from the NSDL were the total number of search results found on Engineering Pathway.
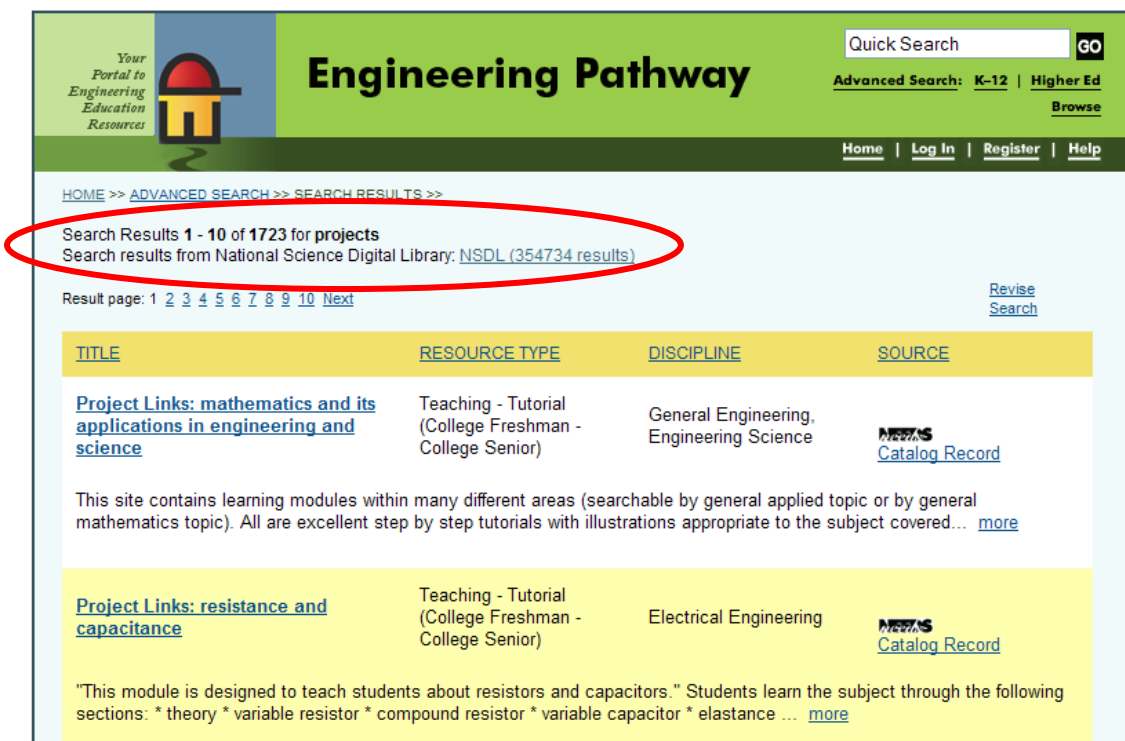
"Search Results" display page on Engineering Pathway

Recommendations
- Make search results more relevant.

- Give users tips on how to perform a search that will result in resources that are more relevant to their search.

- Provide users information about how the search results are ranked.

- On the "Search Results" display page, make the number of search results from Engineering Pathway more apparent than the search results from the NSDL.
    - For example, relocate the search results from the NSDL away from the number of search results from Engineering Pathway.

> ***User #6:*** *Why is this resource listed at the top of the list, is it like Google?*
>
> ***User #6****: Oh, there are 354,000 results, that's a lot.*
>
> ***User #5:*** *So it looks like it is engineering, I guess it popped up because its cell phone.*

Teach Engineering

Findings
- Search results not relevant
    - One user searched for "cells" and the resources that appeared were not related to cells at all; some of the top hits were for fuel cells and cell phones.

- Unsure how search results were ranked
    - One user searched for "cells" and the top hit of the search results appeared to be selected because it had the keyword "cells" in the description (only twice), but the result had nothing to do with an activity on cells
    - It appears that the search results are ranked alphabetically, not by relevancy to search keyword(s).

- Users did not click on "see details" to view all search results
    - When users searched, they thought that the results that were shown on the "Search Results" display page were all of the results available. Users did not realize that there were actually more search results and that they could click "see details" to see the entire list of search results. Because of this users made their decision based on which resources were immediately displayed.
    - Users also did not realize that clicking on "see details" would allow them to see a listing of all of the details about the results.

Recommendations
- Improve relevancy of search results

- Rank results by relevancy to search criteria

- Make it clear that there are more search results than listed on the initial "search results" display page

"Search Results" display page on TeachEngineering

Quick Search

Engineering Pathway

Findings

- Every user used the "Quick Search" box to search for resources.
  - This was done when users had trouble finding a way to search the Engineering Pathway site using the left navigation bar.
  - Several users automatically used the "Quick Search" box to search for resources, because they were familiar with using it from searching on other websites.
  - One user searched for "genetics" using "Quick Search" and all of the results were either case studies or higher education resources. She (a K-12 teacher) then felt that this proved that Engineering Pathway was not the website for her.

- Users became frustrated when the "Quick Search" results were too broad and not relevant to what they were looking for.

"Quick Search" box on Engineering Pathway Homepage

Recommendations

- Make it easier for users to find alternate ways to search for K-12 resources on the homepage instead of having to use "Quick Search".

> *User #2:* Often I go to quick search, and then I find it isn't the right place to go.
>
> *User #5:* Actually it looks like this stuff is not very useful, there is six pages of it, so it says case studies, college students, and this is the kind of thing that there is so much to wade through so if I don't see it on the first page I don't know if it is going to be helpful to me.

Advanced Search

Engineering Pathway

Findings

- When using the "Advanced Search" at the top of the homepage, users were unsure about what to enter into several of the search fields, because it was linked to a combined advanced search (both K-12 and higher education).

- For example, some of the fields that teachers were unsure of were: "Discipline", "Resource Type", and "ABET Outcome".

- Users do not realize that there is a specific "K-12 Advanced Search".
  - For example, users clicked on the "Advanced Search" link in the top right corner of the homepage, instead of clicking on the "K-12" advanced search link.

- The "K-12 Advanced Search" page default searches over the grade range "PreK-K" through "PreK-K."

"Advanced Search" links on Engineering Pathway Homepage

"K-12 Advanced Search" page on Engineering Pathway

Recommendations

- Clarify separate advanced search options for the entire sire, K-12, and higher education.

- Change the "K-12 advanced search" page to search across the default range "from grade PreK-K through grade 12."

> *User #5: Looks like I can do an advanced search and I can fill it all in. (Searched for genetics and demonstration) And there are no results, so it looks like there is not a lot. It's engineering and I'm life science so I'm not really surprised.*

Resource Display Page

Engineering Pathway

Findings

- When users were on the "Resource Display" page, they were unsure how to view the resource. After searching the page, they assumed that they had to download it to their computer.
    - Users did not realize that they had to click on a link to view the resource.

    - Next to the resource link the label was titled "Download URL"; users thought that they had to download the resource to their computer.

    - Users expected the picture (thumbnail of the resource) to be clickable

- After struggling with how to view the resource, one user went to the "First Time Users" page, but was unable to find information about how to view the resource.

- Once users figured out how to view a resource on Engineering Pathway, they were surprised when they were directed to a website other than Engineering Pathway. Users then had difficulty getting back to Engineering Pathway.

"Resource Display" page on Engineering Pathway

Recommendations

- Provide users with clear information on how to view the resource.
  - For example, one way to do this would be to use a more descriptive title than "Download URL", such as "Click Here to View Resource".

- Allow users to click on the thumbnail of the resource to view the resource (link the thumbnail to the resource).

- On the "First Time Users" page, clearly explain how to view a resource. One way to do this is to add it to the "Frequently Asked Questions" page.

- Clearly notify users that they will be navigating away from the Engineering Pathway website when viewing resources. This could be done with a disclaimer or notification on the resource page.

User #2: To see it, it is not exactly clear what you have to do. So I guess I have to download it, that's the URL... (Clicked on more information about resource and nothing came up.) (Clicked on first time users and couldn't find anything.) I'm stumped on how to see the resource and I'm not sure what to do. I could download the URL and see what happens.

User #4: I was kind of surprised it took me to an outside link. So it looks like this is a place where you look at other lessons that are already online and they kind of put them together in the same spot.

TeachEngineering

Findings

- Users were frustrated with the presentation of information on the "Resource Display" page.
  - Users were confused about the hierarchy of information
    - They thought that the information most relevant to the current lesson should be highest on the page.
    - Users could not find the attachments and procedure of the lesson or activity.

  - The users were overwhelmed with the amount of text on the page and the long scroll needed to view the entire lesson.

  - User's eyes skipped over the summary at the beginning of the lesson because all of the summary information was too close together.

- For example, several users suggested that a summary of what the lesson was about be created and did not realize there was already one there.

- Users do not want to spend a lot of time looking through materials to find what they want. They want to be able to quickly see if this is what they need.
    - For example, one user wanted to be able to see thumbnails of attachments so they could quickly get a feel for what the activity would involve.

"Resource Display" page on TeachEngineering

Recommendations
- Re-order the information on the "Resource Display" page
  - Put the most relevant information at the top of the page
  - Move the related curriculum and standards towards the bottom of the page

- Reduce the amount of text on the "Resource Display" page.
  - One way to do this would be to use links to display additional information about the lesson.

- In the summary box, add spaces to separate text in order to make it easier to read.

> ***User #6:*** *The scroll bar is so small and long. How much is here?*
>
> ***User #5:*** *I don't have time to look through all of this.*
>
> ***User #6****: Where is the lesson? Let's see... will you help me out? I see the summary, but I can't see… I keep scrolling down… oh there it is… I see…long scroll, huh?*
>
> ***User #5****: There is so much writing and I have to sit here and read through a lot. It looks really daunting. Have the lesson at the top and the supplemental stuff separate at the bottom. To have all of that before the activity is a lot.*
>
> ***User #6:*** *I saw "related curriculum" so I was already thinking about clicking on something else, then I saw "educational standards", and then this is where the lesson starts. I think for the layout I would put introduction, motivation, the picture, and related curriculum. As a teacher if I'm looking for a lesson, I want to get a sense for what the lesson is about*
>
> ***User #6:*** *Get the recipe first and then what you need at the bottom.*

Submitting Resources

Engineering Pathway

Findings
- It is not clear to users that in order to submit a resource the resource must already be located online. Most of the users were expecting to be able to upload documents that they created.

- Users thought that the "Submit Resource" page was very long. They were unclear exactly how many pages long it was.

- On the "Submit Resource" page, there is a button labeled "continue", this button actually previews the submission.
- On the Submit Resource" page, there is a button labeled "create new learning resource", this button actually submits the resource.

- Once a resource has been created, the owner cannot remove it or delete it from Engineering Pathway.

"Submit Resource" page on Engineering Pathway

"Submit Resource" page on Engineering Pathway

"Submit Resource" page on Engineering Pathway

Recommendations

- Make it clear to the users that in order to submit a resource they must have a URL where the resource is located, before they fill out the information about the resource on the submission form.

- Consider allowing users to upload files.

- Rename buttons on resource submission page:
  - "continue" → "preview submission"
  - "create new learning resource" → "submit new learning resource" or "finish"

- Enable users to remove or delete resources that they uploaded or created

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User #5: *If I have a worksheet that I have to upload it says there is a URL so if the worksheet isn't already somewhere else I guess you can't do it.*

TeachEngineering

Findings

- Users were discouraged when trying to submit a resource, because there are no clear instructions about how to do so and they have to e-mail for this information.

"Submit Curriculum" page on TeachEngineering

Recommendations
- Provide clear instructions about how to submit a resource.

> ***User #5:*** *So then I would download a template for that. So that tells me what information I need to have so it is standard with all the other ones. It tells me what format to put it in and then it says to learn more about the process to e-mail us with your questions, it doesn't really say how to submit them, so I guess I would e-mail and say I have a question and ask them how to submit them*

My Workspace

Engineering Pathway

Findings
- When viewing the "My Workspace" page, all of the saved resources and links are hard to distinguish from each other.

- There is no way for users to organize or sort their saved resources on the "My Workspace" page.

- When viewing a resource that is already saved to the "My Workspace" page, it still shows a button saying "Save to Workspace".
  - This created confusion among users as they were unsure if they had successfully added the resource to their "My Workspace" or not.

"My Workspace" page on Engineering Pathway

"Resource Display" page on Engineering Pathway

Recommendations

- Add a line of space between the saved resources and links

- Change the "Save to Workspace" button to "Remove from Workspace" or gray out the button so it appears to not be an option (since it is already saved)

- Allow users to organize or sort their saved resources. One way to do this would be to sort them by:
  - Title
  - Subject area
  - Date added

Quick Fix Recommendations

Several recommendations can be addressed quickly to improve the usability of the Engineering Pathway and TeachEngineering websites, they are shown below.

Engineering Pathway

Terminology
Use terms that K-12 teachers would be more familiar with and provide definitions for terms that may be ambiguous. Consider revising the following terms: research findings, AEE, and IJEE papers.

Navigation
On the "K-12" homepage, the "Search K-12 Curriculum" should be moved higher up on the page to improve visibility (above the fold line). The box that contains the link to the "ASEE website" should be moved to the "Curricular Resources" page that contains suggested website links that have K-12 teaching resources.

K-12 "Curricular Resources" page
When navigating to the K-12 "Curricular Resources" page, all users expected to be able to search for K-12 curricular resources from this page. The page currently displays other websites that can be used to search for teaching resources. The title of the page should accurately reflect the material of the page.

Advanced Search
Clearly distinguish between the "Advanced Search", "K-12", and "Higher Ed" links. It is not clear to the users that these links are clickable. Consider removing the combined "Advanced Search" link and only keep the "K-12" and "Higher Ed" advanced search features.

On the "K-12 Advanced Search" page the default search fields are "Pre-K" through "Pre-K". When users search for specific topics related to higher grade levels they were frustrated that there were no results and did not realize that it was searching "Pre-K" through "Pre-K". The search fields should search the entire collection ("Pre-K" through "12") unless specified by the user.

Resource Display Page
Provide users with clear instructions as to how to view the resource.

Enable the thumbnail of the resource to be clickable (linking the user to the resource).

Make it clear to users that they will be directed away from the Engineering Pathway website when viewing a resource.

Search Results Display Page
On the "Search Results" display page the "Revise Search" link in the top right corner of the page appears to be two separate links.

At the top left of the "Search Results" display page, the number of results from Engineering Pathway should be more prominent than number of results from the NSDL.

Revise the "First Time Users" Page
Distinguish between the links that you can click on and the topic headers. Several of the titles use blue text and are underlined, which makes users think they can click on it because it resembles a link format.

The "Navigating Engineering Pathway" link on the "First Time Users" page gives a description of what Engineering Pathway is and does not tell users how to navigate the website. Consider revising the titles of the links to reflect the information that they provide.

Users were confused by the "Basic Digital Library Use" link and did not realize that it would explain to them how to navigate the Engineering Pathway website. Information on how to navigate the website should also be included under the "Navigating Engineering Pathway" link as well.

Update the "Frequently Asked Questions" page
On the "Frequently Asked Questions" page the answer to the question "How big is Engineering Pathway? " should be updated to reflect the current number of education resources. (over 25,000 instead of 10,000)

Include information about how to view a resource.

Creating an Account
When users create an account, Engineering Pathway should provide a confirmation page to inform the user that their new account has been successfully created. In addition, the website should provide them with information about their log-in status; who they are logged in as, and if they are logged in.

Submitting a Resource
Inform users that a resource must be located online before they can submit it to Engineering Pathway.

On the "Submit Resource" page, change the "continue" button to "preview submission". Change the "create new learning resource" button to "submit new learning resource" or "finish".

Enable users to remove or delete resources that they created or uploaded.

My Workspace
Add a line of space between the saved resources and links.

Change the "save to workspace" button to "remove from workspace" or gray out the button so it appears to not be an option.

Teach Engineering

Terminology
Consider revising the following term: lesson dependency.

Navigation
Change the "Browse" link on the homepage to direct users to the "Browse Curriculum" page (instead of the "Browse Standards" page)

Resource Display Page
Put the most relevant information at the top of the page. Move the "Related Curriculum" and "Educational Standards" towards the bottom of the page.

Use links to display additional information about the lesson in order to reduce the amount of text on the page.

Add spaces to separate the text In the "summary box" in order to make it easier to read.

Search Field Options
On the "Simple Search" page, under the search box, it says "Cool (really!!!) Search Options"; consider revising to "Tips to Search Better" or "Tips to Improve Your Search".

Recommendations for Further Study

This study was an initial evaluation of the K-12 component of the Engineering Pathway and TeachEngineering websites. The methods used were a good first step at evaluating the websites but an extension of this study would be useful in order to gather more input from K-12 users.

The findings of this study reflect the needs of middle and high school teachers in the Bay Area, as they were the group of teachers that were interviewed. These needs are representative because interviews were conducted until the same topics and needs kept coming up and no new information was obtained. It would be worthwhile to interview teachers from other areas of the US; while their teaching methods will most likely be similar, there could be potential differences not reflected in this study. It would also be useful to talk to elementary teachers to see what their needs are as they could be very different from middle and high school level.

While the initial usability testing provided useful feedback for this study, as with the interviews, for future studies, a continuation of the usability testing done in this study should include K-12 teachers from other areas of the US and elementary teachers.

Lastly, a survey could prove useful if distributed to teachers across the United States. A survey would be useful if there were specific features or needs that were being investigated.

Appendix

K-12 TEACHERS

User #	Grade	Current Subject	Years Teaching
1	8	Physical Science	30
2	8	Algebra	24
3	7-9	Life Science, Physical Science, Math Support	20
4	6-8	Physical Science & Computer	8
5	7	Life Science	2
6	7	Pre-Algebra & Algebra	10
7	9,10	Algebra II	1

GRADUATE STUDENTS (in the school of education)

User #	Grade	Student Teaching Experience
1	5	English, Math
2	9-12	Tutoring
3	12	AP Environmental Science
4	6-8	Language Arts
5	6	History, Math
6	1	Social Studies
7	K	General
8	3	Math
9	8-12	Algebra I, Algebra II, Pre-Calculus
10	10	Tutoring Math
11	2	Math, Science, English, History
12	10	English

GRADUATE STUDENT INSTRUCTORS (in the computer science department)

User #	Grade	Teaching Experience
1	undergraduate	Computer Science
2	undergraduate	Computer Science
3	undergraduate	Computer Science

APPENDIX B: USABILITY TESTING GUIDE

Introduction
- Explain the purpose of the usability study

Homepage
- Initial impressions of Engineering Pathway homepage
- Purpose of site

Tasks
- Register for an account and log in
- Find the K-12 "Curricular Resources" page
- Search for resources
  - Resource related to curriculum
  - Sound wave simulation activity for high school students
  - Hands-on activity related to recycling
  - 5th grade lesson plan related to volcanoes
- Add resources to "My Workspace"
- Searching for a resource you might use
  - Quick Search
  - Advanced Search
- Upload a new resource
- Manage "My Workspace"
  - Access the sound wave simulation resource
  - Remove the sound wave simulation resource
- Log out

APPENDIX C: USABILITY TESTING KEY FINDINGS

CODING ROUND #1 (NOTES)

Key
User #1   User #2   User #3   User #4   User #5   User #6

What is your impression of the EP website?
Obviously has something to do with educations k-12 resources
So getting engineering into your classroom.
So research findings, is that like studies you've done.
All these are buttons? (left side navigation bar)
(Links page) Too dense, top three really great, click on these.
Wants to click on buttons about topics I'm interested in.
Mind map Labs→ mentos → rockets
Didn't realize it took him to another page.

Engineering, broken down into K-12 and higher ed
Don't know what broadening participation is.
Don't like that the picture changes every 3 seconds
Is it sponsored is there going to be some financial hook.
Who is it?
NSDL is that the server
Supported by NSF that looks good
So I went to a site map which for me is easier
About us, who are you?
Often I go to quick search then I find it isn't the right place to go.
(Clicks on resource slope)
One comment and no reviews, how new is this website?
Started in 1998, not that new.
To see it, it is not exactly clear what you have to do. So I guess I have to download it, that's the
url. (Clicked on more information about resource and nothing came up.)
(Clicked on first time users) didn't find anything.
I'm stumped on how to see the resource and I'm not sure what to do.
I could download the url and see what happens.
It looks pretty clear to me. Easy to get to curriculum.
Less interested in research findings that actual curriculum.
Easy to navigate.
(Tried advanced search)
This is obviously more geared to engineering, but it is as good as other sites I've seen.
The quality of the materials it leads you to, I don't have experience with that.
I had more faith in it and less suspension and higher quality than joe schmoe. (b/c it was NSF)

I started looking for middle school and it had K-12 resources so then I would try to narrow it down to 7th grade.
I like the day in history.
I would probably browse this site.
I would google in, or type in.
(Quick search) Solar system
Is this engineering pathway part of Berkeley? Or just a bunch of engineering schools.
(Searching resource display page to find out what he needs to do.)
(Double click on everything and uses one finger)
(Clicked on solar system resource and trying to figure out what it does.)
Laptop tray is always booked.
(Searches for density using quick search)
If it is easy for me to do, it is pretty easy for anybody to do.
(on teach engineering resource)
Wow, there is a lot of good stuff here.
This is all printer friendly, print resources out the way they are.
Most of it is pretty basic.
None of this is found in my text book.

Physical science
Resources for kids and wait no, resources for educators.
Resources for educators instead of teachers.
I think it is all physical science, b/c it says engineering instead of science pathway, but I guess it is also math, so math and physical science.
I would go over here (left navigation bar) or I would just type in here.
(Typed in rockets to do a quick search)
So I would read the little blurbs here (description of the resources)
Anything that is related to what I was doing.
I may not of thought of using a balloon to make rockets, but I might see it and be like this is interesting and want to get more information about it.
So it looks like this is a place where you look at other lessons that are already online and they kind of put them together in the same spot.
If you walk them through it.
If you walk like 100 teachers through it 20 might use it.
I was kind of surprised it took me to an outside link.
So if you took them all and they were standardized, so they are all set up the same way, so I know where to look, so I don't have to search, I don't have to take as much time to figure how to navigate it.
It's standard, so you look at it once and you know how to do it.
I would look for information, images, readability for my students, do I want them to read this.
Like this page is set up differently.
I would look at it and see if it is information just for me or for my students.
I would look at it and try to see it through my kids eyes.

Have them go through a worksheet so they are accountable to read through it and get specific information.
Definitely more guided instead of just have them go through.
It would be nice to have some worksheet, so if I wanted to use this and have my kids go there, it would be more labor for me to write something up to have them be accountable for something.
I use worksheets from different sites.
The purpose of the worksheet is to get them focused on specific material.
If I can rework them (worksheets) I will rework them.

I see education and k-12 a lot. I see the little kid. So I think it is a way to bring engineering into the classroom.
There is a lot of stuff on the homepage, so there is a lot to read.
I see the NSDL so I know that is a good think, but I don't know what it stands for, but I know it is a science thing.
There are some awards and stuff like that.
There is a lot to see her, it is not a simple website, there is a lot going on so that is promising.
I would probably go to K-12 resources and then to curricular resources.
Being life science, I probably wouldn't click on NASA or engineering, or the robo lab. My class isn't really about building or engineering, so that probably wouldn't be applicable to me.
So I click on teach engineering and I want to see what they have.
It says search and browse, so I usually like to browse.
(She didn't know what standards to type into TE, there were no California)
On teach engineering homepage, at bottom it says search and browse, when you click on browse it brings you to browsing the standards.***
Engineering pathway it searches Pre-K through Pre-K automatically (default)
I guess I'm just looking at the standards. **Time Marker 41:44**
That is a little misleading.
I think this is just the standards, so I guess I can click over here and oh yea here all the lessons and it tells me all the standards from different states.
If I have something similar I'm not going to waste my time looking at it.
It looks like it tells me what it is and what it does, it gives me background and concepts.
It looks like it does have an activity here that would be good to use, kind a.
Like I wouldn't use this because I want my kids to be accountable and it doesn't have oh wait it says there is something attached.
It would be nice if I could alter this on my computer.
It would be nice to able to see it here. If I'm searching for it I just want to see a thumbnail or a diagram of what it is, so when I'm looking for something I can just go through here and look real quick.
I'm looking for something to supplement what I already have, so I want to be looking through really quick and get an idea if it is close to what I want or not.
There is so much writing and I have to sit here and read through a lot.
It looks really daunting.
Have the lesson at the top and the supplemental stuff separate at the bottom.

To have all of that before the activity is a lot.

What is this telling me to do, what they are doing time and this is how you will do it.

I don't want to spend a lot of time to teach all the extra that is not exactly what I want.

(submitting a resource)

So then I would download a template for that.

So that tells me what information I need to have so it is standard with all the other ones.

It tells me what format to put it in and then it says to learn more about the process to email us with your questions, it doesn't really say how to submit them, so I guess I would email and say I have a question and ask them how to submit them. **Time Marker 50:50**

It was 2.5 pages and that was a lot and I'm looking for quick things, like worksheets and activities.

Also to have people contribute to it and have other people be like this goes really good with mitosis or heredity and then that way all that information could get there and it wouldn't have to be just me.

(Quick search)

Tels I know tels. It looks like there is not one that I would use, it says college. (Quick search genetics)

Actually it looks like this stuff is not very useful, there is six pages of it, so it says case studies, college students, and this is the kind of thing that there is so much to wade through so if I don't see it on the first page I don't know if it is going to be helpful to me.

(clicked on advanced search not K-12 or higher ed, just advanced search under search box)

Looks like I can do advanced search and I can fill it all in. (Searched for genetics and demonstration)

And there is no results, so looks like there is not a lot. **Time Marker 53**

It's engineering and I'm life science so I'm not really surprised by that.

There are not a lot of ways to bring (physics) that in at this level.

(Submit resources on navigation bar)

So I don't know what these are aeeig

So it looks like I have to create an account, so that is another thing like.

Do you want me to create one? I guess it doesn't take that long. So submit resources, engineering pathway, so yea so it look slike this is, it looks like there is a lot to do, but it looks easier, I guess they tell you what you have to do. Like if I have a worksheet that I have to upload it says like there is a url so if the worksheet isn't already somewhere else I guess you can't do it.

Everything else looks like it is probably ok.

So this is like a website that someone has told me a lot about, it looks like it gives me a description so it looks like there are places for reviews and comments.

(quick search for cells)

So it looks like it is engineering, I guess it popped up because its cell phone.

Current events about bio ethics or stem cells that would be useful.

I think there is a lot of things I could click on.

It is a lot of text, but it is organized in a way that is pretty user friendly.

I will probably be able to find something that I'm looking for.

I think it is good. It is all about finding whatever you can wherever you can.

So if EP doesn't have what I need then it will take me somewhere that it has.
If there are four different teacher domains and one doesn't have a lot.

Cool pictures
looks at k-12 → quality lessons, interested at research findings, search k-12 curriculum, starting wide – searches for projects (quick search), "don't strike me as lessons" what does "interactive" mean? K-8 grade, when things are that broad (clicks on resource), looks more like a game, looking for more of a hands-on activity, something to o in classroom, might, could recommend to kids, like kids to explore
can't find engineering pathway website, can't go back to original page
quick searches for "projects," looks at top of search page and sees 354,000 results (in NSDL library) → shows link stands out more than EP search results
not sure how search results are ranked, why is resource listed at top of list, is it like google goes to TE, teacher resource about engineering education, initially chose browse from homepage (link at bottom), **TM: 56:10,** "oh there are the standards" stuck in standards for over a minute. How would I, oh these are all standards though, these aren't lessons. Hmmm… over 2 mins… this isn't lessons, I thought it was going to be looking for activities (58:47 → we show how to search,
searches using left search bar, what does lesson dependency mean???,
time required, cost = valuable, where is the lesson? Let's see. **TM: (1:00:43)** "Will you help me out?" I see the summary, but I can't see… I keep scrolling down… oh there it is… I see… loooooooooooooooooooooooong scroll, likes grade level, group size, summary, I saw related curriculum so I was already thinking about clicking on something else" saw educational standards, then this is where the lesson starts. I think I would for the layout, I would put introduction and motivation and the picture, related curriculum. As a teacher I'm looking for a lesson I want to get a sense for what the lesson is about. This does it a little bit, but I'm not as excited as when I see this. I'm not searching by standards at this point. Get the recipe first and then what you need at the bottom. I like the vocabulary.

CODING ROUND #2 (THEMES)

What is your impression of the EP website (from looking at homepage)?
Cool pictures
Engineering, broken down into K-12 and higher ed
Don't know what broadening participation
Don't like that the picture changes every 3 seconds
Is it sponsored is there going to be some financial hook.
Who is it?
NSDL is that the server
Supported by NSF that looks good
I started looking for middle school and it had K-12 resources so then I would try to narrow it down to 7th grade.
I like the day in history.
I would probably browse this site.
Obviously has something to do with educations k-12 resources
So getting engineering into your classroom.
So research findings, is that like studies you've done.
All these are buttons? (left side navigation bar)
Physical science
Resources for kids and wait no, resources for educators.
Resources for educators instead of teachers.
I think it is all physical science, b/c it says engineering instead of science pathway, but I guess it is also math, so math and physical science.
I see education and k-12 a lot. I see the little kid. So I think it is a way to bring engineering into the classroom.
There is a lot of stuff on the homepage, so there is a lot to read.
I see the NSDL so I know that is a good think, but I don't know what it stands for, but I know it is a science thing.
There are some awards and stuff like that.
There is a lot to see her, it is not a simple website, there is a lot going on so that is promising.

Engineering Pathway
Everyone searched using quick search, then thought search results were too broad and not relevant
Didn't realize that when you click on a resource link that you leave the EP website (opens new window, doesn't know how to get back to EP website)
Saw 354,000 search results (from NSDL) and thought those were the results (NSDL link number stands out more than the EP results number)
When saw number of results, curious about how ranked, is it like Google?
Searched for slope, clicked on a search result, looks a resource display page, sees 1 comment and 0 reviews, questions how new website is, sees "publication date" thinks it is the publication date of the website (1998) and says "oh it's not that new," not sure what you have to do to see

the resource. "I guess I have to download it, that's the url." Tried to click on "more information about resource" but nothing comes up. Clicks on "first time users" link and looks for information on how to access resource, but doesn't help him. "I'm stumped on how to see the resource and I'm not sure what to do. I could download the url and see what happens."

Search relevancy → quick searched for cells, one of top hit was cell phones

Less interested in research findings than curriculum

This is obviously more geared to engineering, but it is as good as other sites I've seen.

I had more faith in it and less suspension and higher quality than joe schmoe. (b/c it was NSF)

Tries to search using left bar navigation to K-12, bring to links page → confused as to where to search, thinks the website just recommends links to go to to look for materials

Thinks pages are too dense (too much text)

Realized that EP was a place where outside resources were brought under the same roof

Surprised when click on resource, opens new window

Quick search searches all material and nothing was relevant to her grade level even though it was six pages of results, case studies, etc… not relevant

Advanced search has K-12 and higher ed format, so searched for demonstration genetics and nothing came up. "It's engineering and I'm life science so I'm not really surprised by that."

Engineering pathway it searches Pre-K through Pre-K automatically (default)

Deterred by having to create an account, but does so for us, doesn't take long, looks easy

No confirmation of having created an account

Submitting a resource on EP

"So I don't know what these are aeeig"

"it looks like there is a lot to do, but it looks easier, I guess they tell you what you have to do. Like if I have a worksheet that I have to upload it says like there is a url so if the worksheet isn't already somewhere else I guess you can't do it."

Teach Engineering

Clicked on browse on front page TE took to browse standards and not browse curriculum – "I guess I am looking at the standards, which is a little misleading."

When looking at lesson on TE, doesn't know what "Lesson Dependency" heading means

When looking at lesson on TE - Says "Where is the lesson???" cannot find the lesson, asks for help, thinks the lesson page is a long scroll

On lesson page, attachments are in pdf form, can't change (wants to be able to change)

On lesson page, would like to see thumbnail of attachments (so can quickly get feel for)

Lesson page is a lot to go through, a lot of text and information on it, I have to read through all of this before I can even figure out if I can use this. There is so much writing and I have to sit here and read through a lot. It looks really daunting.

Liked time required, cost, grade level, group size, summary

Sees "related curriculum" already thinking about clicking on something else

Teachers want to see most relevant information first -- "get the recipe first and then what you need at the bottom"

Wow, there is a lot of good stuff here.

This is all printer friendly, print resources out the way they are.

None of this is found in my text book.

Liked that lessons were standardized on TE (all lessons in same format/look same, look at it once and don't have to don't have to relearn each time) So if you took them all and they were standardized, so they are all set up the same way, so I know where to look, so I don't have to search, I don't have to take as much time to figure how to navigate it. It's standard, so you look at it once and you know how to do it.

She didn't know what standards to type into TE, there were no California

Submitting a resource on TE

Form looks like a lot to fill in.

It tells me what format to put it in and then it says to learn more about the process to email us with your questions, it doesn't really say how to submit them, so I guess I would email and say I have a question and ask them how to submit them.

Also to have people contribute to it and have other people be like this goes really good with mitosis or heredity and then that way all that information could get there and it wouldn't have to be just me.