

DESIGN FEATURES OF ONLINE TEACHER PROFESSIONAL DEVELOPMENT: A DESIGN CASE FOR RE-DEVELOPING THE EDHUB LIBRARY TO IMPROVE USABILITY AND ALIGNMENT OF CONTENT WITH TEACHER STANDARDS

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The EdHub Library is an online teacher professional development platform that serves 250 school districts as part of the Network for Educator Effectiveness in Missouri. It has a collection of more than 300 online activities. This design case describes the efforts of re-developing EdHub due to technical and usability issues of the first generation of the content management platform. The second generation of EdHub was the product of two prototypes and two user testing sessions between January 2018–April 2018. A literature review of information-seeking habits of K-12 teachers and web design and usability standards guided the development of the second generation of EdHub to support teachers' browsing and searching behaviors. Five design decisions support the second generation of EdHub in terms of (1) priority of visual elements, (2) ease of navigation, (3) content alignment with Missouri teacher standards, (4) organization of results in the search engine, and (5) unifying learning objectives, activities, reflection, and external resources.

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INTRODUCTION

Teacher professional development (PD) is an essential aspect of continuing education and professional development of teachers' careers. Studies have shown the impact of PD on improving teaching practices and changing teachers' beliefs and attitudes. Borko (2004) describes teacher PD as a contextualized educational system that consists of a PD program, facilitators as providers of PD, and teachers as the recipients of PD.

Online platforms allow teachers to access resources and communities of practice 24/7 (Rice & Dawley, 2009). Online platforms can deliver multiple opportunities for professional development, coaching or peer-mentoring, student-focused lesson planning, and customized training materials. Research studies suggest strong evidence between teacher professional development and reflection. When teachers perform journaling self-reflection activities in professional development, teachers can critically assess their classroom practices that lead to increased student learning (Thorpe, 2004; Chitpin, 2006; Pultorak, 1993; Yang, 2009; Saylor & Johnson, 2014). With the rise of internet technologies, online platforms make online teacher professional development and self-reflection activities possible.

Along with similar online teacher professional development platforms such as PE Central and MyTeachingPartner, the EdHub Library is an online professional development platform with more than 300 online modules along with self-reflection activities that are aligned with Missouri teacher standards (Hanson, Pennington, Prusak & Wilkinson, 2017, MyTeachingPartner, 2017). This paper describes the efforts for developing the second iteration of the EdHub Library based on user testing sessions of prototypes, review of the research literature of teachers' information-seeking habits, and specific platform usage findings related to EdHub users.

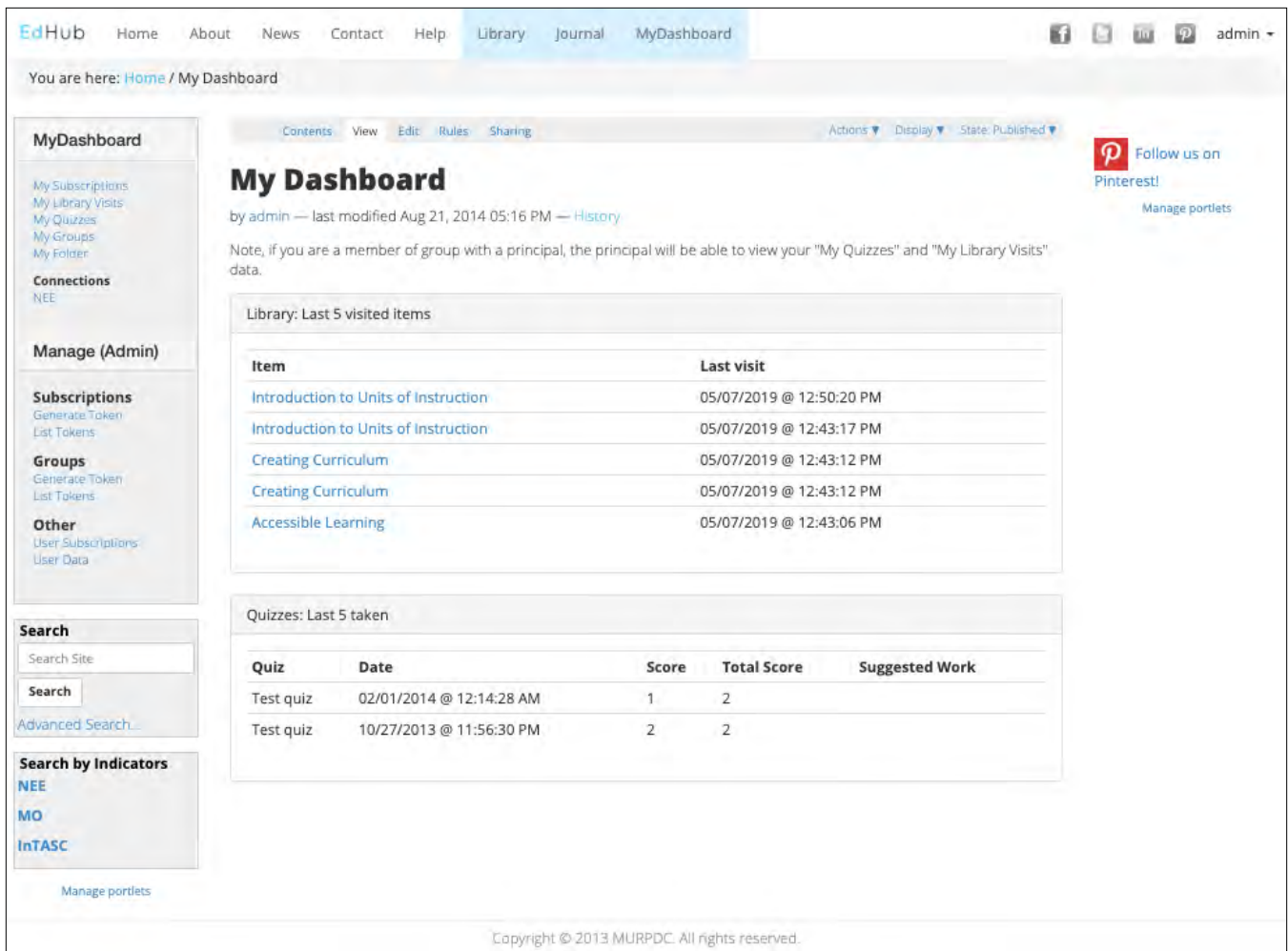


FIGURE 1. EdHub Generation 1 School Administrator Dashboard.

CONTEXT

EdHub is the online professional development component of the Network of Educator Effectiveness (NEE) at the University of Missouri. NEE is a comprehensive system that tracks multiple measures of educator effectiveness to support teacher growth through classroom observations, student and teacher surveys, and yearly teacher observation training sessions for school administrators. The EdHub Library was initially funded by the Bill and Melinda Gates Foundation in 2014 in partnership with the University of Missouri. Since 2014, my responsibilities include (1) collaborating with subject matter experts on content writing, (2) developing self-paced modules and face-to-face training, (3) maintaining and deploying materials, and (4) implementing web analytics across the platform.

NEE school districts have access to (1) a video library of best practices in classroom teaching, (2) a video library of examples for scoring classroom observations, (3) a catalog of self-paced online modules, (4) copyrighted assessment instruments, (5) journal reflection activities, and (6) yearly calibration training sessions for school administrators. EdHub

provides online professional development resources on a wide variety of topics for teachers and instructional leaders that support instructional practices based on indicators of teacher effectiveness.

The first generation of the EdHub platform was built on an open-source content management platform called Plone. On the EdHub platform, users registered for an account using their school email address to access online professional development, journal features, an administrator and teacher dashboards, as shown in Figure 1. In the EdHub platform, teachers and administrators were organized by the school district. School administrators could observe teacher activity and read journal entries when teachers shared their journals with administrators.

When searching for professional development in the first generation of the platform, users could either browse resources from the homepage directory or search for materials tagged by teacher standards. Each activity contained a voluntary journal activity that teachers might choose to complete and share with school administrators.

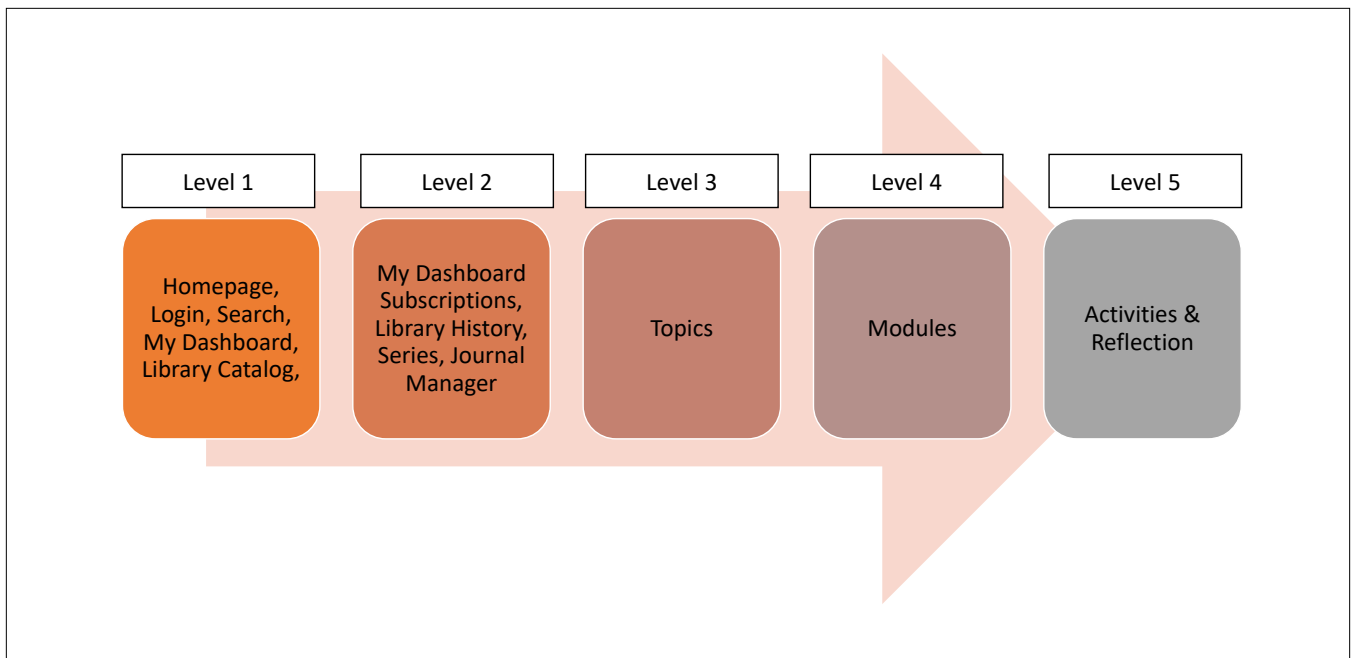


FIGURE 2. Five-Level Sequential Navigation of EdHub Generation 1.

Three types of learning objects are available in EdHub, including (1) self-paced materials, (2) open lessons that don't require login credentials, and (3) blended activities. The EdHub Library team is composed of two Instructional Designers who develop professional development materials in-house. The professional development materials are aligned with teacher standards in collaboration with NEE trainers and subject matter experts.

Design Motivation

The motivation for redesigning the library from the ground up was to (1) improve usability of the site, including structure, navigation, and content access in order to facilitate efficient navigation of resources without additional logins or user permissions, and (2) improve the site's privacy, as users had expressed concern about the visibility and sharing of their journal reflection entries with other school districts on the platform.

A survey was sent to approximately 300 school districts in 2016 asking for feedback from Missouri teachers in terms of their frequency of use, alignment of EdHub content with their PD needs, and barriers related to access. Even though the survey response rate from teachers was approximately five percent, survey results were consistent with the feedback from school administrators who attended mandatory in-person training sessions. The feedback from the teacher survey and in-person training sessions from administrators shared common areas of improvement as follows:

1. To improve navigation and usability of the site
2. To make the platform accessible to all schools without login and user registration
3. To eliminate privacy and sharing issues over teacher reflection
4. To maintain the platform and content within the department

To Improve Navigation and Usability of the Site

Responses from the 2016 survey showed that school districts experienced technical challenges in accessing the EdHub Library. The majority of responses involved simplifying login and navigation requirements that allowed them to navigate relevant materials related to their professional development planning, units of instruction development, and student lesson planning.

The first generation of the platform had several navigation issues and five levels of access for navigating instructional modules. Platform features (Search, My Dashboard, Library Catalog, and Journal) were accessible from the homepage as the primary navigation menu. Navigation issues were present in the Library Catalog that contained all instructional modules organized by topics, modules, and activities/reflection. The navigation of the Library Catalog could only be accessed in a sequential structure without giving users the ability to skip sections.

For example, users accessed content topic modules located at the fourth level from the Library Catalog homepage. As users navigated through the series, topics, modules, and activities, users became overwhelmed by the number of descriptions for each section. The series or instructional themes

described the overall summary of the topics within the series. Also, the alignment of professional development and teacher standards was not present until users navigated to the modules. The navigation prevented users from properly assessing materials and their alignment with teacher standards. Even though the first generation of EdHub provided a breadcrumb menu to help users to understand their location in the library, the menu became lengthy as users navigated to module sections. Figure 2 shows the sequential navigation of the first iteration of the EdHub platform.

With the implementation of the sequential navigation structure, users found the information overwhelming as they navigated through the series, topics, modules, and activities. The navigation structure prevented users from browsing the entire catalog and searching for specific pieces of professional development. Also, users could only use the left menu to navigate the site and perform search functions. In video demonstration 1, the user performed several steps to access a module's overview, activities, and resources in three separate pages.

Video demonstration 1. EdHub Generation 1 Navigation Challenges.

https://media.dlib.indiana.edu/media_objects/5t34t258n

To Make the Platform Accessible to All Schools Without Login and User Registration

After signing up for an account on TheEdHub.org, users entered group and content tokens that allowed them to access their assigned school districts and designated professional development materials. Users were required to enter two tokens or access codes. First, users entered the group token that placed teachers in their respective school districts. Second, users entered a content token to control access to different types of materials based on their role and employment status. Without these codes, registered users could not access any of the content, features, and school districts.

Also, the content codes allowed principals and teachers to access different types of materials. For example, school administrators had access to the entire catalog of professional development and principal training materials. In contrast, teachers had access to the whole professional development catalog except for principal training materials and copyrighted indicator rubrics.

Although users did not experience issues with entering the access code for their assigned school districts, users experienced issues with entering the access code for professional development materials. In most cases, teachers copied and pasted the access code for materials with blank spaces from the registration email that caused EdHub to warn users of an invalid access code. Teachers who moved to new school districts needed two new access codes for their respective schools and professional development materials. However,

teachers who changed school districts could not migrate their journal entries and user activity to their new school districts.

To Eliminate Privacy and Sharing Issues Over Teacher Reflection

In the first iteration of the EdHub Library, teachers expressed their concern with the lack of full privacy controls over journal entries based on the 2016 survey and on-site training sessions. The journal feature in EdHub allowed teachers to record their professional development activities and lesson planning.

As teachers worked on their journal entries, teachers set their journals as draft status that could only be viewed by them. Once teachers completed their journal entries, teachers had the option to set journals private or publish them as public on the platform that was available to all registered users regardless of school district. Teacher feedback identified the need for full control over journal entries by allowing them to publish their journal entries to selected individuals within a school district group. Even though the EdHub staff and school administrators were unable to see private journal entries, NEE decommissioned the journal feature due to potential liability.

Although the first iteration of EdHub intended to create a community of practice that allowed sharing of materials within a school (e.g., sharing units of instructions among teachers of the same subject matter), an additional layer of privacy was required for sharing journal entries with specific individuals.

Due to time constraints and limited resources, the journal feature was not incorporated in the second generation of EdHub. Instead, teachers could download the journal template from the homepage. Also, teachers were responsible for sharing with their supervisors and storing their journal entries.

To Maintain the Platform and Content Within the Department

The first iteration of the EdHub Library was developed by a third-party vendor in Missouri, Practical Concepts Consulting, using an open-source content management system called Plone. Although Plone was a highly customizable platform that handled user permissions and content access, the finalized production version of the library had issues related to navigation, privacy, and user and access permission settings.

These issues prevented users from engaging with the journal feature and navigating to professional development materials. For EdHub administrators, the platform could not handle uploading and maintaining multimedia assets and external links. With this particular limitation on the web

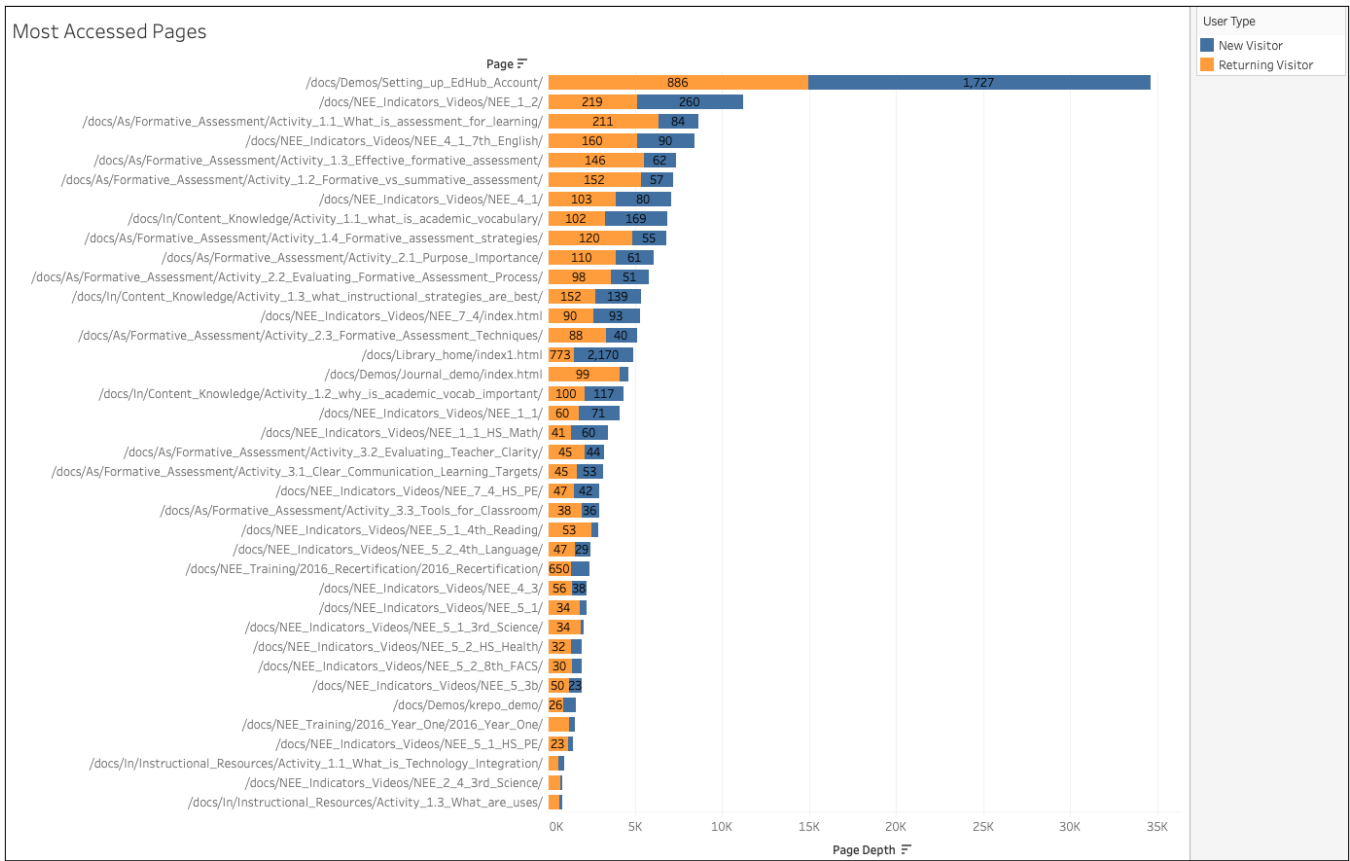


FIGURE 3. Most accessed pages in EdHub Generation 1.

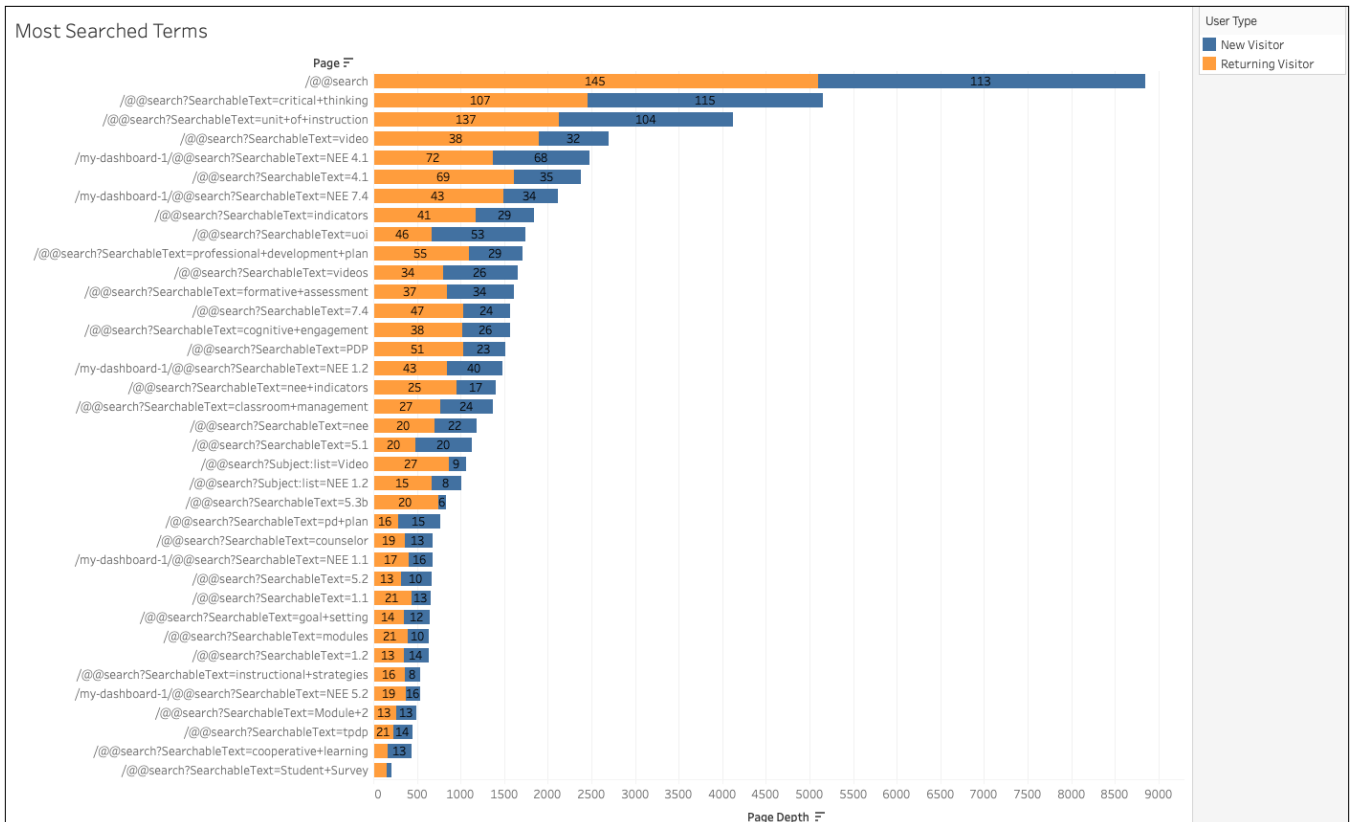


FIGURE 4. Most searched terms in EdHub Generation 1.

storage, multimedia assets were hosted outside the platform to accommodate web traffic.

Even though the platform would have required external funding to fix the platform's user access settings and privacy controls of the journal feature, the first iteration of EdHub also needed a significant overhaul to improve navigation and search of materials. At the time of my employment in 2014, the platform was already in use without any user and technical testing.

In December 2018, the platform was decommissioned in favor of an embedded version of EdHub within the NEE Data Tool that required no additional logins and worked within the existing process of collecting teachers' classroom observation data.

Design Decisions and Literature Review on Teachers' Search Habits

In October 2015, the free version of Google web analytics in the first iteration of EdHub provided stakeholders with information about users' library navigation and login patterns. Although the free version of Google Analytics generated rich data about users (e.g., page views and time on page) and their point of access (e.g., NEE Data Tool or EdHub domain), Google Analytics did not track IP addresses, personal identifiable information, or contents of teachers' journal artifacts.

The web analytics data showed that users navigated to activities related to EdHub how-tos, assessment, rubric implementation, and principal training materials from October 2015 to February 2017 (Figure 3). Even though these activities were required during the on-site training sessions in the summer and at the beginning of the school year, there were little to no page views for other activities available in the library.

In Figure 4, web analytics of the first generation of EdHub showed that users performed specific searches related to teacher indicators (e.g., NEE 4.1 for student problem-solving and critical thinking, NEE 7.4 for monitoring effect of instruction) and particular processes for professional development (e.g., TPDP or teacher professional development plan). Interestingly, users performed search queries using teacher indicators (e.g., 1.1, 1.2, 5.1) rather than entering actual words for different areas of teacher professional development. Also, users performed specific search queries related to professional development processes such as units of instruction, classroom observation videos, professional development plans, and student surveys.

In a specific study related to the first iteration of EdHub, I performed a clustering analysis of web analytics data to derive use cases and navigation patterns of new and returning visitors. Four out of seven navigation patterns indicated that

new and returning users accessed EdHub through the NEE Data Tool (Leung, 2018).

New and returning school administrators accessed the site to review group and content access codes, user profile preferences, reset passwords, and reviewed teachers' journal entries. Also, new and returning school administrators accessed mandatory training related to recertification and classroom observation processes. New and returning teachers accessed the site to perform journal tasks and accessed materials related to cognitive engagement, affective engagement, and assessment.

By exploring the web analytics data, feedback from training sessions, and support calls, the redesign of the EdHub Library incorporated five design decisions during development and testing of prototype A and B. The design decisions accounted for two types of users who would use the second generation of EdHub. First, users (e.g., first-year teachers) who were new to professional development did not fully understand teacher indicator alignment or individuals (e.g., library specialists, paraprofessionals, speech coaches, and instructional coaches) who assisted teachers and did not use teacher indicators in their roles. Second, users (e.g., tenured teachers and school administrators) who were seasoned teachers and understood how to search for standards-based professional development.

The design decisions stemmed from three sources: (1) web analytics data of the first generation of EdHub, (2) 2016 teacher survey, and (3) feedback from mandatory training sessions of school administrators. The overarching goal of the design decisions was to support users with multiple ways of searching and browsing professional development within a familiar environment (i.e., NEE Data Tool) regardless of professional development experience. The following design decisions were based on the literature of teachers' information-seeking behaviors and Nielsen's heuristics for user-interface design.

Design Decision 1: Prioritize Visual Elements

In user interface design, Nielsen (1994) articulated general or broad principles for interaction design that included (1) visibility of system status, (2) match between the system and real world, (3) user control and freedom, (4) consistency and standards, (5) error prevention, (6) recognition rather than recall, (7) flexibility and efficiency of use, (8) aesthetic and minimalist design, (9) help users recognize, diagnose, and recover from errors, and (10) help and documentation. More specifically to teachers' information behaviors, Limberg (1999) identified three major patterns of teachers' variation of information-seeking habits in the areas of fact-finding, choosing the right information, and analyzing and scrutinizing information.

Even though the first generation of the platform did not meet Nielsen's heuristics in terms of consistency and standards, recognition rather than recall, and aesthetic and minimalist design, the redesign of EdHub emphasized the implementation of the aftermentioned heuristics principles that helped both non-experienced and experienced users with consistent interface experiences.

These consistent interface experiences involved previewing all topics from the library homepage and their alignment with teacher indicators, accessing instructional modules in two (e.g., using the search engine or teacher indicator sitemaps) or three steps (e.g., navigating from the homepage, topic list, and module), and recognizing the location of materials with consistent breadcrumb navigation available in all pages of the library.

The first generation of EdHub did not prioritize the organization and preview of the library catalog and its contents. This issue prevented users from assessing the usefulness and navigation of instructional modules. Also, the content alignment to teacher indicators was not evident as users navigated sequentially to instructional modules. The second generation of EdHub allowed users to assess the contents of topics with consistent arrangements from the homepage to the desired professional development module. This decision benefited non-experienced users who were casually browsing topics on the homepage without a specific topic or standard.

As shown in video demonstration 2, prototype A organized the EdHub Library in three sections (getting started, search engine feature, and topic categories). In video demonstration 3, prototype B of the EdHub homepage was reorganized in the four main sections in a vertical view starting with the getting started section, search engine feature, indicator sitemaps, and topic categories organized in alphabetical order.

Video demonstration 2. Homepage EdHub Generation 2 Prototype A.

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Video demonstration 3. Homepage EdHub Generation 2 Prototype B.

https://media.dlib.indiana.edu/media_objects/np193t51b

Design Decision 2: Ease of Navigation Across All Levels

In the first iteration of the platform, a common characteristic between new and returning teachers and administrators groups was the increased web traffic to web pages that listed all resources by teacher indicators (Leung, 2018). Even though the library offered around 300 activities, users did not access other areas of the library, such as teacher-student communication, data analysis, Common Core State Standards, and Next Generation Science Standards, and family and community involvement.

This decision aimed to improve the information architecture of EdHub by changing the navigation structure and information presentation. In the second generation of EdHub, the navigation structure changed from a sequential navigation scheme to a hierarchical structure. The hierarchical structure allowed users to navigate the library in three steps or less with consistent alignment with teacher indicators. Unlike the first generation of EdHub, the information presentation of topics was consistent across the homepage, topics, and modules.

For non-experienced and experienced users, the homepage of the second generation of EdHub provided consistent overviews of teacher indicator alignment and overviews of the topics and their content. At the topic level, topics were organized based on the topic's previews from the homepage with precise alignment to teacher indicators. At the module level, learning objectives, activities, reflection, and resources were organized consistently and aligned with teacher indicators. In video demonstration 4 of prototype A, a topic category was organized into subtopic categories with relevant descriptions and a filter option to search by term. In video demonstration 5 of prototype A, a module provided users with a single point of access to objectives, activities, tasks, and resources.

Video demonstration 4. Level 2: Topics EdHub Generation 2 Prototype A.

https://media.dlib.indiana.edu/media_objects/xw42ns53g

Video demonstration 5. Level 3: Modules EdHub Generation 2 Prototype A.

https://media.dlib.indiana.edu/media_objects/3t946830n

Design Decision 3: Search Materials with Sitemaps Across Multiple and Individual Teacher Standards

With increased web traffic to indicator pages in the first generation of EdHub, this design decision was carried over to the second generation of EdHub with changes to the navigation that allowed for user input within the lists to filter materials by keyword or indicator. In the first generation of EdHub, the sitemaps required two pages to list all resources by teacher indicators. In the second generation of EdHub, the sitemaps were single pages that provided direct access to instructional modules by indicating the alignment and location of materials.

The sitemaps presented a clear benefit in terms of narrowing the information-seeking needs of users. According to Shipman (2015), teachers most frequently looked for instructional design of lesson plans, exercises, assessment tools, and action research topics related to teaching. While sitemaps provide users with the ability to narrow their choices, sitemaps might provide users with a certain level of confidence in finding professional development aligned with indicators. Williams and Coles (2007) argued that teachers expressed

less confidence in their information literacy abilities for finding and evaluating research-based information related to teaching.

The second generation of the EdHub Library provided different types of training modules, including classroom observation video examples, self-paced instructional modules, examples of units of instruction, face-to-face training materials, and classroom observation self-assessment activities.

With teacher indicator sitemaps in the second generation of EdHub, users were able to find specific professional development with alignment to indicators regardless of the type of professional development activity. This design decision benefited experienced users looking for targeted professional development by teacher standards. In video demonstration 6 of prototype B, indicator sitemaps allowed users to navigate to a full list of instructional modules by browsing the list by indicator or entering terms to narrow module topics of interest.

Video demonstration 6. EdHub Search by Indicator Generation 2 Prototype B.

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Design Decision 4: Search Materials with a Search Engine and Provide Query Results Organized by the Homepage Topic Structure

Using a search engine to find information is a common feature across websites. Kundu (2015) reported that teachers preferred using a search engine over printed materials for locating professional development topics. Limberg and Sundin (2006) said that teachers' information-seeking approaches were both user-oriented and context-dependent when searching for subject-specific and general information applicable to several contexts and applications in the classroom.

While teacher indicator sitemaps were characterized by context-dependent searches based on users' information needs of teacher indicators, the search engine also allows for user-oriented information tasks based on keywords of interest. The search engine feature enabled non-experienced users to locate materials across multiple topics and modules without fully understanding the alignment with teacher standards.

The search engine results were presented with a similar topic structure from the EdHub homepage across multiple topics. For example, the search term "technology" displayed in the search engine results across several topics in Indicator Classroom Exemplars, Communication, Beginning Teacher Assistance Instructional Strategies, and Professional Practices. In video demonstration 7 of prototype B, the search engine feature allowed users to search modules across multiple topics with their respective topic category.

Video demonstration 7. EdHub Search Engine Generation 2 Prototype B.

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Even though this design decision was implemented across the homepage, topic, and module in prototype A, the user testing showed that users had display issues when searching at the topic and module-level due to the lack of adequate space on the top right of the page. In prototype B, the search engine was only available on the homepage that provided proper space for previewing and navigating search results.

Design decision 5: Create a Single Point of Access for Learning Objectives, Activities, and External Resources

In the first generation of EdHub, instructional modules were in three separate pages. For example, users navigated sequentially to reach the external resources and used the back button in the browser or breadcrumb menu to return to the previous page. In the second generation of EdHub, the components of an instructional module are logically laid out in a single page in three distinct segments, including learning objectives, activities and tasks, and resources. The bookmark navigation menu at the top of the module allowed users to navigate to different sections of the instructional module.

According to Ermeling (2010), Joyce and Showers (2002), and Peery (2002), teachers preferred looking for instructional solutions with immediate improvement in student outcomes. By presenting the entire instructional module, the alignment of content to teacher indicators was evident at the beginning of the module. It also allowed non-experienced and experienced users to make judgments if a particular material addressed their professional development needs. In video demonstration 8 of prototype B, instructional modules were kept with the similar organizational structure based on prototype A, but the search engine at the module level was eliminated due to display issues.

Video demonstration 8. Level 3: Modules EdHub Generation 2 Prototype B.

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PROJECT DESCRIPTION AND TEAM MEMBERS

Before developing and testing prototypes of EdHub, the NEE team suggested that the professional development materials could be hosted in Canvas learning management system (LMS) in early September 2017. As a cost-saving measure, migrating EdHub materials to Canvas LMS would leverage existing resources with minimal downtime. Even though I mocked up and tested an alternative interface of the library in Canvas and similar systems, several challenges were as follows:

1. The linear sequence of modules did not support searching of content across multiple indicators.
2. The linear sequence of modules did not support the browsing of content at a high level to provide a bird's-eye view of what is available in the library. The content cannot be easily explored using a modular approach.
3. The lack of search engine support within Canvas prevented users from locating modules across several topics and indicators.
4. Logins for non-student members were not allowed at the university at the time.
5. Course quotas did not accommodate the large number of resources already on EdHub. The complexity and lack of tracking changes of multimedia learning objects within a Canvas course shell could be easily broken when moving assets between folders and directories.

To overcome the limitations of Canvas, I developed a prototype as a standalone version of the EdHub Library using Bootstrap, Cascading Style Sheets (CSS), and HTML. This project also incorporated a third-party search engine called SiteSearch360 that allowed for customized indexing of web

resources, keyword dictionaries, and search results previews (SiteSearch360, n.d.).

The redesign project consisted of four phases for 11 months from initial meetings for phasing out the first generation of EdHub to the final communication of the availability of the second version of EdHub to all school districts.

The team consisted of two Instructional Designers (one developer and one subject-matter expert), five NEE trainers, and one director. I was responsible for developing the prototypes and keeping track of changes. I was also the Instructional Designer accountable for maintaining and deploying the platform. Table 1 describes a summary of project events in developing and testing the second generation of the platform.

Overall, the second generation of EdHub encapsulated five design decisions in the development and testing of two prototypes and two user testing sessions: (1) visual priority of elements, (2) ease of navigation, (3) browsing materials by teacher indicators, (4) searching across multiple content

1. EDHUB GENERATION 2 REQUIREMENTS	
October 2017	<ul style="list-style-type: none"> • Migrate content to a new webserver • Meet with internal stakeholders for phasing out EdHub Generation 1 • Establish a timeline for EdHub Generation 1 phasing out
November 2017	<ul style="list-style-type: none"> • Meet with IT for integrating EdHub Generation 2 into an existing tool • Meet with internal stakeholders to prioritize essential functions of EdHub
December 2017	<ul style="list-style-type: none"> • Announce phasing out of EdHub Generation 1 to all school districts
2. EDHUB GENERATION 2 PROTOTYPE & TESTING	
January 2018	<ul style="list-style-type: none"> • Prototype initial idea by incorporating five design decisions: Visual priority, navigation, browsing by indicators, searching across content, and unifying module, activities, tasks, and resources in one page.
February 2018	<ul style="list-style-type: none"> • Conduct user testing with trainers of prototype A in a test environment • Complete content migration to the new server
March 2018	<ul style="list-style-type: none"> • Incorporate feedback from prototype A for improving search engine results organization
April 2018	<ul style="list-style-type: none"> • Create an MS Word of the journal template • Conduct user testing with trainers and external participants on prototype B in the test environment • Finalize technical testing of prototype B in the production environment
3. EDHUB GENERATION 2 DEPLOYMENT	
May 2018	<ul style="list-style-type: none"> • Deploy EdHub Generation 2 for Summer Training 2018 in the production environment • Perform adjustments to user tutorials per user feedback from training sessions
August 2018	<ul style="list-style-type: none"> • Communicate deployment of EdHub Generation 2 to all school districts
4. EDHUB GENERATION 1 PHASE-OUT	
December 2018	<ul style="list-style-type: none"> • Phase out EdHub Generation 1

TABLE 1. Summary of Project Milestones.

topics, and (5) consolidating module activities, resources, and reflection within a single page.

Phase 1: EdHub Generation 2 Requirements

In October 2017, the NEE team held several meetings to discuss phasing out the first generation of EdHub. The group also discussed finding a new web hosting service for storing multimedia assets and instructional materials that could accommodate substantial web traffic of 35,000 users based on web analytics data (Leung, 2018). In November and December 2017, internal stakeholders and IT staff discussed the possibility of embedding EdHub within the existing Data Tool that collected classroom observation scores and student surveys. Accessing the library within the Data Tool was a priority for stakeholders since it would eliminate the need for teachers to remember login credentials and access tokens for groups and content.

We also discussed the platform’s elements that were required for teachers to provide easier access and navigation to professional development materials. Due to the lack of funding and expertise in Plone development, platform features, such as journals, administrator dashboard, and content and group access codes, did not need further development by IT staff. NEE notified users about the phasing out of the platform and asked users to download any journal entries from the old platform until December 2018.

Phase 2: EdHub Generation 2 Prototype and Testing

During the prototype and user testing phase in January–February 2018, I developed prototype A of the EdHub homepage that contained relevant information about getting started, bookmarks, news, and curated content sections. Users could glance over topics available from the homepage. When a module was selected from the topic list, users had the entire module organized in three clear headings as objectives, activities, and resources.

The critical differences between prototype A and the first iteration of the EdHub involved (1) collapsing five levels of sequential navigation down to three hierarchical levels, (2) prioritizing important information first in clear sections that allowed users to look at overviews of all topics, (3) presenting content alignment and consistency with teacher indicators at all levels, and (4) encapsulating module information in a single page without having to navigate each section.

By implementing a hierarchical or tree structure in the prototype, users began with broader categories of information.

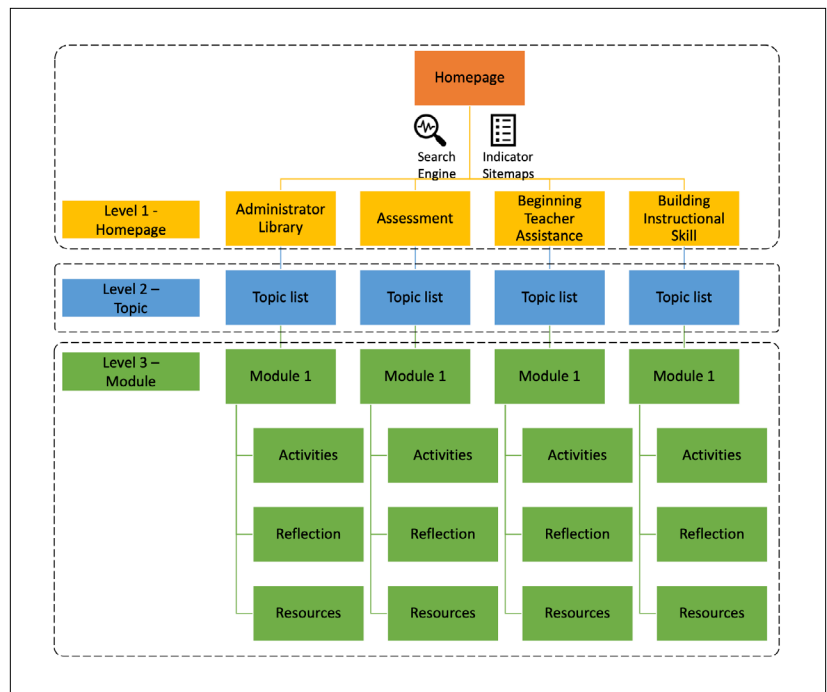


FIGURE 5. Three-Level Hierarchical Structure of EdHub Generation 2.

They then drilled down to specific topics and modules to find more detailed information. Unlike the sequential structure, the hierarchical structure allowed for efficient navigation in and out of topics and modules, as shown in Figure 5. It also incorporated breadcrumbs throughout the library to indicate the location of materials and facilitate navigation.

In the first user testing session in March–April 2018, five trainers were given full access to prototype A of EdHub. These five users were trainers for NEE who had not previewed the prototype, but were aware of the navigation challenges of the first iteration of EdHub. Participants were given written instructions about any obstacles in performing eight tasks for locating and browsing professional development modules.

These tasks included looking for materials under an hour related to (1) Instructional Videos related to Indicator 7.4, (2) Cognitive Engagement, (3) Evaluation of School Counselor, (4) Beginning Teacher Assistance, (5) Critical Thinking, (6) Professional Development related to Indicator 5.3, (7) Units of Instruction Examples, and (8) a module of their choice. For each task, participants were asked to check whether they were able to find the module with their location in the library, write down any suggestions or challenges during the task, and provide overall feedback for the entire user experience.

Although all participants were able to perform all tasks in prototype A under 30 minutes with their correct locations of the materials, two pieces of feedback were related to the visual elements and search

functions of the homepage. User feedback also indicated display issues with search engine results at the topic and module levels. More specifically, users suggested the following items incorporated in the homepage for the next prototype.

1. Change the location of the search bar function and gold boxes (getting started and bookmarks), to the bottom of the EdHub logo
2. Eliminate News and Curated content sections
3. Reduce the size of the EdHub logo to make the Getting Started section more prominent
4. Add a Social bookmark section
5. Eliminate the search engine feature at the topic and module level due to screen size constraints
6. Improve the presentation and organization of search engine results to reflect content groups on the EdHub homepage
7. Organize the homepage in four logical sections and accommodate different ways to look for content as follows:
 - a. Providing getting started information and the journal template for download
 - b. Presenting search engine results by topic
 - c. Browsing by teacher indicators using dedicated sitemaps
 - d. Browsing topics in alphabetical order

With significant changes to the homepage layout and search engine results display, the old prototype became prototype B that incorporated dedicated pages for displaying all professional development materials by teacher indicators. Four significant sections of the EdHub homepage were displayed in prototype B by prioritizing the overview of the topic contents available in the library, as shown in Figure 6.

These prominent sections of the homepage included (1) information on getting started and mandatory training modules, (2) locating materials using a search engine, (3) browsing lists of materials by teacher indicators, and (4) browsing all available topics with previews of topics and alignment with teacher indicators.

With prototype B deployed in the test server, the second user testing session included the five NEE trainers from the first user testing session of prototype A. The same group

of testers helped to verify the improvements and identify further navigation challenges. In addition to the NEE trainers, three participants outside NEE at the Assessment Resource Center (ARC) volunteered to participate in the second user testing session.

These outside participants had not seen the prototypes and had no experience with teacher professional development. A total of 8 participants were given instructions with eight preselected topics different from the first user testing session. Participants were asked to check if they were able

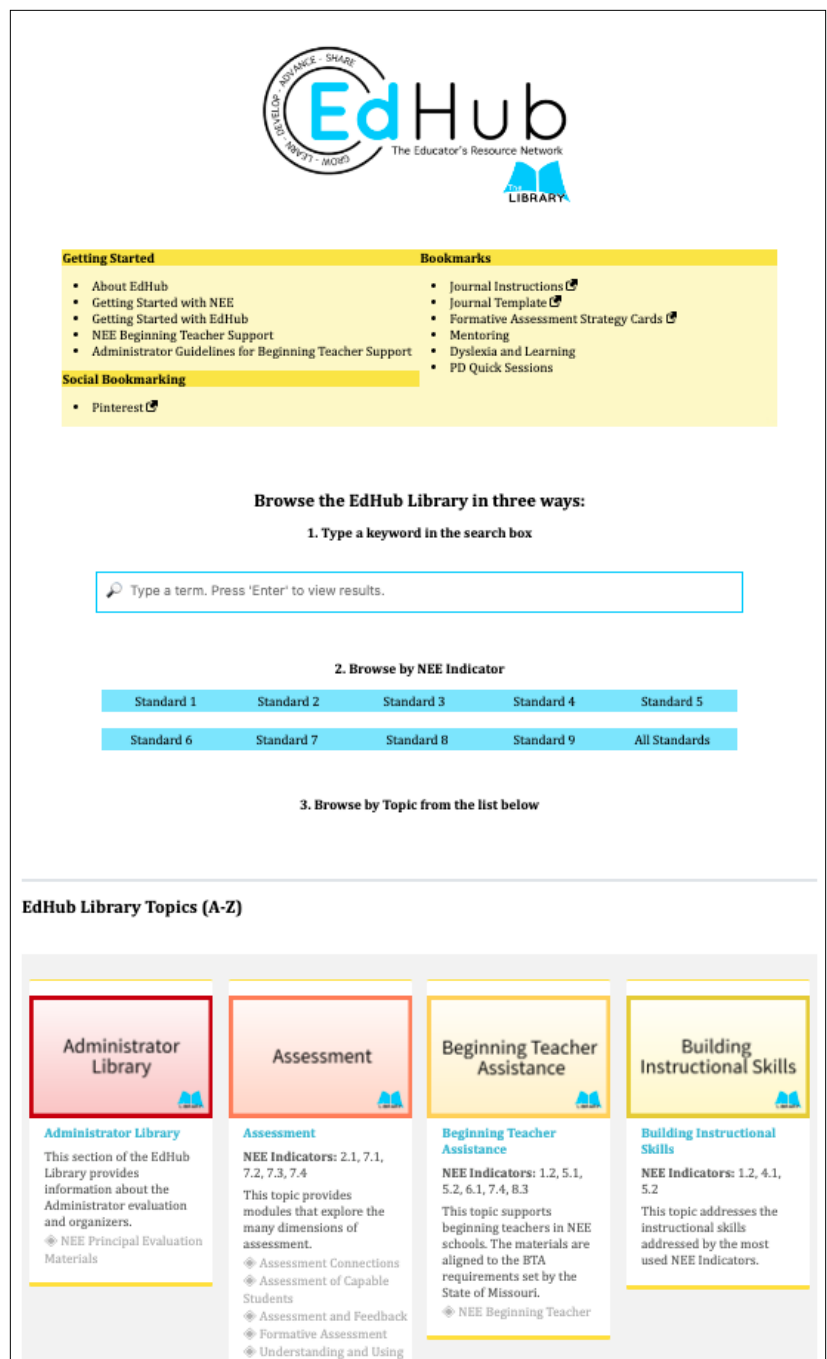


FIGURE 6. Reorganization of the EdHub Homepage Prototype B.

to locate the topic, jot down the location of the material, and provide specific feedback or challenges for each task. Participants were also asked to indicate the search method of their choice using the search engine, sitemaps, or the Edhub homepage topic list.

While the five NEE trainers performed all tasks successfully under 20 minutes using teacher indicator sitemaps and provided positive feedback for the changes implemented in prototype B, the outside participants spent around 30-40 minutes locating topics by browsing the EdHub homepage and using the search engine. However, the external participants did not use the sitemaps because of the lack of familiarity with teacher indicators. To verify the correctness of the tasks, I checked the users' responses to the materials' location.

The overall user feedback in prototype B indicated (1) the ease of readability of the library homepage with clear previews of topics and alignment, (2) user choice for searching materials by indicator, search engine, or browsing the homepage, (3) the ease of use in accessing desired materials, and (4) general awareness in recalling the location of modules in the library.

Although five outside participants responded to the recruitment call, two participants were unable to attend the sessions due to scheduling issues. Also, the user testing sessions did not contain the journal template. The template was a Microsoft Word document with blank spaces for entering teacher reflection that was not necessary for performing tasks during user testing sessions.

Nielsen and Launder (1993) noted that 75-99% of usability problems could be detected with five users. While the user testing sessions met the minimum number of participants with experienced and non-experienced users based on Nielsen and Launder's recommendation, it would have been possible to generate additional insights related to usability of the platform and users' information needs by recruiting additional external users with no prior knowledge or experience in teacher professional development.

Towards the end of the prototype and testing phase in April 2018, prototype B was finalized with minor tweaks to topic titles based on the second user testing session. In collaboration with the IT team, prototype B was embedded in the production server within the NEE Data Tool using the iframe HTML tag. In the technical testing of the library, the IT team discovered that the display height of EdHub did not render correctly in the production server.

The height of EdHub collapsed to the height of the menu options in the Data Tool, which was around 400 pixels in height. Even though the iframe code of EdHub in the test environment displayed adequately, the iframe code required additional height and width parameters of 600 pixels

and 100 percent, respectively. With these parameters, the height of EdHub was preserved within another resource by overriding the custom CSS properties of the Data Tool in the production server.

Phase 3: EdHub Generation 2 Deployment

Once the display issue was fixed in the production server, the second generation of EdHub was ready to roll out for Summer Training in May 2018. These training sessions served two goals. First, the training provided principals with practice opportunities for scoring classroom observations of teachers available in the EdHub Library. Second, the training sessions allowed principals to get acquainted with the second generation of EdHub.

In training surveys, principals highlighted (1) the ease of navigation and location of professional development materials using a variety of search methods, (2) the ability for curating targeted materials by teacher indicators, (3) the ability to preview the alignment of teacher indicators and materials in the homepage and search engine results, and (4) the inclusion of video tutorials for teachers on EdHub.

In August 2018, NEE communicated the full transition of the EdHub Library to all school districts at the beginning of the new school year. NEE also reminded school districts to download any journal entries and documents in the first version of EdHub.

Phase 4: EdHub Generation 1 Phase-Out

In December 2018, the first generation of EdHub was de-funct in favor of an embedded version of EdHub in the NEE Data Tool. At this point, I rolled out how-to video tutorials for teachers and migrated all instructional modules to the new web hosting service. Even though the first generation of EdHub was not accessible after the implementation of the new platform, an archive was created to keep copies of web analytics data of instructional modules and user access for a future analysis between the two versions of EdHub.

CONCLUSION

Online teacher professional development platforms enable teachers to access resources remotely and plan for professional growth based on self-identified professional development needs or recommended by their school administrator. While teachers' professional needs and experience with professional development vary significantly, this design case specifically explores the process of redesigning online teacher professional development and testing two prototypes with experienced and non-experienced users.

Even though the second generation of EdHub supports user-oriented and context-dependent information-seeking needs of users using state teacher standards in a fully online

environment, this design case may not be applicable to other forms of online teacher professional development structures that do not rely on teacher standards and hybrid or web-enhanced delivery methods. While professional development can be developed in traditional learning management systems (LMS), the linear presentation of information may not be adequate for users to assess context-specific tasks of aligning teacher standards with professional development modules.

In this design case, the feedback from teachers and administrators emphasized the need to improve EdHub in terms of (1) navigation and usability, (2) ease of access, (3) ensuring user privacy of teacher reflection, and (4) in-house maintenance of the library. The second generation of the EdHub Library was refined through two user testing sessions that ensured a clear separation and prominence of the sections in the homepage to support experienced and non-experienced users. Also, the navigation scheme was restructured from five levels of sequential steps to three steps using a hierarchical structure. The hierarchical structure allowed for better navigation and assessment of materials with teacher standards at all levels of the library.

The design decisions implemented in the second generation of EdHub support the self-regulation activities of teachers and school administrators in their acquisition of professional development. Self-regulation refers to the process of monitoring progress, checking outcomes, and redirecting unsuccessful efforts while participating in the learning process (Zimmerman, 2002). Self-regulation activities involve multiple techniques for evaluating and monitoring learning, including, self-monitoring, self-instruction, goal setting, and self-reinforcement.

As users consciously apply cognitive, metacognitive, and motivation strategies to their learning environment, EdHub enables teachers of various self-regulating capacities to locate professional development materials by using the search engine, indicator sitemaps, or homepage topic directory while assessing the alignment of materials to teacher standards during their information-seeking task.

While the EdHub Library features a redesigned hierarchical navigation structure and several ways to help teachers and school administrators to locate materials based on teacher standards, EdHub accommodates different types of user-oriented and context-dependent information-seeking tasks.

In user-oriented tasks, for example, new teachers are able to locate materials curated to their PD needs under the Beginning Teacher Assistance topic from the EdHub homepage. EdHub also provides a dedicated section in the homepage for practicing classroom observation scoring evaluation activities that provide principals and assistant principals with on-demand training simulations of classroom observations with immediate corrective feedback.

In context-dependent tasks, the EdHub Library supports building leaders in locating PD resources that fit school district goals by using teacher standards sitemaps. For subject-specific materials, for instance, math teachers are able to use the search engine to locate materials that target multiple topics in student engagement, formative assessment, classroom observation, and examples of units of instruction. While EdHub accommodates the individual needs of users, EdHub helps collaborative groups to curate materials using the search engine that organizes search engine results by topic category.

Finally, the design case benefits developers of online platforms and designers of teacher professional development by creating an understanding of user needs in online K-12 settings. For example, developers of online platforms are able to support teachers' information-seeking with effective navigation schemes and better affordances of web interfaces. Designers of teacher professional development materials are able to understand the implications of teachers' information needs and information architectures in standards-based PD.

Even though the second generation of EdHub supports various types of users and information tasks, further research within the EdHub Library design case is required in understanding self-regulation activities and information-seeking preferences (e.g., search engine, teacher standards sitemap, homepage directory) among teachers and school principals of various degrees of professional development needs and experience.

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