An Online Catalog of Tools and Techniques for Teaching

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Abstract

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There are many different techniques and tools to make education more diverse. Finding information about these techniques and tools though is not always easy. To help teachers in their education, this project is about creating a website that functions as an online catalog of tools and techniques. Our main focus is the interface of the website, making the catalog easy to use. The target group is teachers at Uppsala University.

To find the best implementation the design of the interface, we began by creating different user stories and building a prototype. The prototype was tested by friends and family of the project team. With feedback from the test, the interface was built, the implementation was then tested by users from the target group. The result was a well-tested website with an, according to the result from the user tests, easy-to-use design.

The result was considered useful by the stakeholders. The website will be used by The Council for Educational Development at the Faculty of Science and Technology at Uppsala University (TUR).
Sammanfattning


Resultat var en vältestad hemsida som, enligt resultat från användartesterna, hade en design som var lätt att använda”. Resultatet ansågs även vara användbart av projektets intressenter. Hemsidan kommer att tas i bruk teknisk-naturvetenskapliga fakultetens universitetspedagogiska råd på Uppsala Universitet (TUR).
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1 Introduction

Have you ever experienced going to a lecture, sitting down with your friends, excited about a new course? The lecturer walks in and starts speaking in a monotone voice about a subject you have no prior knowledge in. Making the information hard to follow and to absorb.

We have had that experience in our education at the university, but we also have had a few courses in which the teachers have used techniques and tools to improve their teaching. These tools and techniques make the education feel a lot more modern than the traditional lectures. Therefore, we started to reflect on why not all teachers use these kinds of techniques and tools. Can it be a matter of the lacking of tools, lacking of knowledge on how to use them or not knowing of their existence? We concluded that one main downfall is that information about these tools and techniques can be hard to find.

For this reason, we decided to implement a front-end for a website that serves as an online catalog with tools and techniques for teaching and with information on how to implement them in the courses. The project’s main focus is the implementation of the interface of the website, making the catalog easy to use. The target group for the project is teachers at Uppsala University.

Creating a easy to use design is not trivial, achieving good design requires knowledge about user experience. A prototype for the website needed to be created, to be able to get an idea of if the layout was viable. The actual website needed to be tested on real people with real needs and varied backgrounds. By doing this we could validate that the design is usable. As well as listening to what the end users, the teachers, gave us as feedback, so the website could be used effectively by as many users as possible.

The result was a well-tested website with an, according to the result from the user tests, easy-to-use design. We hope that this will encourage teachers to try out new methods on how to share their knowledge and that this will contribute to better learning for students. The result of the project was considered useful by the stakeholders. The website will be used by The Council for Educational Development at the Faculty of Science and Technology at Uppsala University.
2 Background

A website has previously been developed by students at Uppsala University within a project called “A Search Tool for Pedagogical Techniques and Supportive Technical tools” [1]. In the report related to this project, one can read that the purpose of the website is for teachers to easily and fast find different tools and techniques and information on how to use and help them educate. Additionally, to provide reviews by teachers that already have used the tools. During the previous project the other project team creates a database, a related Application Programming Interface (API) and a simple search function, this was implemented on a website hosted on a university server. To display the contents of the database the previous project group created a website. This website had functions like a search page and a browse page, but the aim of the previous group was not to develop an interface which is why the website can be considered a skeleton, a website with functionality but no design.

The goal with this project described in this report is to provide an interface for a website with information about different techniques and tools for teachers, the same website referenced above. Teachers can use the information found on the website in their education, hopefully to reach out to more students.

2.1 Learning theory

The different ways students process, absorb and retain knowledge when learning are described as learning theory [20]. Each student learns in a different way, there are many studies trying to pinpoint how people take in and retain information.

Donelson and Forsyth summarize a plethora of teaching tools and pedagogical techniques into four very important categories in teaching, two of them relevant in our project [15]. In the category “Knowledge: deep understanding of the field“, they mention streaming online lectures, learning modules and flash cards among other tools. Under “Literacy’s: proficiency in reading,writing [..]“ they list peer commentary and review, virtual problem based learning groups and other tools. Information about the teaching tools and pedagogical techniques mentioned above is available on the website of this project, with the goal of making it easier for teachers to use. This is relevant because knowledge, literacy and personal development are goals we want to achieve through teaching [43].

According to the National Research Council, one definition of learning is “when a person can apply knowledge with already known skills and concepts[..]“. [32] The National
Research Council continues by writing that this means the new knowledge will be more rooted in the memory. In a lecture, if teachers can help the students connect the new knowledge with concepts previously presented in the course and presenting the connection between them, this could improve the information retention with the students. To facilitate teaching, teachers can use different pedagogical techniques.

### 2.2 Pedagogical techniques

Pedagogical techniques refer to different techniques and methods that are used in education [47]. One goal of the pedagogical methods and techniques is to promote the relations and associations humans have within the subject that is taught. As personalities relate and associate things differently, it can be hard to find a pedagogical solution that fits a group of people, for example, a class.

In order for a university to offer as good of an education as possible, it must overcome this hurdle. Lectures at universities are often held to a large number of students, and it can be hard to make it personal. To make the education suitable for as many students as possible, different pedagogical techniques can be used. For example, Active Learning is a technique which involves students more in the learning process compared to other methods [25].

Flipped classroom is another technique, using this technique the teacher gives the students some form of homework to prepare for the lecture, it can be watching a video lecture or listening to a podcast. At the actual class instead of a traditional lecture, the teacher can use the time for more practical work [62]. Pedagogical techniques can be combined with digital education tools. The tools can facilitate the use of the technique.

### 2.3 Auxiliary tools for education

Teachers have a plethora of tools for facilitating education for their students. These tools are of different forms and can be helpful in implementing a technique for pedagogy such as "active learning" and "flipped classroom". Example of tools are e-books, smart boards, etc. They do not necessarily need to be digital though many are. An example of a digital tool, which will be described below in this subsection, is Scalable learning, where on the other hand a tool with analog implementation is a mentometer button, a way to let the students vote anonymously.

Scalable learning is a type of screen casting. The service provides interactive online
tools such as videos and quizzes. Scalable learning can be combined with one or more pedagogical techniques, for example, flipped classroom, but can also be used alone as a complement to traditional lectures [41].

Another tool is mentometer; this tool is a response system [29]. Mentometers can be used in classrooms, when the teacher asks a question the students can answer using the keypads on the mentometers. With mentometers, teachers can create a more interactive lecture for the students, for example asking ”what problem do you want me to solve on the board” or ”is there any part do you want me to go through again”. In this way a teacher can create a democratic environment in the classroom.

### 2.4 How teachers find information today

Today teachers at Uppsala University are offered to attend courses, seminars, conferences and workshops to find information about different tools and techniques [7]. To attend seminars, conferences etc. can be time-consuming as they can last a whole day or more. There are other universities that offer website services that provide information about different tools and techniques. For example University of Leicester provides a guide to different tools for education on their website [55]. There are variations on traditional lecture techniques and digital tools. Brown University has a website that provides information about many digital tools [5].

There is a lot of information about different techniques and tools today online, but to find the information can be difficult. It can take time to search for information and it can also be hard to connect different digital tools with existing pedagogical techniques. This could potentially cause teachers to choose to not use modern techniques and tools in their education.

### 2.5 Stakeholders

The stakeholder for the project was Felix Ho. He works at the Department of Chemistry at Ångström Laboratory and is also a member of TUR at Faculty of Science and Technology at Uppsala University (Teknat) [57]. The council TUR is responsible for educating the teachers further at Uppsala University [7]. Education is done through courses, seminars, conferences, and workshops. The aim of the courses, conferences, etc. is to develop education at the university further.
3 Purpose, aims, and motivation

We want teachers to easily be able to find different methods of education they could implement in their teaching. This could mean implementing new digital tools in their class or trying out a new pedagogical technique. We believe that this will result in better learning for students.

To achieve this, we developed a web-based service that works as a catalog of different tools and techniques. As mentioned in Section 2, this project was based on the work of another project. Our focus was the usability of this service. Usability means that a user can experience a website without encountering problems [40]. The people using the website should feel satisfied with the search of techniques and tools and we want them to be able to enter the site without knowing what they are searching for and leave with a digital technique and/or tool to improve their teaching.

3.1 Target group

The target group for this project is teachers at Uppsala University. We have to keep in mind that users will use the website differently. Users can have a strong idea what they want to achieve when entering the website and other users will only seek for inspiration. We want both of these potential users to be able to accomplish their goals. In the future the target group might be extended to teachers in general, at different universities but also at lower levels of education. Also, many of the teachers at Uppsala University may not understand Swedish and it is important to remember for the implementation.

3.2 Motivation

There are a lot of different techniques and tools to use in education to facilitate for teachers. With these, the education can be made more modern and the subject taught can be made more understandable for the students [46]. For this purpose, it makes sense to use different techniques and tools to facilitate the education. Using these can make the education more tailored for students.

As mentioned in Section 2.4, there is no service that provides a catalog for tools and techniques in education specifically for teachers at Uppsala University. The time it takes to search for information about the existing tools and techniques can be a reason not to implement them in the education. This would be solved with our website.
3 Purpose, aims, and motivation

3.2.1 Sustainable development

One important perspective in this project was how the project will help a more sustainable future. This project provides a service that makes it easier for teachers to diversify their teaching methods. Having a flexible education means the education increases in quality and hopefully teaches on a deeper level that is lifelong [15, pp 227-250].

This aspect associates with the sustainable development agenda. The sustainable development agenda is a set of goals set by the UN for the world to reach by 2030 [54]. They consist of 17 goals for a sustainable world, focusing on different areas of a sustainable world such as people, prosperity, planet, peace, and partnership.

The project directly associates with goal number 4. The UN describes goal number 4 as "Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all" [54]. The project can aligned with this because the aim of the project is to make education more accessible to all by making the education more modern.

3.2.2 Similar projects at other universities

There are several websites at different universities that, similar to this project, collect data about different tools and techniques. For example University of Sussex and The University of Leicester. What the different websites have in common is the lack of simplicity or logical structure. When inspecting University of Sussex’s equivalent to the website of our project, the user can not search for a more specific tool or technique [56]. The University of Leicester offers a similar service; they offer categories such as "supporting students learning" and "assessing students learning". The University of Leicester does not offer a search service but does make the strategies more accessible to find than on the University of Sussex website [55].

3.3 Ethics

The project will result in a website with different tools and techniques. For every tool and technique the ambition is to have at least one reference person. By reference person on the website we mean a teacher at Uppsala university that has used the technique/tool in their teaching and is willing to be a reference. The purpose is that a user of the website has a person to ask how to use the tool/technique.

Every reference person is a teacher at Uppsala University who has given consent to
publish their email address and name of the teacher. It is important to consider to whom
the personal data of the teachers is shared. The conditions of being a reference person is
to agree to have their email address and phone number published at the website. This so
other teachers could contact the person for advice and inspirations about the tool/tech-
nique. Having the email address available online should not be in itself an issue since
Uppsala University staff already have personal information publicly available on Up-
psala University’s web page [58]. At Uppsala University, teachers email address and
phone number are published on the website. So, the teachers that have accepted to be
reference persons have already allowed this information to be shown. What could be
an ethical issue is if the website will be promoted to others than teachers at Uppsala
University in the future. Then consent about the published data need to be reconfirmed
from the reference persons, this is discussed under Future Work in Section 12.

Another important point to consider is impartiality when deciding what tools and tech-
niques that are presented at the website. For example, the tools/techniques that are
presented on the website should not only be our favorites, the website should have
a variation. Although this problem is something that in reality cannot be completely
avoided as the team of this project do not decide the content of the website, just how the
content is presented. For adding and removing techniques/tools the website will have
an admin page. This admin page will not be available from the actual website, it will
be on a hidden link which is password protected. To change the content, the user need
to have access this hidden link and log in. It will be the stakeholder of the project who
decides who will have admin rights. This makes it hard for us to control the impartiality
of the content.

### 3.3.1 Availability

The catalog’s content and appearance have to be thoroughly examined to suit ideally
everyone, even those with different disabilities. One aspect we thought of when we
started designing the website was how to handle users with vision impairment. We
did research about this and found that there are plugins for different browsers that offer
screen reading. Screen reading is a technology that helps people with impaired vision,
for example by reading the content on the website out loud [61]. However, our website
contains images which may cause problems for a screen reader. So we had too keep in
mind what images we chose. In this case we chose to have non-descriptive images, like
icons, what only works as a visual decoration rather than being descriptive. In this way
a screen reader plugin would work.

Another aspect to think of when talking about vision impairment is color-blindness.
After research about designing websites for color-blind users we found that there are
plugins for this too. Different browsers offer plugins that color-blind people can use on their computer which changes the color of the website. With this in mind, we used the same color for a certain type of element, buttons for example, to make the website look more streamlined either if the user is color-blind or not.

4 Related work

Universities around the world each have their own ways of making their education more modern. In this report, the focus is mainly on Uppsala University but in sub sections of this chapter we also discuss some other universities. Related work from these are discussed below.

4.1 Services as Uppsala University

Uppsala University provides different ways to inspire teachers to learn about pedagogical techniques and tools. Two of them are conferences and online resources. In the two sections below we will discuss this more.

4.1.1 Conferences

TUR organizes a yearly conference called the conference on higher education pedagogy (TUK), where teachers can find information about pedagogical techniques. At this conference teachers can present a technique or tool they use [50]. This way teachers can share their favorite techniques and get inspired by each others discoveries and methods. This also means that the attendees of the conference have a first hand source of information about how the technique works. In this sense the conference covers the same criteria as this project, getting the information in a comprehensible way. At a conference, as opposed to the other events held by TUR, the attendees have the opportunity to browse through and take in what seems most relevant to them.

There is also a conference held bi-yearly by Uppsala University’s Division for Quality Enhancement called The Conference for University Pedagogical Development. This is not concentrated to Teknat as TUK is, but university wide [27]. At the conference ”Teachers and researchers at Uppsala University are invited to spend an intensive conference day sharing their knowledge [...]”. This seems to have a similar structure to the TUK conference and therefore would share the previously mentioned benefits.
An important point to consider is the time and effort involved in spending one or two
days at a conference. There is no reason why there should not be a way for teachers
who are not able to or do not want to attend the conference to be able to get similar
information as the attendees. Our service could even be a complement to a conference,
the teachers could hear about the technique or tool from a fellow teacher, easily find
it on the website and find general information as well as information about licensing,
platforms and what techniques or tools are related to it. This is why the search function
we provide should be comprehensive if the user has a strong idea of what they are
looking for beforehand. By giving references to teachers who have used the tool or
technique, we hope to achieve a similar effect to hearing about the technique or tool
directly from a colleague. Giving the user the benefit of having someone to ask.

4.1.2 Online resources

The target group for this project was teachers at Uppsala University. Uppsala University
does not offer a service that collects and presents different digital tools for education.
However, they do have two online services that provide help in education, MedFarm-
DoIT and Medarbetarportalen.

MedFarmDoIT is a service that provides help in IT tools for the medicine and phar-
mary faculty [64]. An example of tools is video lectures. MedFarmDoIT provides a
room for lecturers in which they can record a lecture. The room also has a whiteboard
and TV in order to assist you. MedFarmDoIT can be related to this project as the aims
of their service is close to ours. The goals are to improve learning for students, making
a more flexible and effective education.

Medarbetarportalen provides helpful tools for teachers at Uppsala University [26]. The
service provides a site for online teaching and different tools.

4.2 Services at other universities

There are some similar services to the project at other universities. Examples of such
universities are the University of Leicester, Brown and the University of Sussex. How
these services are related will be described below.

University of Leicester provides a guide to different tools for education on their website
[55]. There are not only digital solutions but variations on traditional lecture techniques.
The techniques are listed but it is not possible to search or organize.
Brown University offers a list of tools for education on their website [5]. They provide information about many digital tools as well as information about what operating systems are suitable and licensing information.

The University of Sussex have a website called learning technologies. This is filled with useful information but lacks a search specific for the learning technologies, so the user needs to choose a technology to read about by its title [56].

One common thing about these services is that the information and tools are a few levels deep. This means that it takes several clicks to get to the information, which this project wanted to minimize. However, the amount of information provided by the other universities were valuable, which is something this project can benefit from.

4.3 Massive Open Online Course

Massive Open Online Course (MOOC) is a concept for a free online course for anyone to enroll [30]. The course is either from an university or from individuals. There are different services available, two of them are edX and Teachthought.

The service edX provides a search tool with functions like filtering by categorization and by text, which are something that this project can get inspiration from. The courses are a collection from Harvard, Massachusetts Institute of Technology (MIT) and more [8].

Teachthought is a non-university based service. At Teachthoughts website there are different subjects; learning, teaching, technology among others [48]. The service does not offer tools and methods directly but instead articles about use cases.

5 Approach and Techniques

In this project different approaches and techniques were used. The project prototype was built and was evaluated with user tests, which we called alpha tests. The website was developed using React together with Bootstrap. When we had a website with functionality additional tests, beta tests, were arranged. Below follows a more detailed description of the approaches and techniques we used and why we used them.
5.1 Prototype

The first built prototype were digital sketches of the intended website. The goal was to visualize the functionality and hierarchy. By making prototypes, one can find flaws in terms of bad design choices before starting implementation, resulting in less time spent on design [10]. These flaws can be found by letting potential users test the prototypes based on different scenarios. For example, “Go to the search tool and find Scalable learning”.

We built the first prototype because, as mentioned, it was easy to test and time could be saved if flaws occurred before spending time on the implementation. The prototype facilitated the coding phase as it could be used as design guidelines. The team knew where objects, buttons, search tool, etc., should be placed. Likewise, it is good that the team agreed on how the website should look, before starting the implementation.

When creating the prototype, one can use different levels of advanced techniques, from simple sketches on paper to using software. One intuitive way is to sketch the idea on a paper, each page of the intended website on a separate paper. One negative aspect of paper prototypes is that they are limited when showing functionality [28]. For example it is hard to show if it is possible to scroll or what happens if hovering over a clickable object on a paper prototype. Therefore, we decided to create our prototypes with a digital tool called Sketch.

5.1.1 Sketch

Sketch is a digital design toolkit. In this program it is easy to build a realistic prototype of a website [42]. There are functions in the program that makes it possible to create simulations when interacting. When a user click on a button on the prototype, they will be navigated to a new page of the prototype. This makes testing the prototype close to testing a real website and developers and testers can find flaws that might not appear when testing paper prototypes. To have a prototype similar to the intended website is something we evaluated higher than the time we would have saved by doing a paper prototype. We also decided that a digital prototype could be better for the alpha tests as people interact with screens differently than how they interact with papers [28]. To have an authentic prototype had high priority, therefore we decided that digital a prototype was preferred.

One option to Sketch is Figma. Figma is also a digital design tool that offers similar services as Sketch [14]. The main difference between Figma and Sketch is that Figma, as
opposed to Sketch, is also available online. Sketch is desktop based only. Even though it might appear easier to share a project by just sharing a link, as in Figma, we concluded that a desktop-based design tool was preferred. This is because we could choose where our prototype file was stored making us more in control of our data. Overall, regarding the design options the services provided, the two services are very similar to each other. One bonus with Sketch was that we had used the program before, so we felt comfortable with it.

One drawback with Sketch is that the service is only available for MacOS. However, in this project it was not a problem. We concluded that the perks with Sketch outweighs the flaws and therefore we chose Sketch to create our prototype.

5.2 Alpha test

When the prototype was done it was evaluated with user tests. The first user tests were called "alpha tests". We had user tests in this part of the project because we wanted to find potential flaws of the system early in the development. The purpose of the alpha test was to see if users found the intended design of the website intuitive to use. As it was only the design and not the functionality that the website provides, we resolved that the users did not need to be in the target group for the project. So instead of the target group, the users were friends and family to us.

We had two scenarios for the test persons to execute on the prototype. There were only two scenarios because the prototype had limited functionality compared to the website we implemented. After the test subjects had performed the scenarios, they were asked to fill in a form about their experience of the prototype. If they had additional feedback to the form, we wrote their opinions down in a separate document.

We decided to have five users test the prototype. We chose to have exactly five users based on a study by Nilsen Norman Group, who describes themselves as “World Leaders in Research-Based User Experience” [34]. The study concludes that when testing on five persons you discover about 80% of the potential usability problems and after the fifth user the observed problems repeat themselves. Adding more users after the fifth one will most likely not achieve in more insight but will take time from other parts of the project. We found this study reliable as the company has a good insight in user design and testing. Therefore we used five persons for the alpha test.

As mentioned above, the users for the alpha test were people in our vicinity like family or friends. They consisted of 2 men and 3 women, all of them spoke Swedish but had good knowledge in English. The age span was 21-56 years old.
5.3 React and similar frameworks

React is a component-based JavaScript framework, it is a redesign of the original ReactJS. Both ReactJS and React have been developed by Facebook for use on their systems and is currently the framework of which Facebook and Instagram are built [37]. Facebook alone has approximately 2.32 billion monthly active users [13]. React is open source and is the second most popular JavaScript framework [44]. The framework uses a virtual Document Object Model (DOM), which significantly increases the speed of which updates in the code can be displayed in a browser. This in short means that only the changes in the code are updated, not the entire HTML [38]. The recommended language to write react components in is called JSX and is a syntax extension to JavaScript. According to React, "most people find it helpful as a visual tool when working with UI inside the JavaScript code" [36].

One of React main competitors is the JavaScript framework Angular [44]. Developed by Google, Angular has strong corporate support [3]. Angular is component based, in a similar way to React, with one main difference being its two-way-binding, affecting the way the HTML and the framework language pass information, to make it more effective [3]. The framework implements TypeScript, which is one of its main selling points. TypeScript is an abstraction of JavaScript, especially useful for developers already comfortable with object-orientation. This since Typescript is object orientated as opposed to JavaScript, which is a scripting language [17]. Angular is said to have a steeper learning curve when compared to React [24].

There are three main open source front-end frameworks available at the moment, including React and Angular, the third one is Vue [44]. There are many competitors to the three available, but a popular framework almost always leads to a lot of documentation and information to be found. More information was something we deemed as positive so narrowed our options down to the three most popular.

The members of the project team have previously had experience in Vue and wanted to expand our knowledge base, using a different framework. Vue is also a younger framework and has less information online [44]. This then left Angular and React to compare. As mentioned the two frameworks share many characteristics; they are both well documented, component-based and popular. The project was relatively small, only three pages with less than 10 components per page, so there was no need for a very powerful framework, such as Angular, created for large scale websites. We considered it more important to be able to understand the basics of a language effectively. Since the project team was comfortable in JavaScript from previous courses, we considered it easier to work in a language closer to it, JSX, than the completely remodeled language TypeScript. Therefore the team chose React for the project.
5.4 Responsive design using Bootstrap

Bootstrap is a CSS- and JavaScript library. The library is used to create responsive layouts using rows and columns. Bootstrap can be added to React to simplify the creation of a layout. Bootstrap also provides finished templates giving the developer the option of using and further customizing styles, such as buttons and headings. Bootstrap calls itself the most "popular" framework [4]. Often Bootstrap is compared to two other frameworks, Foundation and Semantic [59]. Being the most popular framework was deemed an excellent motivation to use it in the project, even though the vast majority of Bootstrap-components were later customized.

5.5 Beta test

This project was heavily centered around usability. How easy a system is to use can be measured in different ways, a central concept in the reviewing of a system is user testing. The characteristics of the alpha, see Section 5.2, and the beta tests we carried out were similar, and the main difference was in the system being tested. In beta testing, it was the finished product that needed to be evaluated. Hopefully, the usability issues with the system, identified during the alpha testing, had been eliminated, and the beta testing confirmed this. The more likely result was that other problems are found and needed to be resolved. During the development, we carried out one round of beta testing. This was performed on a version of the system which had been created through React. The test subjects were then asked to fill in a form, the questions of which can be found in Appendix A. The results of the beta testing are analyzed in Section 9.4 of this report.

5.6 GitHub

For this project GitHub was used to collaborate on the same code. GitHub is a service where developers can store, network and collaborate on code [22]. To control that everyone in the team understood each other’s code we used the pull request function on GitHub. Each time a team member had change or added code to the project this team member made a pull request. A pull request let the other team members know about the changes [18]. Once a pull request is present another team member needed to review and confirm the changes before the new code was added to the main code. This helped to meet the requirement about code conventions and documented code, which are described in Section 7.1.1. If the team member reviewing the code did not understand or agree with the new code, the pull request would not be approved. This helped the requirement that the team understands the code we collaborated on.
Our stakeholder had access to our project at GitHub so he could control that the code met the requirements during the process. So, if the code would not meet the requirements it could be detected early and not in the end of the implementation part of the project.

6 System structure

The system consists of three main parts as seen in Figure 1. Only one of these parts has been developed through this project, that is the frontend hosting. Making this usable has been the primary objective, how we work on this is mentioned in Section 5. The hosting of the website is done by Uppsala University’s server because it is a requirement from the stakeholder. The front-end consists of React and Bootstrap (see Section 5.3 and 5.4).

One part that has been provided to us is the back-end which is the database. The previous project (see Section 2) implemented the database, and therefore we only use an API to read and write necessary data.

The third part is the user part and is divided into two sections because the website has two different kinds of users. One is a user who can access the search tool and explore the content and the second one is an administrator that can edit, add and remove data from the database. Both kinds of users are accessing the website through an arbitrary browser. The administrators are appointed by our stakeholder and not controlled by us. It is necessary to have administrators to keep the data up to date.
6.1 Potential problems

To create a program which meets the different requirements, there are several problems to be tackled. Our main focus for the project is to create the front-end, which includes several different parts; from the communication with the database to creating intuitive buttons on the website. Our solution needs to be properly integrated with the current parts that are already finished, for instance, the database. Everything needs to be functional and user-friendly. The functionality is easy to test, but the user-friendliness is much tougher since the users have different technical backgrounds and prerequisites, and that needs to be considered in our solution. We tackle this potential problem with user tests, which are described in Section 7.2.3.

The faculty will not continuously maintain the website after our project finishes, so it needs to be able to prevail without frequent updates. This can be a significant problem if we do not address it, so it is essential to keep it in mind.

The current solution for the structure of the website needs to be evaluated. That the solution is already implemented, does not mean it is the most optimal for this project’s needs. The time and effort involved in changing the current implementations need to be weighed against the benefits. A central part to evaluate is the server solution on the university servers and to see if it is the most optimal solution. The different aspects of the server’s evaluation are authentication, databases, storage, and hosting.

The problem about maintaining the website and the structure are two things that are out of the scope for this project. Therefore, we will mention the problems to our stakeholder, but they are nothing we will be able to solve within the project.

7 Requirements and Evaluation methods

The requirements for this project were set by the stakeholders together with the project team. The project team decided on how these requirements could be evaluated to show that the requirements were fulfilled.

7.1 The requirements

This sections describes the requirements set on this project. The three main requirements are on the documentation of the code, the loading time and the usability of the
7 Requirements and Evaluation methods

website.

7.1.1 Coding conventions and documented code

Coding conventions are a set of rules on how to write your code [31]. One example is if one function name starts with a capital letter all function names should start with capital letter and vice versa. Our stakeholder wanted a code standard to be used, namely the Airbnb style guide [2]. The Airbnb style guide is a convention on how to write JavaScript code with the React framework. The style covers naming of functions and files, alignments, declarations and other rules [2]. More info about how React was used in the project can be found in Section 5.3.

Documented code means that all functions should have a comment on what the function does and when the specific function is called in the program. For example for this project if the purpose of a function is to get information about a technique from the database, this should be understood from reading the function name and comment.

The main purpose with following a convention and document the code is readability [16]. As the team consists of four persons it is important that we can read and understand each other’s code. Also, the requirement is necessary for future development of the project. After the project, the implementation of the website might continue, and it is important then that the code is easy to understand.

7.1.2 Loading time of the website

The website needs to load fast which means the website needs to load under three seconds. Otherwise users will have a bad user experience, according to Think with Google in 2016, 40% of the users will leave the site if it is not loaded after 3 seconds [52]. The technology has improved and what was considered fast in 2016 is starting to be considered slow today in 2019. To emphasize the 3 second loading time, another study by Hosting Tribunal from October in 2018 says that long loading time can also negatively affect the overall experience for the user. This is true even if the website works correctly when loaded [21]. Adding further seconds to the loading time the user satisfaction decreases with 16% [51]. With these studies as a basis together with the wish of our stakeholder, we consider this requirement reasonable to follow. In the future 3 seconds might be considered too slow as loading time but today it fits in to users’ expectations.
7 Requirements and Evaluation methods

The Daily Egg writes that one way to reduce the loading time is to compress the HTML, CSS and JavaScript files [51]. They continue by saying that this can be done by combining the files and making the code content as short as possible. Reducing the files will minimize the HTTP requests which is the key for low loading time [65]. This is because when minimizing HTTP requests for loading each image, style sheet or similar element will be reduced. [51].

7.1.3 Usability

The third requirement of the project is that the website should have good usability. Usability means that a user can experience a website without encountering problems [40]. The Nilsen Norman group describes different aspects when talking about usability [33]. They start by mentioning that it is important for users to be able to achieve basic tasks the first time they encounter the design of the website. Another aspect is how users perform tasks and remember functionality when being more used to the design. The Nilsen Norman group continues by saying that usability also refers to how many errors the users make when performing tasks and if they can recover and proceed with the task afterwards. Finally, they mention that the overall satisfaction with how pleasant the design is to use is important when it comes to usability.

7.2 Evaluation methods

To control if the requirements were fulfilled we constructed ways to evaluate them. Below there are descriptions on how we evaluated the demands: code convention, loading speed and usability.

7.2.1 Code conventions

In order to enforce the code convention used in this project, the software tool ESLint was used and configured with the Airbnb style guide in mind [11]. ESLint checks the code for violations of the convention, highlights the error and suggests a solution. Our stakeholder approved this enforcement as he reviewed the code. This is relevant since it was important to our stakeholder that future developments of the project could be started with as much ease as possible.
7.2.2 Loading tests

To test the loading speed of the website there are different online tests. We chose GTmetrix as an evaluation method for the loading test. GTmetrix is a website that tests how long it takes for a website to load and then gives recommendations on how to optimize the website [19]. To analyze and test with GTmetrix the URL of the website is applied to GTmetrix. Then GTmetrix gives statistics about performance in terms of loading speed, HTTP requests and page size. With this test we can control that the website loads fast enough and met the loading time requirement.

7.2.3 User tests

To evaluate the usability of the website we arranged user tests, one alpha test and one beta test. The alpha test was arranged on the prototype built in Sketch and the test subjects were friends and family of the team, not from our designated target group (read more under Section 3.1. The test subjects were between the age of 23 to 59 and had different range of computer experience. One example was that some test subjects scrolled with the arrow keys to find more information while using the prototype and others had enough experience to press Ctrl + F to search for the word they were looking for. We resolved that the users did not need to be in the target group as we only wanted to test the design choices and not the functionalities that the website would later provide.

When the website had basic functionality the beta tests were arranged. The test subjects were picked by the stakeholder and they were teachers except for one who was a librarian, all at Uppsala University. The target group was teachers at Uppsala University, hence the selection of test subjects. As with the alpha tests, the users had different range of computer experience. They were all from different departments of the university and a variety of ages. Some of them learned how the website worked after just one try and some of them needed to read the entire page each test to succeed with the task they were given. The tasks during the tests were chosen to test both searching for something by a name and finding a new technique or tool to fulfill some criteria.

A form was used to evaluate the user experience, this was filled out by the test subjects at the end of the test. This form is called the SUS-form and is widely used for small scale usability tests [60].

After the beta test we had a meeting with the stakeholder of the project. We presented the feedback we had received and what actions on the implementation we planned to take. The stakeholder was shown the finished website, and asked to give feedback. He
approved the finished website and gave suggestions for future improvements. When the stakeholder had approved the website the usability requirement was considered fulfilled.

8 Implementation of the React application

The website was built using React. Why we chose to use React and more information about the framework can be read about in Section 5.3. React allowed work to be divided easily as the website consists of components, for example header, buttons and boxes. Worth noting is that components can be used in other components, i.e a box-component might consist of a button component, shown in Figure 2 and 3.

![Circle Image Component](image1)

Figure 2 Circle Image Component

![Component consisting of circle image and text](image2)

Figure 3 Component consisting of circle image and text

Working in this way made the process more parallelized as each member could focus on their own specific component with their own CSS files. When the components were done, they were assembled into pages, shown in Figure 4. Using another feature of
React, states, made conditional rendering easy to implement. This was useful when fetching data from the database. When waiting for data a loading component is shown, otherwise the data is rendered.

9 Evaluation results

Using the evaluation methods described in Section 7.2 we evaluated the result. This entailed evaluating user tests, loading time and coding convention. The results are described below.

9.1 Evaluation result of coding conventions

The main benefit of following a code standard is readability and to facilitate for future development of a project. As the code in this project enforced the Airbnb style guide, we believe that the code will be easier to understand [2] than without any code standard. A style guide is a convention of how to write code, making sure that all code is consistent throughout the program [63]. Since this convention is clearly documented there should be no deviations in the code. That the code follows the style can be further confirmed by using ESLint for JavaScript. ESLint is a tool for finding patterns in code which marks every instance of which the code does not follow convention [12]. By using the plugin and the Airbnb standard we are satisfied that our code is of an acceptable standard.
9 Evaluation results

9.2 Evaluation result of loading time

The loading time of the website is heavily dependent on the server, and since the front-end was not on a server at the time of testing, any test done would not give a fair result for the final loading time. Seeing as we would not be able to draw any relevant conclusions from the result, the decision was made to not go through with tests of the loading time.

9.3 Evaluation result of alpha test

To get a basic idea of how a user finds the website we had people test a prototype of the website. The test subjects for the alpha test was friends and family to the team, these tests are described more in Section 7.2.3.

One of the conclusions reached was to rename the page called ”explore” and instead call it ”browse”, for clarity. Another one was to make it more obvious what was a link and not, making the user aware of what is clickable.

9.4 Evaluation result of beta test

To test the usability of the website, tests needed to be carried out. We had five test-subjects, all university staff. More information about the test and the test-subjects can be found in Section 7.2.3.

To evaluate the experiences of the users we used the SUS-form, this is also described in Section 7.2.3. The averaged answers to this form has been compiled and can be found together with the form used as well as an English translation in Appendix A. Question 3 is ”I thought that the system was easy to use” and the average rating for this question was 3.8 out of 5. The result was positive. This is backed up by the average rating of 2.2 from question 8 which is ”I found the system very cumbersome to use”. The result was deemed as satisfactory seeing as the feedback from the tests could be used to improve the site.

The test subjects were encouraged to give feedback on what they would like to change on the website. Three out of the five subjects individually brought up the idea of not having search and browse as separate functions but rather have one page. This page would then have the same functionality as browse, with the added functionality of being able to search straight away and sort amongst the tools and techniques, without necessarily knowing what they are looking for beforehand.
Another point made was that the boxes containing the tools had too much text and the layout of the boxes’ caused the text to be cut off. Some users would rather have had only keywords in these boxes rather than an entire description. These boxes also contained a big plus-sign to expand the boxes and show more text, some of the users found this confusing.

Changes carried out as a result of the user tests were:

- Combining the search page and the browse page into one with the functionality of both.

- Changing the layout for the boxes with tools and changing the information from a complete description to a short description and the related keywords.

- Removing the plus sign since a shorter description made it redundant.

10 Results and discussion

The project’s aim was to make a functional and user-friendly website to browse different tools and methods for teaching and learning. The result lived up to this and met almost all the requirements for the project as described in Section 7.

Figure 5 The former project group’s website
10 Results and discussion

Figure 6 The start page of our website during the beta tests

Figure 7 The final form of the start page of our website

10.1 The website

Figure 5 shows how the former project team made the website. Our project’s primary purpose was to make the website user-friendly and that the users feel enthusiastic to use the website several times when they want information. The different tools and methods should be easy to find and it should also be easy to see which tool or method suits the user’s needs. Our ambition was also to make the website’s different parts easy accessible by few clicks and easy to understand.

Figure 6 is how the website looked during the beta tests. After the beta tests, the website
changed based on the feedback the tests generated. The main change was that, instead of having two separate pages, “Search” and “Browse” as seen in Figure 7, it is now one combined page with the button “Get started” at the start page. The change made the website easier to understand, because “Search” and “Browse” were too similar and it was hard to know the difference between the two functions.

The beta tests were essential for the success of the project and made the website easier to understand, mainly because the test subjects were our targeted group of users. We had to have tests because we, as the developers of the website, could not be the ones evaluating it. After the beta tests we realized that functions we thought were distinct, e.g., “Search” and “Browse”, were not as distinct to other users who do not use the website constantly. By using beta tests, we decreased the risk and made the website as good as possible.

The website’s content was not completed during our project, but it was beyond our project’s scope. We set up a very basic admin-page because it was our least prioritized task, but essentially we implemented some functionality. Hence, the result of the admin page is functional, but does not have the most optimal user interface.

Another aspect of the project is our intended target groups as described in Section 3.1. The purpose was to make the website usable for both teachers who have deep knowledge about the tools and methods and those who have not (read more in Section 7.2.3). The not as experienced users should be able to use the website as a source of inspiration. The website is now suitable for the experience and not entirely optimized for the not experienced. This can easily be altered through the content and hence our stakeholder’s responsibility. The content can be altered by having different keywords or by changing the descriptions of the tools and methods.

11 Conclusions

The goal with this project was to create a user-friendly website which served as a catalog for techniques and tools to use in the teachers’ education. The reasoning behind this goal was that we wanted teachers to easily be able to find different methods of education they could implement in their teaching. This could mean implementing new digital tools in their class or trying out a new pedagogical technique. We believe that this will result in better learning for students.

The target group for the project was teachers at Uppsala University. The target group include both users who have a strong idea what they want to achieve using the website but also users who do not, who just want to find inspiration. We wanted both of these
potential users to accomplish their goals.

The main focus of the website was the front-end design, so we made a lot of effort designing the layout. This resulted in a digital prototype by which the design choices could be evaluated in an alpha test before the implementation of a website started. When the website had some functionality and the design from the digital prototype was implemented, the website was tested through beta tests. From the user tests we evaluated the website design and made changes based on the aspects brought up on the tests, more information about this can be found in Section 9.3-9.4.

The goal of the project was to have a user-friendly website suitable for users with or without an idea what they want to achieve. By evaluating user tests, it can be seen that this was successful. The goal was successful in terms of design choices. Overall, the users found the design of the website easy and pleasant to use. As mentioned, the design was the main focus, but we also had our two groups of potential users to keep in mind. From the user tests we also concluded that the website was suitable for the target group that had a strong idea what to achieve at the website. For users who only search for inspiration, without any intentions the project could be improved. The feedback we received was that it was hard to just “click around” and find a tool without knowing what you were looking for. We received feedback and recommendations on how to accomplish this goal, for instance, changing the two separate pages “Search” and “Browse” into one page instead, so this will be improved.

Overall, we are happy about the project and pleased with our work. The timeline for how the work was planned was suitable for this kind of project. To have two user tests was helpful and important for the end result.

12 Future work

Several enhancements can be made to the website. One option is to make the website more interactive by incorporating a login-function for all users so that they can leave reviews on the different methods and techniques. Reviews would also make the website more engaging, and the users could see how the techniques and methods are used. The review function would work as a complement to the reference person.

Due to the time limitations with the project, we did not have time to make the website mobile and tablet responsive. This is one of the more important tasks for future work so the users can use the website regardless of their device.
Uppsala University’s Student Portal has a function which can read the website aloud for those who have a visual impairment [45]. The service would make the website accessible to more people and can be implemented as a separate feature. The Student Portal has another function, which is translation. Uppsala University has many teachers who may not understand Swedish, and that is why our website is currently only in English. Although, the university is still a Swedish constitution and one alteration could be to have a translation function between Swedish and English on the website.

The website is now developed for Uppsala University, and the reference persons are from Uppsala University. A possible future development is to make it available to other universities in Sweden and around the world. One option is to establish a collaboration between different universities for the website’s content.
References


References


Each one of the five test subjects filled in the form below in Swedish. The average answer is marked on the scale and written out below each question.

Figure 8 The results of the tests in Swedish
1. I think that I would like to use this system frequently 3,4
2. I found the system unnecessarily complex 2,6
3. I thought the system was easy to use 3,8
4. I think that I would need the support of a technical person to be able to use this system 1,8
5. I found the various functions in this system were well integrated 3,4
6. I thought there was too much inconsistency in this system 2,2
7. I would imagine that most people would learn to use this system very quickly 4,2
8. I found the system very cumbersome to use 2,2
9. I felt very confident using the system 4
10. I needed to learn a lot of things before I could get going with this system 2

**Figure 9** The results of the tests in English