

# NORTH DAKOTA ATLAS

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## ABSTRACT

The North Dakota Atlas is a collaborative project between the Departments of American Indian Studies, Anthropology, Biology, Communications, Computer Science, History, Integrated Studies, and Religious Studies seeking to create an online atlas. The purpose of the atlas is to engage an interdisciplinary group of students in experiential and collaborative learning to map demographic, economic, and social changes across the state. It will serve as an important resource for policy makers, community members, and K-12 colleagues and students, which will expand student's education experiences with significant community engagement. Finally, it will provide a tangible product for public consumption to increase participation of the public as informed citizens.

**Index Terms**— Web Design, Atlas, Maps, History, North Dakota

## 1. INTRODUCTION

The North Dakota Atlas website began as a senior project for another group. They set up a server and designed an interactive website, but it was never officially finished. Dr. Michael Niedzielski of the Geography Department wanted to see the project through but had some difficulties in the past with different groups of students coming in and out on the project. The goal this semester was to overhaul the entire website with new graphics, interactive maps, and to give it a clean, finished look.

## 2. APPROACH

### 2.1 Simplicity

One of the main goals of the atlas is to convey the work students have done in a clear, concise manner. Simple websites enable users to find the content they need without complications. "A cluttered website tries to convey too much info and too many messages at one time...Too many messages communicated on a website means that none of the

messages are communicated properly" [2]. More pages with focused content will contribute to this goal.

Further, a study was published named *The Impact of Visual Layout Factors on Performance in Web Pages: Cross-Language Study*. This study included tracking a user's eye movements. The authors write "We investigated interactions among four visual layout factors in Web page design...Performance was particularly poor in pages with many links" [5]. In order for this project to be effective, the visuals used on the site must establish a clear pattern for the user to follow. The fewer links and distractions, the easier it is for the user to navigate the site.

The original North Dakota Atlas site was a scroll style. All the information was on one page and the user had to continuously scroll for more content. To keep the website simple, the new design requires minimal scrolling and multiple pages with themes. The landing page provides two options to direct the users. There are more menus included to simplify the website design, including a page dedicated to a map table of contents.



Figure 1. Landing page on ndatlas.und.edu

The clean and simple layout of the North Dakota atlas webpages implements Bootstrap, "the most popular HTML, CSS, and JS framework for developing responsive, mobile first projects on the web" [3]. Most modern pages are based

off templates, but Bootstrap allows the designer to build from scratch with simple elements. “Bootstrap easily and efficiently scales your websites and applications with a single code base, from phones to tablets to desktops with CSS media queries” [3]. The Bootstrap manual provides small portions of code that are easily copied or modified for the web designers use. The use of Bootstrap enables an organized, simple, and modern design.

## 2.2 Usability and Efficiency

The usability and efficiency of a website are closely related. If the site runs slowly, users may get frustrated and move onto another source. In the book *Web Cartography*, it is noted that “the web map should not be too too large in both image and file size. Otherwise it is likely the user will be unwilling to wait for the map to download” [1].

According to Ilya Grigorik, the author of *Image Optimization*, “optimizing images can often yield some of the largest byte savings and performance improvements for your website.” He continues by advising “CSS effects and CSS animations can be used to produce resolution-independent assets that always look sharp... Vector graphics use lines, points, and polygons to represent an image... Vector formats are ideally suited for images that consist of simple geometric shapes” [4]. Vector shapes prevent fuzziness and confusion in graphics.

The atlas project uses vector graphic maps to display the data for each year in relation to the topic presented. These maps render well on various electronic devices.



Figure 2. Railroads map page, version 1

## 2.4 Maps, The Students Work

The main goal of this project is to display the work students from various departments have done. The format of an online atlas was favored because it includes maps, graphs, and text interacting together based on a specific theme.

According to Daniel Richard of the Institute of Cartography, “An atlas should be a combination of maps and additional information combined with a well-structured work.” Further, “An atlas is a bound collection of maps. It often includes illustrations, informative tables, or textual

matter...” For an online atlas to be successful, “Maps produced with vector graphics applications...presented in an attractive way... and exported to a raster file format give best results.”

The maps that were used in the past were interactive maps implemented with an extension called Leaflet. These maps presented interesting information, however they were very slow to load. They had to request the information from a completely different server then load it to the ndatlas server. Also, they had zooming capabilities that slowed the site and were unnecessary. These delays led to the reimaging of the ND atlas page with static images.

The North Dakota Atlas project includes interactive components. “Maps can be defined as graphic representations of our environment... The browser and the fact that most of these maps have to travel over networks put some constraints on the design and physical nature of web maps” [1]. To avoid these delays, it will be strictly front-end development with JavaScript that does not rely on information on other servers. Daniel Richard mentions that maps graphics are very suitable for interaction. “It is possible to put all kinds of additional information behind the map image. This extra information could be made accessible via techniques such as mouse-over” [1]. The expansion of the Atlas page may use this technique to create more advanced visuals based on the vector maps currently being used.

## 3. WORK ACCOMPLISHED

### 3.1 Phase One

During the first meeting with Dr. Niedzielski he was hesitant to allow another student to work on the atlas. He said the students that had done work on the project in the past did not accomplish as much as was desired and the department was considering hiring someone to complete it. I told him I had success with working quickly in the past, showed him some examples of websites I had designed and completed, and promised the project would be completed on time.

The goal for the first semester was to have a new website live before December, including all menus, webpages, and graphics. The initial redesign process began with a few rough drafts of the webpages. Once a template and color combination were selected, the individual web pages were designed.

After the redesign, the webpage is composed of more individual pages, but the organization is easy to follow. The user enters the site at ndatlas.und.edu and views the landing page. They can choose from two buttons, one that takes them to the map glossary and another that takes them to an explanation of the project. The homepage provides a description of how the project got started while the student page contains pictures of students that provided research for the descriptions and maps of the website. The development page and individual map pages were modifications of code

available on the original ND Atlas website, with a few style changes.

Work began on the Citizen Science Grid server (managed by Dr. Travis Desell) temporarily so Dr. Niedzielski could follow along with the template designs. This server was based in PHP, so using strictly HTML, CSS, and JavaScript was not an issue. Eventually, work was transitioned offline on a local server. This was not as convenient for updates, but screenshots were used to communicate style ideas. All coding was done using Vim through the command line. Referencing the original GitHub repository (UND-CSCI491/nd125), a new repository (ndatlas) was created and linked to the North Dakota Atlas homepage to bypass the previous site designs. This process was necessary because the students who had set up the project did not leave instructions to access the GitHub branch or change the permissions to modify the site.

The ndatlas server can be accessed by installing the AnyConnect Secure Mobility Client. It is the same VPN used to access the shell at school. Once the VPN was setup, Travis Desell set up an account on the server to access the live code. After logging in, (ssh [lwingate@ndatlas.und.edu](mailto:lwingate@ndatlas.und.edu)) the live code can be accessed in the directory /var/www/ndatlas.



Figure 3. The Cisco Campus VPN

After multiple edits and redesigns, the initial web pages were ready to be uploaded onto the ndatlas server and go live. Marshall Mattingly, a graduate student in the Computer Science program, had previously worked on the North Dakota Atlas as his senior project and had done all the setup for the server. He assisted in translating all the HTML code to Jade, a template engine used with NodeJS. Overall, the translation process was very time consuming and took a week longer than expected.

Once the webpage was live, teachers from all the Humanities departments at UND provided feedback on the design and style aspects of the entire site. Before the end of the semester, the entire site had been completed to the specifications required.

The first version of the website was presented to the public at UND by Dr. Michael Niedzielski on Thursday, December 8<sup>th</sup> and in New York City by Dr. Debbie Storrs.

### 3.2 Phase Two

The goals for the second semester included site maintenance, optimizing images, adding more map pages to the website, and creating an interactive map that didn't require pulling data from a different server. Dr. Niedzielski also specifically requested a play button on the individual map pages that would cycle through the maps and show changes overtime.

The addition of new map templates to the webpage was simple. In order to add onto the website, a new jade file had to be created. The map pages all must extend the page template master.jade, a JavaScript file, and a CSS file. Finally, the new map page must be added to the "server.js" file so the URL becomes active and part of the web directory.

At first, it was undecided which maps would be interactive. It was decided that maps displaying many individual entities that required individual explanation, such as cities or religion, would be the best option. Public Building Projects became the first interactive map and was created using an image map, or a photo with clickable points. Each point was specified by coordinates in relation to the picture size and have an id that is referenced in the JavaScript file. When the area is clicked, the text in the sidebar is replaced with a description and picture(s) of the location.

In the final weeks of the project, great consideration was taken on the overall presentation of information. Backgrounds were darkened so the white font stood out, the site menu was adjusted so it stood out against new backgrounds, and colorful backgrounds were added to the map pages.



Figure 4. Public Building Projects map page

### 3.3 Issues Encountered and Future Opportunities

There were many difficulties and challenges to overcome during this project. Originally the site was slow because a lot of the data presented in graphs and charts was fetched from another server. Once the new changes went live, the site was

slow because of the various maps and background images. In order to reduce the load time, the images were optimized. There is still some lag when the user clicks the buttons to view the different maps on the map pages. Further work could be done on the images and other aspects of the webpage for efficiency.

Another issue with the website is its cross-platform performance. Not all the pages in the atlas are responsive or dynamic, leading to issues when people may visit the site on a smart phone or tablet. Separate applications could be developed to allow access for various devices.

At some points during the project there were issues with the local branch not lining up with the live code. Although this should be expected during development, a strict order of adding new pages, committing them, and then pushing to the main branch needs to be followed. Once the changes are pushed, they must be pulled from the ndatlas server. A few times the code did not line up (due to pulling before anything was pushed) and code was lost. Marshall Mattingly was extremely helpful during these events. He was able to sort through the git commits and restore some of the lost code; unfortunately, reworking and updating the code was still required.

The play buttons Dr. Niedzielski requested on each map page still have timing issues if the page is not completely loaded. The JavaScript is referencing images on the server, but the image load time still lags. The speed it takes JavaScript to switch the images was lowered from one second to two seconds and the performance was greatly improved, however other solutions could be considered. For example, the maps can be preloaded in the CSS script to improve load time.

The most challenging issue during this project was the organization of Jade templates. Access to the main server where the atlas is hosted (ndatlas) was not available until later in the first semester and waiting for login information would have caused significant delays, so the project began development without Jade templates.

Once the local code was completed to satisfaction, it came time to translate the HTML scripts to Jade. This process was time consuming and rushed for the first release. There was no obvious way to divide the preexisting code into Jade templates, so some poor design decisions were made. Each webpage had its own HTML, CSS, and JS script. Once Jade was introduced, a master template was created to maintain the standard menu at the top of all the webpages. The map pages consisted of maps with and without narratives on the side, so two more templates were created to accommodate. Finally, the individual map pages extended a map template and the master template.

This organization functioned well for the first version of the website but became difficult as changes needed to be made to individual map pages. For example, some map pages were influenced by the map template CSS script instead of its own corresponding CSS. When a stylistic

change needed to be made, the CSS script with the corresponding element needed to be tracked down. A total reorganization of the templates and scripts was completed in the second semester so changes in the backgrounds and styles of individual pages were easily accessible. The current working model consists of the master template, included on all the webpages on the site, and a separate page that extends the master with its own styles and formatting. The map template was kept on the server for future reference but is no longer extended on any of the pages.

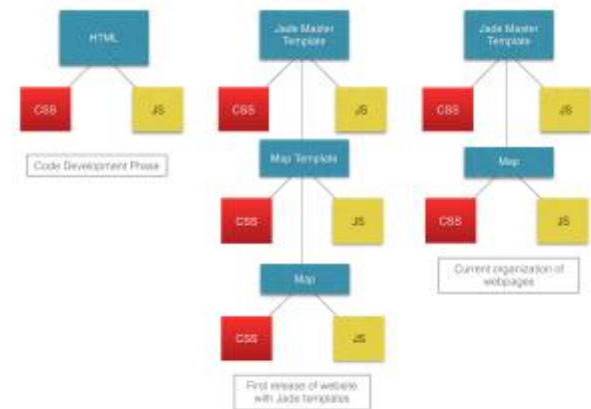


Figure 5. Code organization for version 1, version 2, and version 3 of the website

## 4. CONCLUSION

The North Dakota Atlas redesign project was a success. The project managed to stay on a strict timeline, completing all the functional and design formats desired by Dr. Niedzielski and the Geography Department. It fulfilled the goal of displaying research done by the students at UND and is a valuable resource for those studying the history and culture of North Dakota.

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