Gamifying Education

A study of how gamification can improve capacity building in platform ecosystems

Steven Nguyen

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Department of Informatics
The Faculty of Mathematics and Natural Sciences

UNIVERSITY OF OSLO

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Abstract

E-learning has become of interest to many groups, especially within education. With the presence of E-learning and all the content that comes with it, different websites compete with various approaches, e.g. styling of the website and its visual content. Learning online has been a great asset and a new approach to learning. However, there are still problems that one may meet when adopting the E-learning way for educational purposes. Learning online lacks the physical presence of the teacher as well as the presence of a classroom full of students, which creates a fun and challenging environment. Motivation has therefore been a problem when trying to learn something new online.

In recent years, gamification has made its presence known as a way to make online resources more fun, interactive, and most importantly motivating for users.

Throughout the master thesis I have gone through several iterations of data collection and analysis phases. Firstly, researching the state of the course IN5320, mainly its website fiftythreetwenty.com which contains all of the course's curriculum. The research aimed to collect feedback from students that has taken the course in the past. After first iteration of data collection and analysis, several problems were addressed; with **motivation** being one of them. Gamification was then researched and applied into the course website as an approach to help solve these problems. Several user-testing, surveys, and interviews were then conducted with gamification elements as the main topic. The feedback was positive and did show that gamification do have an impact on motivating users.

Contents

List of Figures

List of Tables

Chapter 1

Introduction

The master's thesis will explore E-learning as an education tool and its usage as a capacity building tool for application development in platform ecosystems, especially within the DHIS2 organization. DHIS2 (District Health Information Software 2) is a collaborative open-source project where international standards meet local innovation, supported by an international community of experts (dhis2.org). Three unique factors about the DHIS2 and its focus are capacity building, global community, and expert network.

Because of its large community and its global state, to capacitate building resources, E-learning has had an essential role in the training of many DHIS2-users. The DHIS2 community contains various types of users, managers, and developers from various countries with different knowledge. My focus will be on a specific platform, fiftythreetwenty.com, used in the master level course IN5320 - Development in the platform ecosystem at UiO. The website fiftythreetwenty.com is used to teach and provides learning resources for frontend-development frameworks and languages such as React, Javascript, CSS, and HTML. It is heavily focused on frontend and app development within the DHIS2 ecosystems. Its goal is to provide the necessary resources for the students to go little or no experience with frontend development to developing and implementing apps within the DHIS2.

The primary target group of the website is the students taking the course.

However, other general students interested in front-end development can make use of the website to learn more. In addition, in the time to come, if the website were to be improved and its content grows, potential users across the world can be using it as a platform to learn the fundamentals of frontend development and app development within the DHIS2 ecosystem. The motivation of this thesis is to research the current state and what impact the course IN5320 has for the student that has taken it, such as motivation level, and learning curve. The findings can benefits both the course IN5320, and the DHIS2 platform.

Fiftythreetwenty provides a decent amount of fundamental learning resources. However, it lacks many factors that make it an excellent website for all students from different backgrounds and experience levels. Each individual has their own learning approaches that the current website does not cover. One of the most common problems with E-learning platforms in general and websites such as fiftythreetwenty.com is that it struggles to motivate its users. As motivation is believed to be an enabler for learning and academic success (Linnenbrink & Pintrich, 2002; Lynch, 2006) [**Linnenbrink**] [12] it is necessary that such platforms have the motivation factor in order to help students be as motivated as possible.

1.1 E-learning motivation

Law, K., Lee, V. and Yu, Y. [11] mentioned and described seven factors that can be used to facilitate motivation in E-learning, especially academic learning within computer programming courses.

Factors such as motivating learning indicate that motivation can be defined as the extent to which persistent effort is directed toward a goal, and learning motivation can be understood as the extent to which persistent effort a student pays toward learning [11]. Another factor is reward and recognition, which refers to having a promise of competence feedback, and recognition implies some degree of external performance evaluation. This emphasizes that the anticipation of performance evaluation can affect students' motivational orientation.

List of the seven factors mentioned by Law, K., Lee, V. and Yu, Y. (2010) [11]:

1. "Factors motivating learning"
2. "Intrinsic factors"
3. "Individual attitude and expectation."
4. "Goals and emotions."
5. "Extrinsic (environmental) factors."
6. "Clear direction."
7. "Punishment."

It is clear that motivation is a powerful factor that is needed to facilitate learning, especially in the case of e-learning and computer programming. Motivation is an abstract concept that is difficult to measure (Law, K., Lee, V. and Yu, Y. (2010)) and is therefore often overlooked.

Additionally, the paper [11] also mentioned different types of E-learning where each have different kind of focus area, learning curve and its own impact.

1.2 Different types of E-learning:

1. Lesson-based learning
2. One-on-one learning
3. Group learning
4. Course-based learning
5. Video-based learning
6. Article-based learning
7. Self-paced learning

8. App-based learning

In this master thesis, I will therefore dive into the case of using E-learning within the computer programming field, as well as how to motivate students using different factors from the list of seven factors above. To narrow down what to study and test in order to improve exactly this within the fiftythreetwenty course, I will test and dive into the design concept gamification, which is a process of design that focuses on human motivation. Gamification can be interpreted in different ways, a way to look at it is to adapt different elements and principle from games into an environment that is not a game, e.g. in our case an education platform. A more specific example to this is can be adapting material elements such as levels and reward, and non-material elements such as excitement or fear of loss into a learning platform. This is indeed a simple explanation, its to be noted that gamification is far more complicated.

The process of gamification includes the use of the eight-core drives where each drive focuses on different aspects and factors from human emotion, system development, social influences, user motivation, and many more. A more thorough description of gamification and the framework I i will use will be provided further down this paper. The concept of gamification aligns really well with the problem that is addressed. The core drives that can be supported also align with many of the factors in the list above. Therefore, it is a suitable solution that deserves attention and should be further studied and tested within E-learning.

It is, however, important to note that I will be focusing on both the technical and theoretical side in the master thesis and will therefore be studying and researching E-learning and gamification from both technical and non-technical points of view to see what works and not, this, in order to build a website that can support variety, aiming for the best E-learning resources for both students at UiO and others within the DHIS2 organization.

Furthermore, as new technologies, packages, libraries, and resources are created with every passing day, it is important that what we make is as

scalable as possible. This is in order to not have to redo the website whenever a big change needs to be made. The technical part have an important role within E-learning resources because with the right technology, the resources will be scalable, making it easier for new resources to be appended to the website. I will therefore dive into technologies such as headless CMS to see what role it plays within a system and how it can be used to help scale website, which will then allow the growth of content easier and faster in order to support students from all stages, which again gives them the motivation that is needed.

1.3 Structure of the thesis

The thesis contains three main parts, reflecting the phases in my research project: **Project scoping phase**, **Gamify process**, and **Evaluation**. Going in a sequential timeline, each part has several chapters describing what was done during that particular time period of the thesis.

I. Project scoping phase

This part describes the early process of my master's thesis, especially the first semester when I was still working closely with the other two master's students that are within the same project. This part goes through how we created our project plan and defined our goals as a group but also as individuals. We went together and defined our main target group in order to start our data collection and follow up by using different methods to analyze the data. Toward the end of this part, with interest in gamification and previous experience with it, in addition to the data and feedback we have collected, I realized that gamification might be an interesting option to explore in order to help address several problems that we discovered, to mention a few problems: motivation, inspriation, excitement, an environment that can support and be use of users from different levels (skillset, background etc).

Therefore, I went and did a bit of research on gamification, understanding the eight core drives, for instance, and created a list of gamification

functionality suggestions that can be applied on our website.

This phase incorporates the following chapters:

3. Research approach

This chapter goes through the research approached I have taken use of throughout the thesis, which is Design Science research. The chapter revolves around the reason of choosing this method, the process of the method and how it fits with my goal.

4. Preliminary study

This chapter revolves around the preliminary studies that I did as an individual as well as what we did as a team. These studies contains both technical and non-technical researches.

5. Project progress

This chapter goes through the process of defining a project plan, with different checkpoints and goals. Additionally, we also defined a list of activities that should be done in order to progress to our goal.

6. Analysis

This chapter goes through our analysis process, describing different methods we used in order to extract the data and feedback from the data collection phase.

II. Gamification phase

This part revolves around the process of doing interviews, surveys, and user testing to find out ways to improve the course website **dhis2-app-course.ifi.uio.no**. In this part, I started by creating a project plan describing what should be done, e.g., finding and contacting potential candidates to do the interview and surveys like in the first part. However, this time with a focus on gamification and how it can help. This part also revolves a lot around further exploring and understanding gamification as a design

principle and how it can be applied in the best way possible. This also includes exploring and implementing a few gamification functionalities from the list I suggested in the previous part.

This phase incorporates these chapters:

7. Project plan

This chapter once again goes through a new project plan, however, this time with a goal to research and explore gamification as tool to help the problems that we found in the first phase. Additionaly, as the other want to explore other area, I continue my own work alone from this phase.

8. Interview & Survey

This chapter goes through the start of a new data collection iteration; defining different interviews question, surveys, user-testing, and last but not least, implementing user progress system.

9. Interview & Survey evaluation

The phase wraps up with the evaluation step, going through and analyize both quantitaive data from surveys and qualitative data from interviews and user-testing. Phase two ended with a good amount of feedback and has helped addressed the impact gamification has given so far, but also possibly more in the future.

III. Evaluation phase

The last part goes through the evaluation of the entire process. Followed by a discussion section on the entire study, and what I have found throughout the entire process. In addition, what I believe can be done in the future to further enhance the resulting artifact that I have come with. Last but not least, what can be done within the gamification field in general.

Chapter 2

Background

2.1 Kernel Theory - Octalsysis

The research question that is being addressed through the master's thesis is, therefore: "How gamification can equip both new and experienced developers with the skills needed to design and develop apps, additionaly, provides motivation, social influences, fun, and an interactive learning environment." Gamification is a wide term, and there exist many different gamification design principles. For my thesis, I will be focusing on the design framework created by Yu-kai Chou [4].

Gamification can be seen as a design concept where the design process is focused on Human motivation. It can be called Human-Focused Design, which is different from Function-Focused-Design, which many systems implement today (Yukaichou 2020).

What we mean by human-focused is that the design process focuses on human feelings. The name gamification is formed because it came from the gaming industry, which was one of the first to master Human-Focused-Design. We have all played a game in our lives, whether it is a simple, lightweight game or a more heavy multiplayer game. What we can draw from our experience of playing games is that they can be really fun, games make you engaged in the storyline, motivated to do things, and all sorts of other feelings.

Its important to have in mind that, although these design elements do motivate the gamer/user, some design elements such as *Unpredictability* or *Avoidance* cab make the user become addicted in some extreme case.

However, what we can extract from this is that the gaming world contains all kinds of fun and engaging elements, we can agree that by adapting and applying them, we can achieve something as good in other domains, which in our case is E-learning and specifically the course IN5320's website.

In this section, I will give a high-level introduction to the Octalysis framework that Yu-kai Chou created. Although there is a lot more to the framework, this section should provide a good enough insight into what the Octalysis framework is and how this can be used when adapting gamification into your application. Looking at the figure 2.1 below, we can see that the Octalysis framework is in an octagon shape with eight angles in total, where each section/angle has its own functionality. These sections are often referred to as the eight-core drives of gamification.

2.2 The eight core drives

In this section I will go through all eight core drives of gamification.

1) Epic meaning & Calling

The first core drive which lays on the top of the octagon is **Epic meaning**. This core drive focuses on the meaning of something: for games its often *the player*. For our case, however,its the user of the application that gets to believe that what they are doing is something greater than themselves [4]. One of the examples of these core drives is to allow the user to contribute to a forum or website with their knowledge. This can be seen in website such as **Wikipedia** or **Quora**.

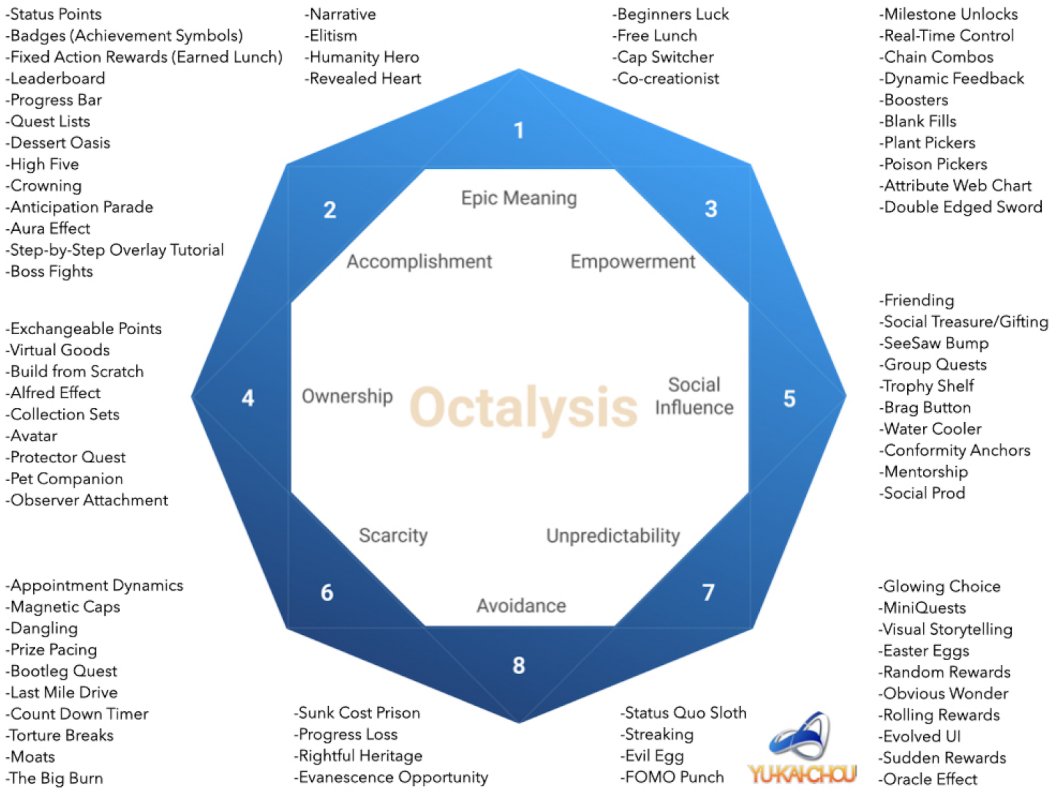


Figure 2.1: The eight core drives of gamification Yu-kai Chou (2020).

2) Development & Accomplishment

The second core drive focuses on creating an environment where the player/user can develop and accomplish great achievements. This usually means creating challenges that allow the user to challenge themselves to overcome and achieve results in terms of knowledge, meaning, and often also material things such as status, badges, and trophies. Examples of this core drive in use can be seen in apps like **Duolingo** and **Kahoot**. Duolingo, for instance, whenever a lesson is completed, user would get a certain medal, or level as an accomplishment.

3) Empowerment of Creativity & Feedback

This core drive focuses on empowering and engaging player/users to be creative when solving challenging tasks and empowering the user to keep going by providing useful feedback where users can learn and see the result of their creativity. An example of this can be found in one of the

newest word-guess videogames **Wordle**. In this game, the user would need to guess different words with little to no hint. This environment empowers the user to be creative and try different approaches to guess the correct word.

4) Ownership & Possession

This core drive focuses on giving the player/user the ownership of something, whether it is material things such as virtual goods like points and avatars or the ability to achieve a certain status/role that unlocks more ability and functionality to the application. In short, the more the user can do in the environment they are in, the more ownership they will feel they have toward that environment. This can be seen in popular social app like **Facebook**, and **Snapchat**.

5) Social Influence & Relatedness

This core drive incorporates all social elements that drive people, including mentorship, acceptance, social responses, companionship, as well as competition and envy [4]. Creating an environment where users can go motivates and challenge each other. Seeing your online friends have one of the highest scores will also motivate you to keep going and achieve the same high score. This does not mean that this core drive is only motivated by focusing on competition. It also means creating a social platform in which everyone can go to share their knowledge and learn from each other. This can be seen in popular apps like **Reddit**, **Quora**, and **Stackoverflow**.

6) Scarcity & Impatience

This core drives utilize the impatience of the user, and in cases where something the user wants is not available at the moment will motivate the user to think about it and be prepared and ready when it's available. This can be found in games that give rewards/points every 4 hours or every day in order to keep playing the game. Another example can also be; a application is about to release a new feature, and the first hundred users to sign up will get it for free.

7) Unpredictability & Curiosity

This core drive focuses on engaging the user by leaving things open and unpredictable. This way, the user is left with a curiosity and wanting to find out more. Although this is a harmless drive, it is also the drive that might affect people with gambling addiction, as it makes the user feel that anything can happen, for instance believing in the chance of hitting the jackpot.

8) Loss & Avoidance

This core drive focuses on avoiding negative outcomes from happening. As Yu-kai Chou described, it could be to avoid losing previous work on a smaller scale, so for games, it could be saving the progress at a particular checkpoint. This also makes the users more active and want to keep going to the next checkpoint to avoid losing the progression they have until now. On a larger scale, however, it could be to avoid admitting that everything they have done until now is useless. Therefore encouragement is also incorporated here.

It is noted that it is not always a specific core drive integrated into an application but often a combination of several core drives. Another factor that should be noted is that although the goal of these eight core drives is to motivate the user, incorrect usage will not give a good results and, in worse cases, will result in the exact opposite. This matter will be unpacked at a later stage in this paper.

2.3 The left brain vs. right brain

In addition to the eight-core drives, the Octalysis framework can be seen as the two sides of a brain, although it's noted that this does not refer to the true science of the human brain.

The left brain of the framework plays the extrinsic part, which can be associated with the logic, calculations, and ownership factors. The right brain

of the framework plays the intrinsic part and can be associated with the brain's creativity, self-expression, and social aspect.

The two sides of the "brain" with their side of core drives create a different meaning. The left brain core drives are extrinsic motivators, where users are motivated because they want to achieve something, whether it is a goal or material goods such as reward, points, and status. On the other hand, the right brain is the intrinsic motivator, the goal here is the opposite of the left brain - the user is encouraged to use their creativity and social factors to achieve sociality, e.g to meet and make friends.

2.4 The White hat vs. Black Hat

The top and the bottom of the Octalysis framework also have their own meaning. The top four core drives, Epic meaning, Accomplishment, Empowerment, and Ownership, are positive motivators. On the hand, the bottom four - Social influence, Scarcity, Unpredictability, and Avoidance are considered negative motivators. What we mean by this is that the top core drives are motivators that make the user want to achieve something because they feel good when doing it. While the bottom core drives use factors that make the user feels terrible if they do not keep going or keep going because they have a FOMO (Fear-Of-Missing-Out) feeling.

However, as mentioned earlier in the last paragraph of Section 2.2, even though the bottom core drives are negative motivators, it does not necessarily mean that they will have a harmful effect if one can utilize these core drives correctly they can still be motivators factor. They can contribute to a more healthy and productive result. It can also be augmented that Social influence can be a positive motivator.

With the Octalysis framework and design principles understood. I can now further research how this framework and its core drives can be applied into the current course website.

Part I

Project scoping phase

Chapter 3

Research approach

3.1 Research methodology: Design Science Research

This study starts with the aim to learn and understand why the course's website fiftythreetwenty works and why it does not, and then come with a suggestion on how to improve it. With this goal in mind, the paradigm well suited for this study would be the interpretive paradigm.

I believe both Design Science Research and Action Design Research are relevant for the methodology. However, because of the differences in the focus these two have and what I align with what I have in mind, I have decided to go with Design Science Research which focuses on the artifact's design. One of the reasons why ADR is not entirely suited for my study would be the involvement and collaboration with the DHIS2 organization if I were to go in that direction, which I decided not to focus on for this thesis because of the timeline. As mentioned earlier, E-learning and gamification are what I wanted to focus on developing and implementing on the course website fiftythreetwenty.

However, it is noted that if the study and implementation of gamification were to have its benefits, the goal could then be to implement the artifacts outside of UiO and within the DHIS2 platform. If this were to be true, ADR could be the methodology to be applied in the future.

According to the Design Science Research Methodology article by Peffers (2008), [15], the process of design science research is about creating and evaluating IT artifacts intended to solve identified organizational problems. It's a process that involves observation of problems that may occur, evaluation, and making research contributions. The term artifact can be anything from models to technical resources.

3.1.1 DSR process cycle

The DSR process model proposed by the authors of the article [15] are described really well and aligns a lot with what I have in mind (Figure 3.1). I have therefore chosen to follow this model when doing my research.

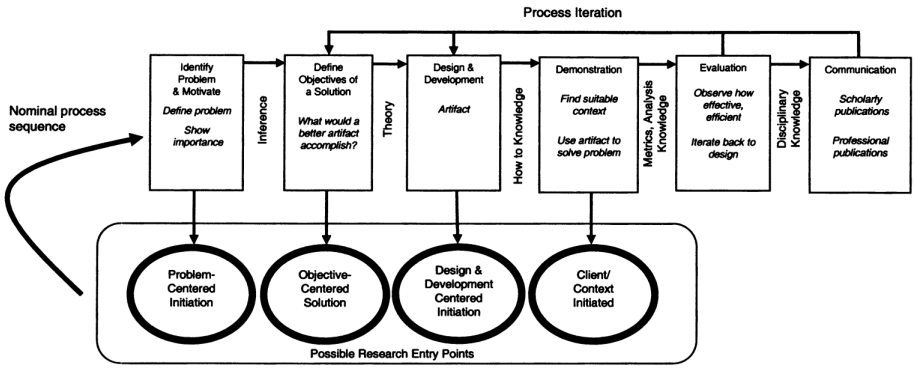


Figure 1. DSRM Process Model

Figure 3.1: The DSRM process Model

3.1.2 DSR activities

The DSR process described by Peffers (2008) [15] contains six activities, with the first activity being ***problem identification and motivation*** as having a defined problem will help toward creating an artifact that effectively

solves the problem.

The second activity is ***define the objectives for a solution***. This activity incorporates defining what objectives the solution should have, either its quantitative or qualitative objectives.

The third activity is ***design and development***, this activity involves designing and creating the artifact. Designing here means defining its architecture, functionality, and the artifact's design.

The fourth activity is ***demonstration***.This activity focuses on demonstrating the developed artifact to the audience. Either by getting the user hands-on with the artifact or giving a group of people a demo of what the artifact does.

The fifth activity is ***evaluation***; this activity focuses on evaluating the resulting artifact and whether or not it aligns with the objectives that we have set out in the second activity. This activity can be done in many ways, either by sending out surveys, interviews, and/or user testing to find a satisfactory solution. Within this step, researchers, in this case, me, will also find out if a further iteration of the process is needed or not. If it does, we go back to the third activity and start over again.

The sixth and last activity is ***Communication***, which can mean communicating the entire process to the desired audience. In my case, this will be to communicate through this paper, dividing the process into different stages such as data collection, analysis, result, etc.

While there exist many other DSR approaches where each has its own process elements, there were few other DSRM that are described and compared in the article; to mention a few are the DSR process by Hevner et al. [8] and the DSR process by Archer [1] Some of these other DSR processes are divided into fewer activities while the steps are more thorough. The DSR process cycle described by Peffers (2008) is a combination of them, and I believe it aligns the most with my goal.

3.2 The Research process

The research process will follow the DSR cycle mentioned above (see Figure 3.1. The problem identification step for my case would be to execute several qualitative research methods to find out the problem(s) students taking the course are having.

3.2.1 Social part

A combination of qualitative and quantitative will be used for the research methods throughout the study. Research methods such as interviews, observation, and focus groups will be used to discover the challenges that the students meet throughout the semester using the course platform and the content it provides. Furthermore, as I focus on the technical and new features that will be developed, methods such as usability testing will be an essential part of my data collection and testing methods.

After a selection of problems has been found and extracted from the research, a solution should be formed. This stage will be to find the objective of the solution (second activity). Here, I would use different methods to sum up the user's feedback and hopefully end up with either some sort of qualitative objectives such as a thorough description or quantitative objectives such as a list of functionality the artifact should have.

The next activity would be to design and develop the artifact. Using software such as Figma to design languages and frameworks such as React to develop the artifact and write documentation to document the solution.

Following the design and development activity will be a demonstration/test and evaluation activity. Here, I want to demonstrate and test the artifact I have created so far to the potential user to evaluate the current artifact. For this, I will be using surveys, user testing, and interviews to receive feedback. Having gone through this process and evaluated the feedback, I would have a good amount of data on whether the current ar-

tifact meets the objective that I have decided in earlier activities and find out whether or not it needs improvement. If the latter were the case, I would find what can be done to improve it.

Lastly, as the goal of this master thesis is to do research and study gamification in an e-learning environment, I will communicate the result of my findings which is the research and all the feedback regarding gamification.

3.2.2 Technical-part

The plan for this entire research process will follow an iterative and agile style. Where I set aside one goal for each iteration/sprint of development. For each iteration, I would create a plan, defining tasks that need to be done and reflect on the result at the end of the iteration. I believe it is important to involve and collect data from previous, current, and potential future users for this project.

Many different software will be taken use of in order to seamlessly carry out the technical development process. Software such as **Github** to store and manage the artifact repository. Apart from its wonderful version-control system, Github also provides many tools to manage the project, such as a project tasks board similar to a kanban-board, issue priority, continuous integration/deployment (CI, CD), and many more.

In addition to **Github** which will be the core DevOps factor of the project. There is many other software that I have in mind. For instance, I will be taken use of **Figma** for design and wireframing, photoshop, and illustrator are also great tools for creating vector or alternating images.

For the programming part, **React** which is a **JavaScript framework** is and will be the core framework for the artifact. Many additional libraries and software packages will be used. Design libraries such as **Material UI**, and software libraries such as **NEXT.JS** are already and will still be integrated into the project to get server-side rendering.

3.3 The applied DSR process cycle

With the DSR process cycle in mind, I have created my process with the inspiration of 3.1, the figure 3.2 describes my version of the DSRM process with a description of each step and at what chapter these steps are being taken use of.

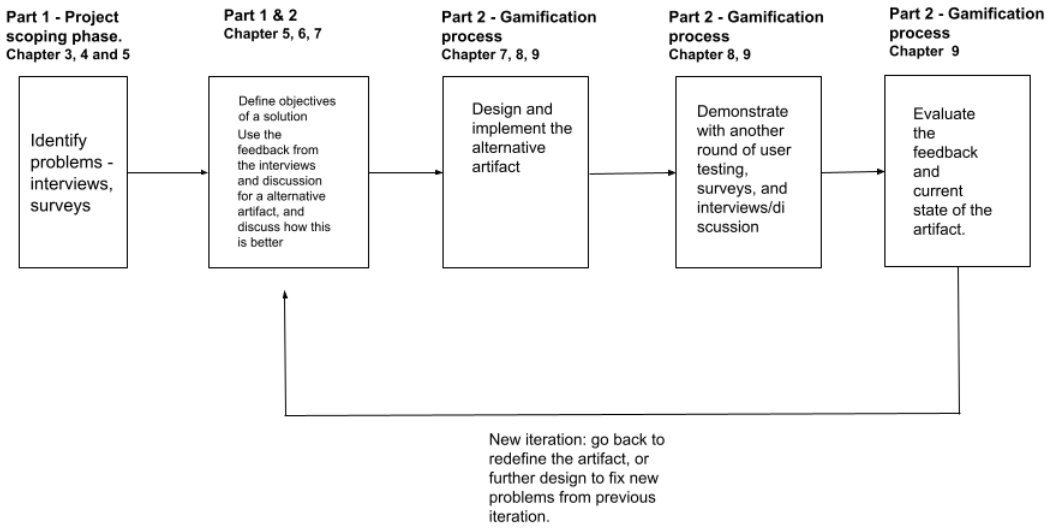


Figure 3.2: The DSRM process Model

Chapter 4

Preliminary study

Through the master thesis, I would like to use both technical knowledge and theoretical knowledge I have acquired through educational and practical experiences. Technical knowledge here implies the knowledge I have gained from doing technical-focused projects, especially from my job as a Software Engineer. Theoretical knowledge will be the knowledge that I have to learn through school, books and documentation.

Due to the COVID situation, there will be some difficulty in collecting data from users in the way I mentioned earlier (less to none available to perform user testing physically). However, as I am researching tools and technologies used online, methods such as online assessment, interview, and user testing can easily be conducted online through zoom.

As the technical phase is involved in the project, I wanted to involve myself as much as possible in finding out the needs of potential users and implementing features toward the goal. In addition to this, I believe that the platform lacks many factors which the **8 core drives** provide. Therefore, it could be an improvement to apply gamification to the platform, enhancing the platform's learning resources and increasing the user's learning curve, and creating a fun and competitive environment. However, this needs to be confirmed by potential users.

Through this chapter, I will give a detailed description of what I did as an individual and what I did with the team in the early stages of the mas-

ter thesis.

Early stage and weekly meetings with master group

Early in January 2021, at the beginning of the second semester, our master group of three members (including me) met through zoom, got to know each other, discussed our expectations and goals, and got started with a draft plan for the project.

Tech discussion: Fiftythreetwenty, strapi and docker

At this early stage, I was quite interested in getting into what kind of technology e.g framework, database, Content management system (CMS) I wanted to work with, furthermore I wanted to also find out what kind of technology we should use for our master project as we were to either improve the current website fiftythreetwenty or make an entirely new website.

Fiftythreetwenty is the primary learning resource website that is being used in the master course IN5320 – Development in platform ecosystems at the Department of Informatics. The website includes learning resources that teach and helps students learn the fundamentals of frontend development, frontend programming languages like Javascript, and frameworks such as React. The website also gives introductions and tutorials on developing front-end apps for the DHIS2 organization. This includes learning their technology stack and APIs standards, such as the design systems used. Students taking the course come from many backgrounds, and how often the website is being used depends on each of the students' levels. Every student, however, to pass, needs to do mandatory exercises, which are provided on the website. My experience as a student who has taken the course is that I did not use the website as often as it was made to, which can indicate that other students may feel the same. The reason here can be that the content is not good enough, the level of the content is too high or low, or even too abstract.

Individual contribution

I met up and discussed with another student (from here I will call him as the co-student) within the Design lab, he was also starting on his master's project, and we were supposed to work together to agree on what kind of technology we should use. This collaboration was the similarity to the problem we wished to solve. We also wanted to make the technology and architecture within Design Lab as similar as possible.

In the first few weeks of January 2021, the co-student and I met to research and discussed potential technology for our application's structure. We went through the current website (fiftythreetwenty.com, which is now renamed dhis2-app-course.ifi.uio.no) and looked into the applied technology and what kind of resources were available. Many external technologies were taken used, but the main technologies are Next.js which is a react framework, and Netlify for the deployment of the website. This was not something that either of us had worked with before, but after some more research and discussion, we found out that it has many advantages and disadvantages. However, it was to our surprise that the amount of work on website infrastructure, content, and design was done within such a small time frame of two months.

The Next.js [14] concept and its attribute is that text and code are written in a markdown file, and one of its most advantages is that the frontend which includes GUI and its interactivity is server-rendered, which means everything is being rendered from the server.

At this point we understood more of the technology that was used for the website, we also understood its pros and cons, some of the pros were how fast the website loads because of server-rendering, also how easy and understandable the code were, making it also easy to add content as everything is written as markdown into the code. However, one of the biggest cons we saw, and I personally did not want to proceed to use this for further development of the app was because of its **scalability**. Reason to this is that the website does not have any databases, as all contents are written into the code hence the markdown concept. I could see this structure working if the website were to only stay as it is. For our master project however, we need to create something that is scalable, as the content will

increase for each year to come.

This was, however, only our first thoughts from what we have experienced and researched so far. Therefore, we decided that we needed to discuss this further with the rest of the group. Furthermore, more thorough research about this concept is required before making any decision.

In addition to the above, I and the co-student also discussed potential technology such as **headless CMS**, which is a content management system, one of the popular CMS which were mentioned to us by the main engineer that created the website was **Strapi**.

From the Strapi documentation page [16]:

- Strapi is a flexible, open-source Headless CMS that gives developers the freedom to choose their favorite tools and frameworks while allowing editors to manage and distribute their content efficiently. Strapi enables the world's largest companies to accelerate content delivery while building beautiful digital experiences by making the admin panel and API extensible through a plugin system.

Data collection phase with interviews: Our thought process was to use strapi as the administration page for managing (create, add, delete) content for our new website and then use the MongoDB as our database for the strapi content. We also discussed the use of docker to make the startup of the environment easier at a later stage. This was however only a small discussion and as we are still at the very early stage we agreed to try and test these technologies out ourselves to see if it is something we could use.

Group meeting and discussion - Late January / Early February

Our next meeting, which is one of the foundation meetings for the entire project as we sat down to discuss and finalize our plan for the entire semester. The topics covered in the meeting was going through a list of all possible activities that have shown up as options during our data col-

Who	When	What
Student A	21.01.2021 10:00	Pilotinterview
Teaching assistant A	26.01.2021 12:00	Strapi, technical architecture
Student B	02.02.2021	Interview fiftythreetwenty.com
Student C		Interview fiftythreetwenty.com
Student X	29.01.2021 12:00	Interview fiftythreetwenty.com
Student Y	29.01.2021 13:00	Interview fiftythreetwenty.com
Student Z	30.01.2021 12:00 AM	Interview fiftythreetwenty.com

Figure 4.1: Our interviews and data collection plan incl. date

lection and planning phase. We decided what we wanted to do, when we needed to do it, and who was responsible for the activity.

One of the most important topics we talked about was the goals and passion each member had for the project, which came out somewhat different in terms of interests. This was important to talk about as it tells us what to expect when working as a team. It's also important that everyone can do something that they are interested in, we took that into account such that everyone will be doing something they enjoy, and, especially, something that they will be writing about in their thesis. Doing something that is not interesting for the person or having conflict of different task may affect team performance and satisfaction [5].

Meeting with supervisor What came next was the meeting with our supervisor to present our plan, get feedback and ask questions before we could fully start the process. The meeting went well, and we received great feedback from our supervisor, a lot of positives about the plan and tasks that we have defined. He also asked several questions about the project, which made us make a few critical decisions. One of which made us decide to drop the integration of the headless CMS technology (Strapi) into the new website.

This was quite a big deal for me as I was extremely interested in the technology. I wanted to learn more about what it can do and how one would come forward to implement it. However, I understood the situation we were in, as there were many things that needed to be done within such a small time frame, and priorities needed to be made.

Some key points and decisions made from the meeting:

- Drop headless CMS strap, the new website could use React + typescript as language and framework, firebase as authentication, and real-time database (test purpose only).
- Going from recreating the entire fiftythreetwenty website to improving the website based on data collected from the data collection phase and applying the new structure to a new website focusing on learning students' topics such as React and DHIS2 concepts.
- Contact to potentially cooperate with some of the core members of the DHIS2 team to create learning resources (e.g., tutorials and workshops) for the new website.

In summary, from this preliminary study, we got to know each other and how we can each contribute individually and together to reach our goal as a group. We also created a plan for our interviews and data collection phase. For my part, I learned that the others are not as interested in the technical aspect of the project as I am. Which for the time being is not a deal-breaker as we have yet to decide the exact direction the project would go. Therefore, we concluded that we would still keep going and execute the data collection and analysis together. Furthermore, I got the opportunity to research and explore different technologies, even though some of them ended up not going through (e.g., CMS Strapi). However, with this process done, we have now a clearer vision of what we can do next: to execute our data collection phase and recreate and improve the fiftythreetwenty website's content based on the data collected. Additionally we will contact the core DHIS2 team members for potential cooperation, as this can be an incredible opportunity to learn and get feedback/information that might otherwise not reveal in the data collection.

Chapter 5

Project progress timeline and detailed plan

Now that we have a better vision of what our goal is, we went together and created a roughly detailed project timeline on what should be done for the rest of the semester. Below is a simple version of our timeline capturing all of the critical steps, and where the goal is to get the feedback, and eventually the requirement specification toward the new artifact 5.1. The feedback would come from users we interviewed within the data-gathering phase. The majority of the users here would be the students who took the course last fall, students who are interested in the course, and last but not least, anyone, who is affected or is affecting the course process, such as the teacher, developer, and people within the DHIS2 organization. In addition to the progress timeline, we have also prior to this phase, created a progress plan 5.2 with different tasks and checkpoints, and a different person would have been assigned different tasks that align with what they want, what fits best for the group, and lastly, our project.

My role throughout this process was to focus on the technology part. This includes researching, exploring, and testing different technologies that would benefit the re-branding/restructuring of the course website. For instance, I test-implemented Strapi in a new project environment that went quite well for the most part. However, as mentioned in the previous chapter will not be continuing with it. Another thing I did was explore and test out implementing a new page with React onto the fifty-

threetwenty.com repository (in my branch). This was to determine the amount of work needed to add new pages/content to the website.

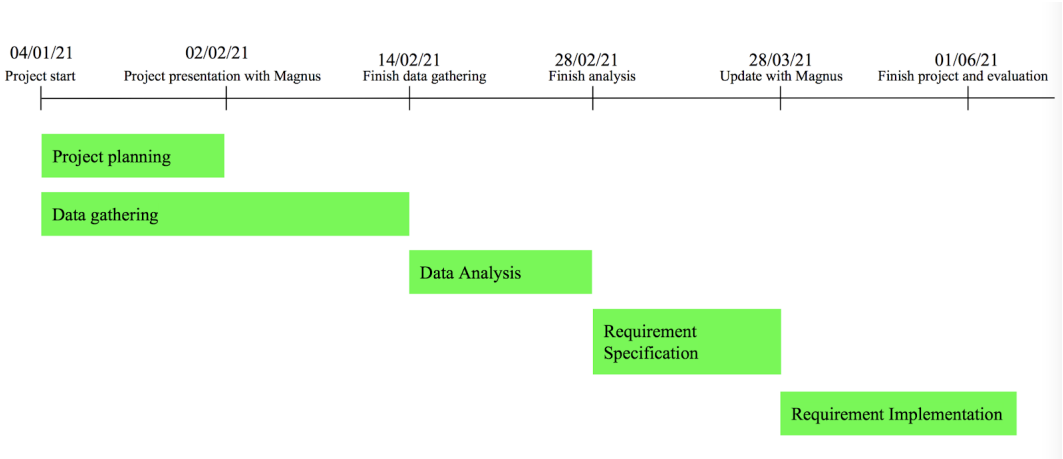


Figure 5.1: Progress timeline with focus on the key point and dates

Tasks	Responsible	Status	2/2	3/2	9/2	10/2	16/2	17/2	23/2	24/2	2
Interview with Magnus		In progress									
Interview with DHIS2 members		Planning									
Meeting with Olav Poppe (hjemmeeksamen)?		Planning									
Interviews with students		In progress									
Decide on curriculum		Planning									
Audit content on website		Planning									
Decide on strapi scope (and hosting)		In progress									
Research 5320/react features		Planning									
Data analysis & requiremen											
Open coding of interviews											
Create content plan/calender											
Create content plan/calender (React)											
Decide on 5320/react features and tech stack											
Decide on 5320/react UI											
Implementation											
Create mandatory assignments											
Improve existing content											
Follow content plan											
Implement UI changes to 5320											
Create react course content											
Plan teaching assistant											
Implement 5320/React											
Master Essay											
Install Matomo											
Create Qualitative feedack mechanism											

Figure 5.2: Our progress plan, in detail regarding the tasks and person with the responsibility, the responsible names are blurred out for anonymous.

Now that all the fundamental processes are starting to form, at least for the first iteration of our master project. The next thing on the list is to start doing some research and start setting up the structure of the new website. As the technical responsible of the group, this includes setting up a GitHub 5.3 repository, project description and creating issues that can be done for the next few week.

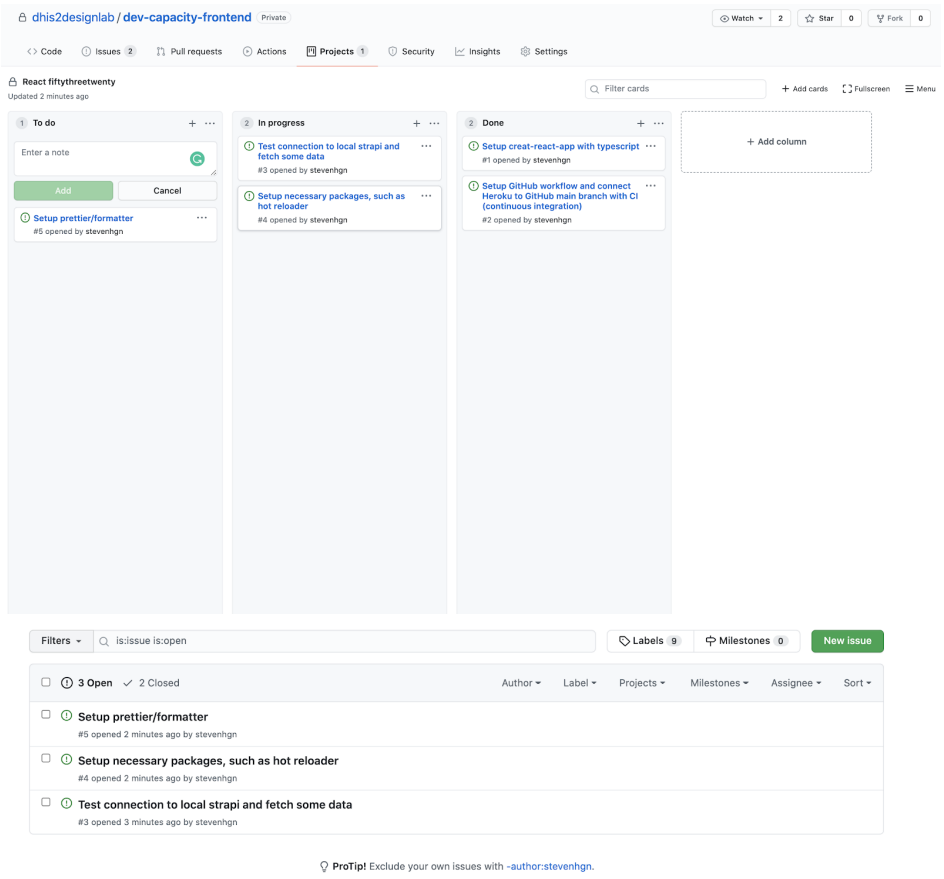


Figure 5.3: The technical part: Github project plan, incl. temporary tasks

Reflecting on what actually went through with the plan

Most of the activities we have stated in our plan were executed and done according to what we planned. However, a few things did not go through, one of them being the CMS Strapi, which I did spend a reasonable amount of time on. We concluded this because we did not have a clear plan for what usage the CMS would give in the near future. The resource required to get integrated into the course would take a bit of our time, although it was possible. However, we concluded that it would be better to focus on the content of the course.

Meetings with other DHIS2 members did go through and did give us some good feedback, but close collaboration between the two groups did not happen as much as we had anticipated, at least for my part. The setup of the GitHub project and Kanban board was not used much by the rest of

the group, and it ended up only being a bit beneficial for me as I did most technology-related work. I believed that having tasks described clearly, and having a way to manage them contribute to and improve our teamwork, but as most of the technical work is done by me, these things became entirely unnecessary. Even though no significant consequences occurred because of this fault and mismatches, we learned to be more thorough and precise with our plans and vision next time to avoid mistakes and time and resources.

Going forward, we agreed to continue with biweekly meetings with the core DHIS2 team to present our research and findings, and get feedback from them. For the next step, we will analyse the data from the interviews, and keep progressing accordingly as we has agreed in our progress plan.

Chapter 6

Analysis

Throughout the data collection phase, we have interviewed around twenty candidates with different background, interest, skill-set and motivation. Most of them are students that has taken the course or attempted in the previous year, mostly from fall 2020, and are currently master students. Most of these candidates have bachelors in informatics from UiO, however, some from Oslo Met, or NTNU. From the interviews we have seen many candidates that has gone through three years of heavy technological courses. While some have had part-time jobs as a developer/engineer, and the course was just a repeat practice of what they have learn or done daily. For other candidates, however, the concepts of Frontend was a whole new world, and it was a struggle for them to get through the obligatory assignments.

Most of the interviews were executed by others in the group. At this time, I was still mainly working on the technology side of the project. After the interviews were done and the amount of data received was sufficient. We decided to do several analysis where the focus of each analysis will be on different parts. One of them would be a user-focused analysis where we identify personas, knowledge, motivations, challenges, learning approaches, and improvement potential. Another analysis will be on the curriculum and how it can be improved, particularly on the size of the curriculum at its current state and what kind of content/topic should be in the curriculum for the semester to come. The two figures 6.1 and 6.2 below show the coding categories that we got from doing open coding and

an overview of what we got from the affinity diagram. Throughout this process, each individual would try to analyze by themselves and then do it once again in the group to compare and discuss a result that makes the most sense.

6.1 Analysis of the user's backgrounds and the different challenges they faced

This data analysis focuses on two dimensions, the user and their impressions of the course. The different coding categories were; Relevant background knowledge, Motivation, Challenges, Suggestions/Improvements, and Preferred learning approach. We decided to look further at these two dimensions because we wanted to explore whether the personal background, e.g. whether individual motivations and programming experience impacts the course impressions and the feedback.

6.1.1 Open coding

We chose open coding as it has given each of us good results when used in the previous project. Even though it can be a bit more time-consuming, doing it both as an individual and then as a team increases the result dependability and trustworthiness [13].

Figure 6.1: Our coding categories.

6.1.2 Affinity diagram

We then perform an affinity diagram analysis process where we would use the categories that we concluded from the open coding as a starting point. We would then spend some time brainstorming and adding whatever fact/comment/discussion related to the board, as in the figure below. After this process, we would go together and start going through the notes, discussing and arguing why specific belongs or does not belongs to that particular category or on the board.

This discussion methods help generate, structure and communicate our ideas with each other. [17]

Figure 6.2: Affinity diagram.

6.1.3 Personas

After the open coding and usage of the affinity diagram, we concluded with four personas representing the people we interviewed and researched. [7] The four personas with detailed information can be seen in the figures below 6.3, 6.4, 6.5, 6.6. These four personas describe the most common user/student background within the course, and future improvements that we make will be based on these persona's backgrounds, characteristics, and problems. The personas that we have contained three different main sections; Goals, Frustrations, and a Scenario, and the persona's background, interests, and learning approaches.

Sweaty Simen

The first persona we came up with was **Sweaty Simen** 6.3, this person has a good amount of previous experience, both from his bachelor and part-time job as a software developer. He 23 years old, and interested in both frontend and backend, he likes to learn new things by doing them, and prefer text because its faster to read.

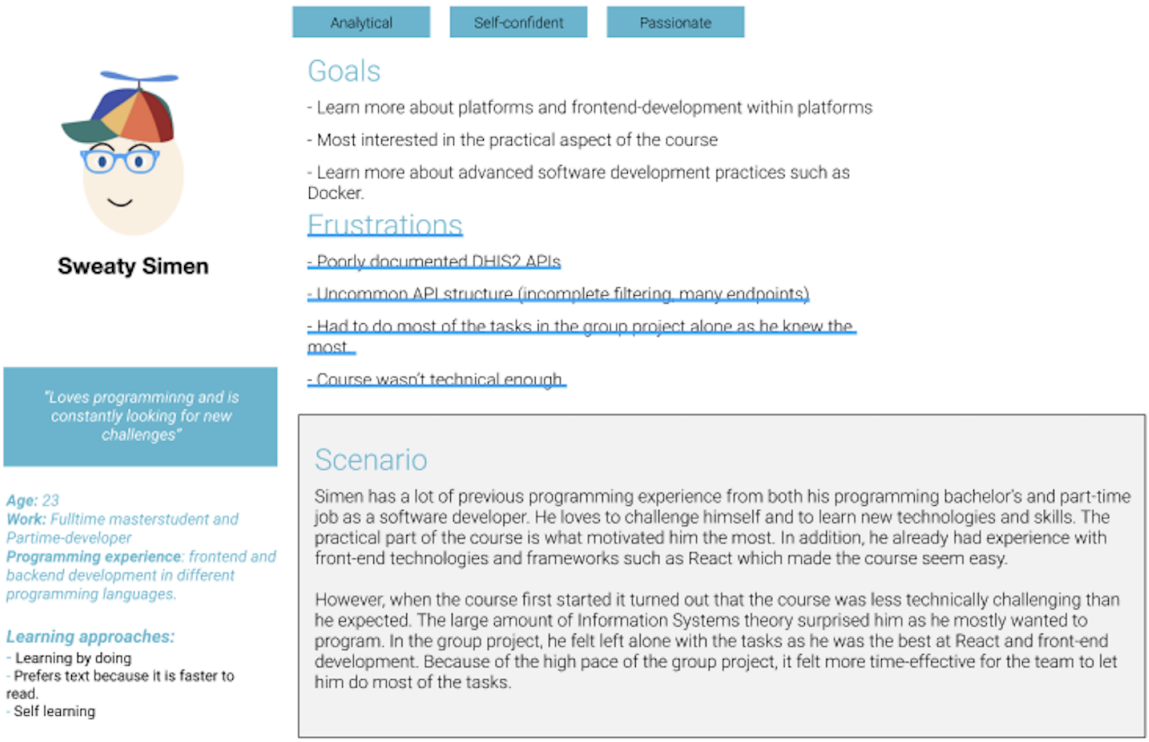


Figure 6.3: Sweaty Simen

Designer Dana

Our second personas is **Designer Dana** 6.4. She is 22 years old and is a full-time student. As her name states, she is a designer and has an eye for user-friendly solutions. She knows a bit about OOP programming but has not done much more than the two mandatory programming courses from UiO. She felt the course was a bit too much and was overwhelmed by the large learning curve that the course provides.

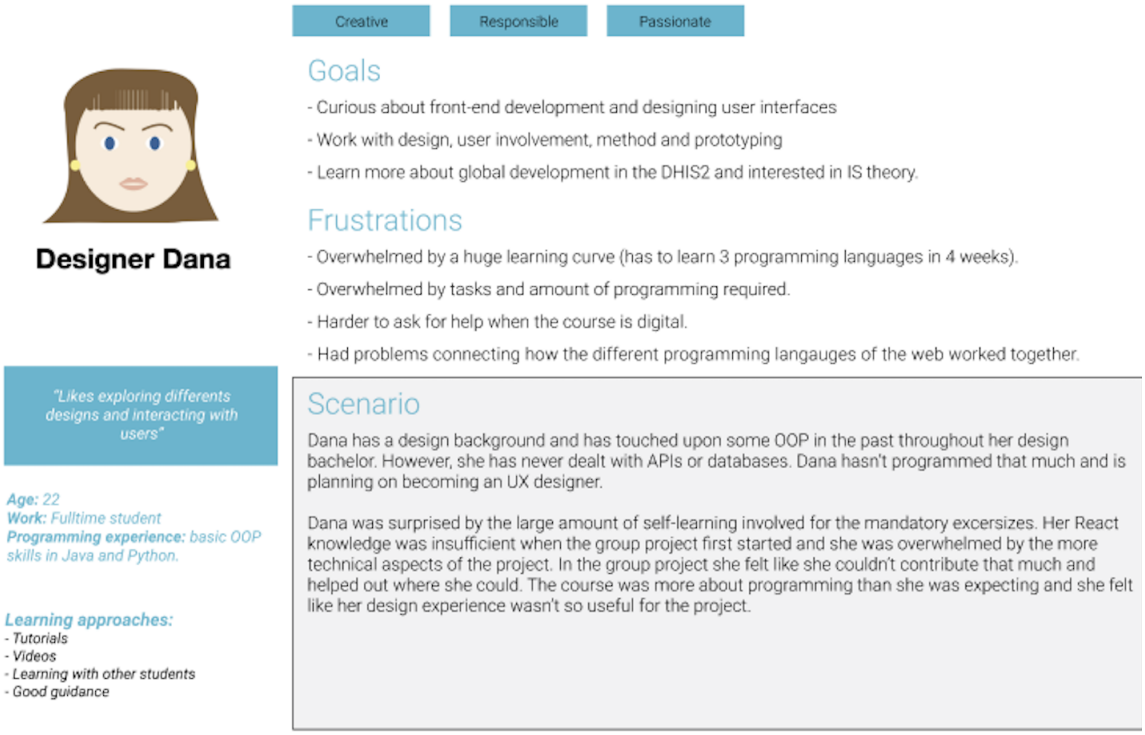


Figure 6.4: Designer Dana

Prosa peter

The third personas we concluded with was **Prosa Peter** 6.5. Prosa Peter tends to be a bit older. As a 25-year-old, he has gone to the common Programming and Systemarchitecture path at UiO, knowing the fundamentals of OOP skills, and are quite advanced in some subject within programming and software development. The course IN5320 did go quite well for him, although he struggled with a few things, such as API documentation and UI component library within the DHIS2.

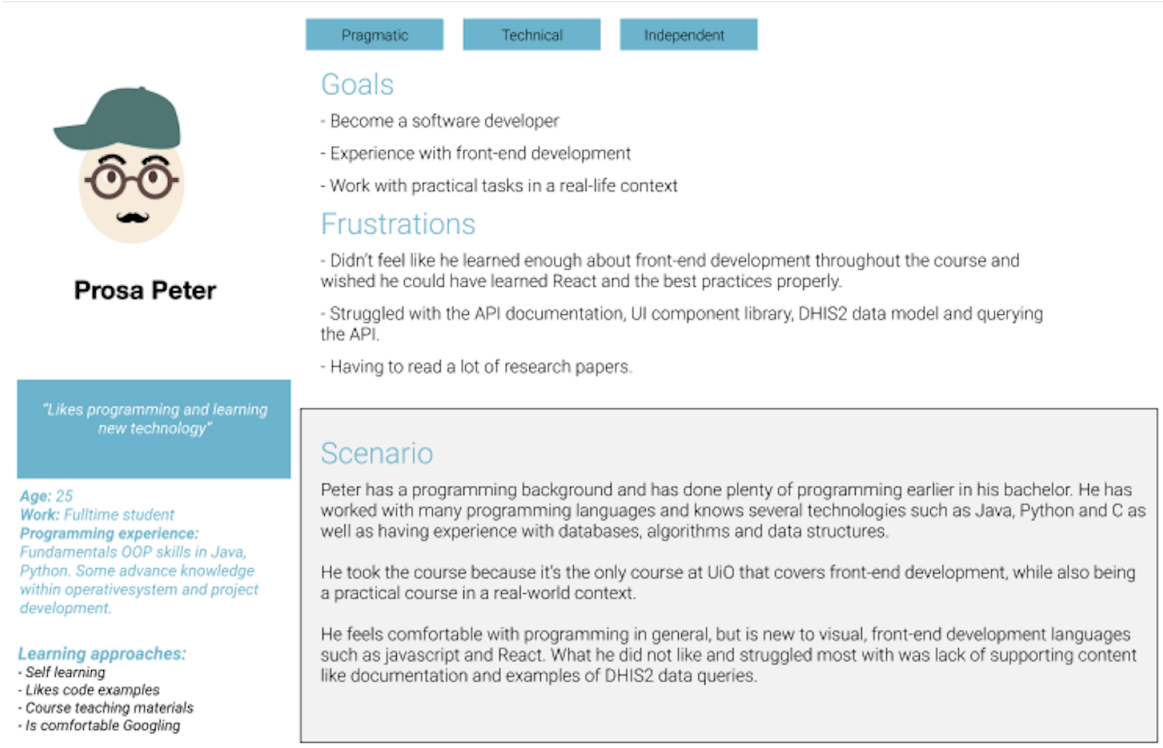


Figure 6.5: Prosa Peter

Motivated Martin

The last personas we concluded with was **Motivated Martin** 6.6. He has a bachelor's in design from Institute for Informatics at UiO. He has some knowledge of programming, but no more than the basic from a few courses that he took during his bachelor's. However, Martin is motivated to learn more about software development and be better at programming, which was why he took the course IN5320.

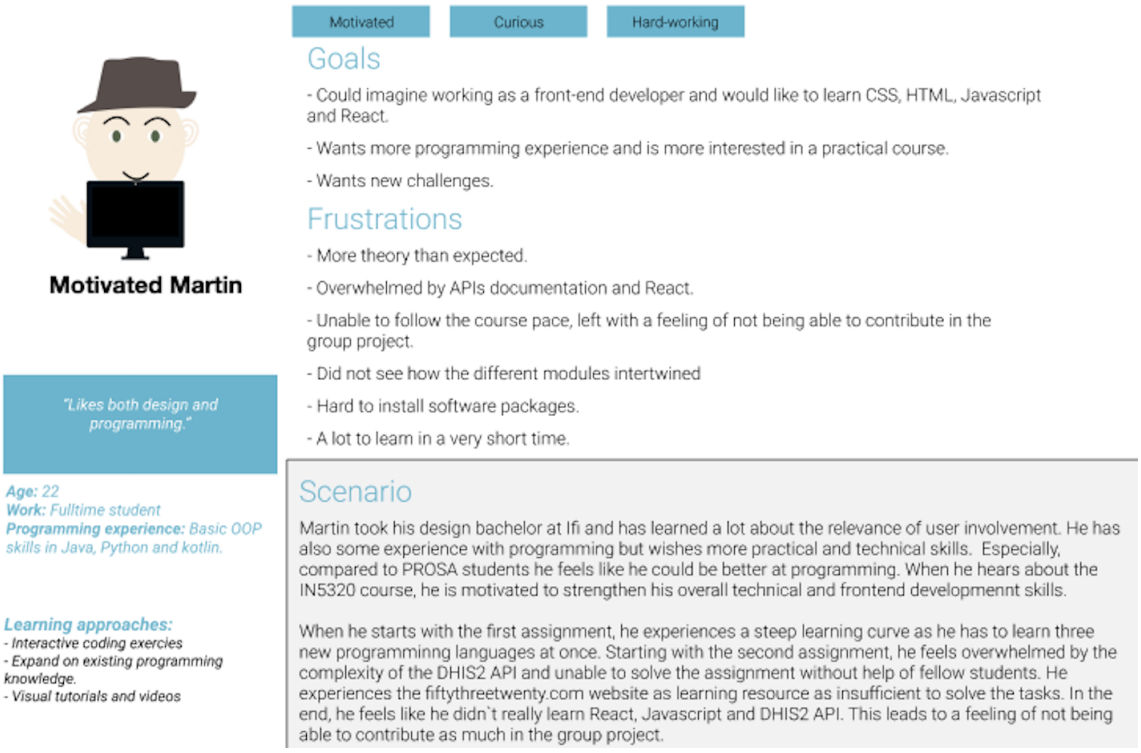


Figure 6.6: Motivated Martin

Gamification and core concepts

With the first iteration of data collection and analysis done, we have come to the stage where we need to explore and decide which new features can be essential for our website and how that functionality can help engage students taking the course. With the four personas that we have concluded, each with a different background, frustrations, problems, and goal: Designer Dana did not have the will and motivation as she struggled through the course, and Sweaty Simen did not feel that the course was enough as he did not learn anything new. Motivated Martin had the motivation to get better at programming, but he also had many problems going through the course. With these personas, we now have a starting ground to start research and explore how gamification can be applied to help solve these problems.

My task was to research gamification: how to "gamify" the website, and go through existing websites that support gamification, especially examples of the eight-core drives within gamification, I researched several apps and

platforms available online, both popular ones such as Duolingo and Kahoot, which is widely used. I also checked out some other unique, less popular platform like **Hackerrank**. Which essentially is a platform used for practicing algorithm questions. All these apps have a lot in common: material elements such as levels, medals, points, and non-material gamification elements, e.g., that motivate and let the user be creative with the approach toward solving a solution. From this, I extract many features that I believe can be applied to the current course's website and help solve the problems that the four personas have shown to have. The figure 6.7 below contains a list of the top potential features, including authentication, which is the core feature that helps enable and tailor a better user experience. Furthermore, the features under section **interactive elements** each support one or more core drives. An example is how implementing ***progress bars*** can support the two core drives of number 2 and 3, which respectively mean **accomplishment** (core nr.2) and **empowering** (core nr. 3).

An explanation explaining the two core drives by **Yu-kai Chou**:

Core drive 2 – Development & Accomplishment is the internal drive of making progress, developing skills, and eventually overcoming challenges. The word "challenge" here is very important, as a badge or trophy without a challenge is not meaningful. This is also the core drive that is the easiest to design for and coincidentally is where most of the PBLs: points, badges, and leaderboards mainly focus on.

In addition, Law, K., Lee, V., and Yu, Y. (2010) [11] mentioned this; the anticipation of performance evaluation can affect students' motivational orientation and task involvement during task performance, and these motivational processes may influence subsequent interest in the task

Core drive 3 - Empowerment of Creativity & Feedbackis when users are engaged in a creative process where they have to repeatedly figure things out and try different combinations. People not only need ways to express their creativity, but they need to be able to see the results of their creativity, receive feedback, and respond in turn. This is why playing with Legos and

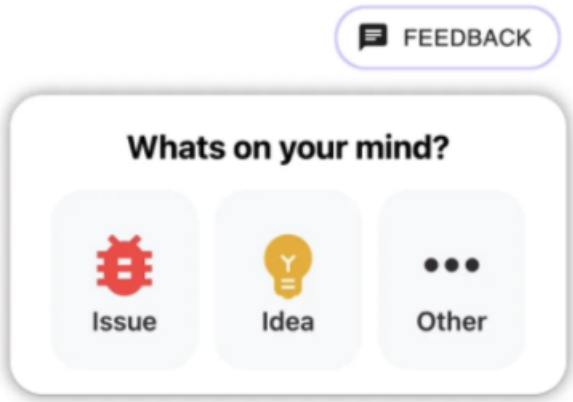
painting is fun and of-and-of-themselves and often becomes Evergreen Mechanics, where a game designer no longer needs to continuously add more content to keep the activity fresh and engaging.

Features:

- **Authentication - Support drive 4**

Interactive elements that support gamification:

- **Score/leader board (check IN5290 Ethical website) - Support core drive 5**
  - **http://kenobi.hackingarena.no/scoreboard**
  - **Core Drive 5: Social Influence & Relatedness**
- **Progress bar** (increase for each tutorials done) **- Support core drive 2 and 3**
  - **Core Drive 2: Development & Accomplishment**
  - **Core Drive 3: Empowerment of Creativity & Feedback**
- **Short intro/learning resources videos**
  - **Test after every tutorial (pluralsight)**
- **Qualitative feedback - Support core drive 3**
  - https://www.reddit.com/r/reactjs/comments/labrol/i_needed_a_feedback_component_for_my_projects/?utm_source=share&utm_medium=ios_app&utm_name=iossmf



- **Interactive code boxes (code sandbox) with immediate feedback** (user can write code to answer the question but at the same time test the coding environment and get feedback) **- Support drive 3**
- **Discussion field, since authentication** is implemented. Users can comment to give feedback, point out errors, ask questions and help others. **Support drive 5**
- **Add related topics to each tutorial/topic** (either it's something we have made, or route to external resources)
- **Add hints -** Support drive 6 and/or 7?

- **Point system - Support core drive 2 and 3**

Figure 6.7: A list of possible gamification features created based on students feedback.

This phase has given us many data on how the student taking the course feel and what kind of struggles they met. We have extracted and generalized four personas, each with a unique background, interest, and frustration. For my part, I once again go back to research. However, this time, having a better vision and perspective about our users, and can therefore easier see what elements other existing platforms have that could solve our users' problems. I created a list of features that I believe would contribute to making the course better. Therefore, the next step is to explore and decide upon a few features to test, implement, and execute another iteration of data collection—however, this time with gamification as the focus.

Part II

Gamification process

Chapter 7

Project plan

The first semester went well; we executed the first iteration of our project with a round of data collection and analyzed the data collected. For the next step, we had to either focus on making the content of the course better or take on the gamification idea to make the course more motivating and engaging. I decided, therefore, to split from the group as my interest did not align with theirs. I was more interested in gamification and how it may help motivates students, while the others wanted to focus more on pure content (e.g., curriculum) and how to improve it. Even though we do not work closely together anymore, we agreed to keep in touch as we work toward the same goal. Starting the semester alone, I wanted to shift and create a plan aligned with my goal. This chapter describes a list of things I did for autumn 2021.

Plan for autumn 2021

1. Implement one or more gamification factors that can support one or more core drives.

2. Test the implementation iteratively with students and professors/teachers related to the course.

Test-object: For my test object, I wanted to focus on the students who have taken the course, are currently in, or are interested in taking it. This would help signal whether gamification would fit in for a large amount of user audience.

- **Students** that:
  - Have taken the course IN5320
  - Currently enrolling in the course IN5320
  - Interested in taking the course the following year.
- **Professor/teacher** that:
  - Lecture in the course
  - Is active in the course or contributing in some way.

Test methodology: I executed several user-testing, surveys, and interviews with the user group mentioned above for the test methodology.

- **User-testing with todo checklist to test the usability (usability testing)**:
  - **The goal** of doing usability testing is to get feedback on the usability of the platform after the new features are added.
- **One-to-one interviews:**
  - **The goal** of doing the one-to-one interviews is to get deeper and more detailed feedback relating to whether the changes leave a good impact on the user. e.g., giving them the motivation to learn more.
  - **The interview's main focus** will be gamification. I test the newly developed progression page with users and get feedback on whether or not this affects the user in any way, both positively or negatively.
- **Surveys:**
  - **The goal** of surveys will be to collect quantitative feedback from the user. The survey will focus on how the user feels about the website, what they feel about the progression page and progress bar, and lastly, what they feel about other potential gamification elements that can be adapted to the website.

About the ICE method

The ICE method was an approach that we together as a group did back in late spring 2021. Because of the small-time frame that we had before, we needed to have something ready, which was by Jun of 2021. There was not enough time to implement every feature we wanted to. Therefore, we used ICE, a score prioritization method by Sean Ellis. From an article by hygger.io [6], the acronyms can be used and determined by understanding the following:

- ***Impact*** *demonstrates how much your idea will positively affect the key metric you're trying to improve.*
- ***Confidence*** *shows how sure you are about Impact. It is also about ease of implementation in some way.*
- ***Ease*** *is about the easiness of implementation. It is an estimation of how much effort and resources can be required to implement this idea.*

With the ICE method and the list of features that I created earlier 6.7, we can together decide which feature should be prioritized. Therefore, we have decided to have the score ranging from 1-to 5, where the higher the score, the more important and easier it is to implement. Looking at figure 8, we can see that thumbs up/down have the best ICE score because of their high score of impact, high confidence that it will make an impact, and lastly, a high score of ease which means that it is not hard to implement. We talked and discussed in the group and determined what each feature ICE score will have. My role here was to discuss an argument for why I feel certain features have a high impact and can be achieved within a short timeframe.

ICE					
Features:	**Impact**	**Confidence**	**Ease**	**ICE score**	**Implement**
Authentication	x	x	x		User can login to get access to their progres-sion
Score/leader board	3	2	2	2.333	
Quiz, Code sandbox?		5 if point system imple-mented			
Point system / Gamification	35	2	2.166 6667		
Discussion field	2.5	3	2	2.5	Maybe. Need to talk to DHIS2 team

Progress bar	3	4	4	3.6667	Yes
More tests/quizzes after every tutorial	4	4	3	3.667	Maybe. Questions and quizzes need to be determined first
Thumbs up/down + Feedback	4	4	4	4	Yes - Alex
Interactive code boxes (code sandbox)	5	4	1	3.333	Yes - Steven
Solution to the code sandbox					
Report a problem/Bug	2	3	4	3	Yes - Gwen

Table 7.1: The ICE scores

Taking in the feedback from previous users via interviews and the different gamification factors and core drive into consideration. As well as the time limit and the result we get from the ICE method, I have come to a conclusion to implement **progress** bars and **interactive code boxes**.

In addition, within gamification, some features are intertwined and need to be implemented and tested together in order for it to give an accurate result. For instance, having a score/leaderboard feature to enable motivation and competition drive will require authentication to be implemented to work fully.

In order to create a smooth and iterative process and the ability to test it as soon as possible, I need to choose features that are both important and independent.

As mentioned in the introduction section, gamification design involves the **eight-core drives** each having its purpose and goal. By implementing **progress bars** the two following core drives will be supported; **accomplishment** (core nr.2) and **empowering** (core nr. 3). With progress bars implemented, the goal is then to help the students that lack motivation by giving them a feeling of **accomplishment** (e.g., done with the first big section of the course). The display of progress bars will also **empower** the students to keep going (e.g., one more task, and they are done with the whole section).

Interactive code boxes and quizzes:
The goal for this autumn is to get these two features implemented and tested and receive feedback from the students about whether these two features leave any real impact.

Gamification in Education - Nadezhda Angelova [10] According to Gabe Zichermann, cited by (Giang, 2013), game mechanics users improve their abilities to learn new skills by 40%. Game approaches lead to a higher level of commitment and motivation of users to activities and processes in which they are involved.

The article mentioned popular learning platforms that allow teachers to manage online learning called **Moodle**. It mentioned how Moodle has implemented gamification and described some of the core features, one of the features was to enable the visibility of the **students progress**, which is, in fact, the **progress bar**.

A function definition of the progress bar is given in the article: - "Progress helps users understand that their actions that may initially seem unrelated and small are connected in a greater whole and lead to achieving a certain goal." - (Nadezhda Angelova, 2014).

Another effect that the progress bar gives is instantaneous and positive feedback that makes the user feel motivated, engaged, and encouraged in their actions. Take the example of the tests and assignments in the application Moodle, where each activity provides some feedback - whether it is general or specific for correct and wrong answers. Even though these

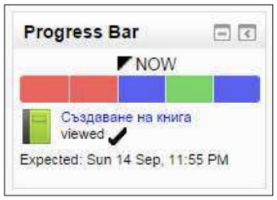


Figure 1. Progress bar (Moodle block).

Figure 2. Quiz results (Moodle block).

Figure 7.1: Example of progress bars and quiz results

gamification features will be the main focus and will be implemented because they have shown their efficiency and how it motivates users. I would also like to focus and draw on the demotivating aspect of gamification and how these features/core drives can be interpreted differently for each person.

The article Personality-targeted Jia (2022) [9] explores the relationship between personality traits and people's perception of different motivational affordances, which in this case is the gamification designs.

The article also studies the demotivational part of the motivational afford-

ances based on their personality and background. For instance, material elements such as the progress bar may not have the same positive effect on everyone. People may interpret the indication of where they are in a particular project or assignment as a demotivating factor, e.g., having 10% done out of 100% after spending several hours would make the user feel devastated and unmotivated to continue.

Chapter 8

Interview & Survey

With the project plan created and ready, the next step was to execute the a new iteration of data collection. In this phase I worked on and created different schema such as user-testing schema, surveys and interviews question with gamification as a the main focus.

8.1 The candidates

I have chosen nine different interview candidates for the interview and survey phase. Each has a different background, personality, skill set, and struggles. Figure 8.1 display the list of the interview candidates and their background information.

The candidates I have chosen are mostly enrolled in one of these three informatics paths at UiO. Informatics: **Digital Leadership**, Informatics: **Interaction design** and Informatics: **Programming and System Architecture (PROSA)**. Although some are enrolled in the same path and course, different people have different interests and may excel in things that are not exactly within the path they are enrolled in.

The candidates are relatively young with an age between 22 to 25 years old, and with a mix of both females and males, with females being the majority. However, the focus of our research on these candidates is not their age or gender but rather their knowledge, skills, both technical and non-technical background, and also their personality.

Looking at the table 8.1 below, we can see that there is quite an exciting mix between the candidate's education/background and their skills which are under the **Additional info** column. For instance, candidate number 1 has an interesting educational background with a mix of law and UX (interaction design) from UiO. These candidates are less technical and have few programming skills but are excellent and knowledgeable within the UX field. In addition, her undergoing law education creates an exciting combination within the IT field.

There are many other interesting backgrounds as well. There are PROSA students who are having trouble with programming, while there are design students (who normally would not go through as many programming courses as PROSA) who are doing well with their programming courses.

8.2 Interview candidates

Cand. number	Age & Gender	Education	Part-time Job	Additional info
1	22, Female	Informatics: UX and Law	UX designer	Little programming knowledge and less technical. Creative and great at UX and interaction design.
2	23, Female	Informatics: Computer science	None	
3	23, Female	Informatics: Digital Economic Leadership	None	Technical and good at programming and computer science field. Has not taken the course before.
4	23, Female	Informatics: Digital Economic Leadership	None	Technical and good at programming and computer science field. Tok the course in Fall 2021.
5	22, Male	Frontend development	None	Good at programming, especially frontend development.

6	24, Male	Informatics: PROSA	Developer	Great programming knowledge, have not had much trouble throughout his university path.
7	23, Male	Informatics: Design to PROSA	None	Decent programming knowledge, previously enrolled in design degree but recently switched to PROSA.
8	22, Female	Informatics: design and interaction	Interaction designer	Creative, and great interaction designer, but has taken extra courses in programming. Has not taken the course before.
9	25, Male	Informatics: PROSA	None	Has described that he has struggled a bit getting through the courses throughout his bachelors, currently taking master.

Table 8.1: Candidates background

1 Tasks

I created a simple user-testing schema containing several tasks that I would ask the interview candidate to complete within a specific time constraint. With this approach, I would stand back and observe their performance and execution and note down the candidates behavior, such as frustration, ease, or if they talk out loud.

ID:	**Task description**	**Comments**
1	Pick one of the topics and tell me what you see	
2	Navigate back to home page	
3	Navigate to the JavaScript topic and finish the **"Variables"** subsection **"What are variables"**	
4	Tell me if you have noticed any changes	
5	Navigate to the **PROGRESS page** and tell me the progress percentage of the topic JavaScript you just did.	
6	Navigate to the **EXERCISES page** and complete one of the exercises.	

Table 8.2: The user-test tasks

2 Surveys

8.2.1 SUS survey

The SUS survey contains a list of statements about the current state of the course website; these statements ask the candidates how they feel about the structure, the design, whether it is motivating, ease of use, and more. The interview candidates can check off with a score ranging from 1 to 5, where one would disagree with the statement, and five would agree with the statement. With this survey, I would get a good indication on whether the current state of the website.

Statement	**1**	**2**	**3**	**4**	**5**
1. I believe the website motivates me to keep learning and solving different tasks.					
2..I feel unmotivated going through the tasks on the website.					
3. I think that I would like to use this system frequently.					
4. I found the system unnecessarily complex.					
5. I thought the system was easy to use.					
6. I think that I would need the support of a technical person to be able to use this system.					
7. I found the various functions in this system were well integrated.					
8. I thought there was too much inconsistency in this system.					
9. I believe that most people would be able to learn to use the website very quickly.					
10. I found the system very cumbersome to use.					
11. I felt very confident using the system.					
12. I felt that its necessary to learn and understand a lot of things before i can feel confident in using the website.					

Table 8.3: SUS survey

8.2.2 Gamification survey

Because of the time constraint and with the unlimited feature that I have got to test and implement, I wanted to receive quantitative feedback on the two features that I have tested.

Statement	**1**	**2**	**3**	**4**	**5**
1. I found the progression bar for each quiz session motivate me and other users to finish the quiz.					
2. I think that the progression bar for each topic motivates me and other users to complete the topic.					

Table 8.4: Gamification survey

3 Interview

A short semi-structured interview focused on the entire experience of using the application and getting qualitative feedback from the candidate. Outside of the listed question below, there will be many follow-up questions and questions that are dedicated to each interview candidate.

1. What do you think about the application's gamification elements (such as levels, progress reward system)?

2. Do you have any suggestions for improving our application?

3. We want to focus on the user's contribution to our content. Is there anything the application is missing that can motivate users to contribute more?

4. Do you have other feedback?

8.2.3 Gamification survey 2

Toward the end of each interview session, I would ask the candidate to fill out a shorter survey that contains several statement suggestions such as; If there were gamification elements such as these, how would you feel

Statement	**1**	**2**	**3**	**4**	**5**
1. Including animations and figures would make the application more fun to use for me.					
2. A level system would motivate me to use the application more frequently.					
3. A level-up pop-up would give me enough information about my current privileges.					
4. A level-up pop-up motivates me to get higher level.					
5. A feedback-screen after the quiz would motivates me to perform better on the next session.					
6. A reward system would motivates me to keep doing more quizzes.					
7. A voting system enhance my trust in the application's content.					

Table 8.5: Gamification survey 2

8.3 The technical part

Although I have been test-implementing several different features throughout the project, I want to dedicate this section to describing the

implementation process of the gamification element **progression** and how it went.

8.3.1 The codebase

As mentioned in earlier chapters, the course's website, fiftythreetwenty, now active under the domain name **dhis2-app-course.ifi.uio.no**. The website's tech stack contains of vanilla Javascript with few React components across the project; the content is written as markdown text. Getting to know and understand the codebase structure was not super complicated. Although, it did take some time to understand the flow of each page and how the components work together.

8.3.2 The approach

After the flow and the structure of the codebase was understood, I proceed on the design of the progress page 8.1 and progress bar 9.2; the design started in Figma, and later tried in codes. The GUI of both the page and the progress bar itself is not complex; the progress bar is just a simple CSS with a width and height set, while several of the GUI design used, e.g., "dropdown arrows" and the "font", are design components already existing in the codebase.

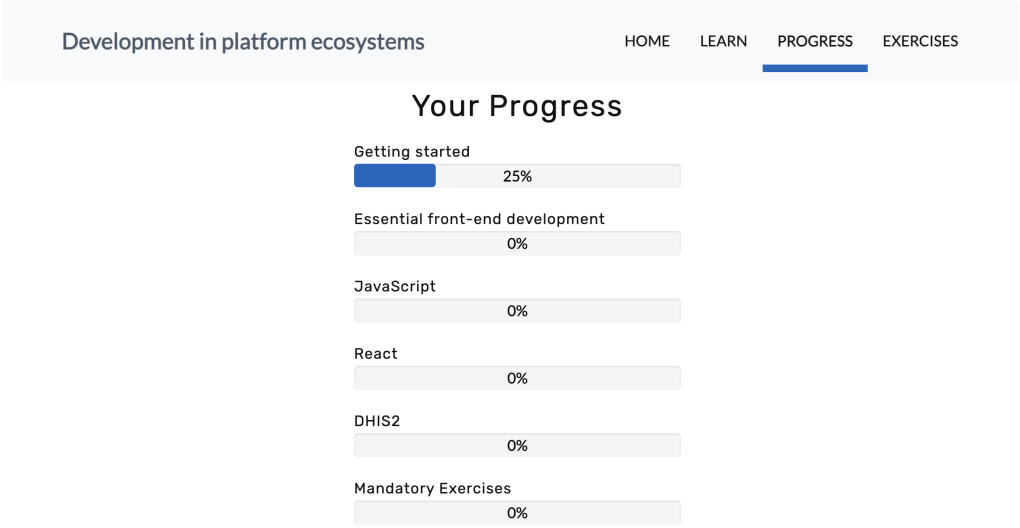


Figure 8.1: A new page showing the progression

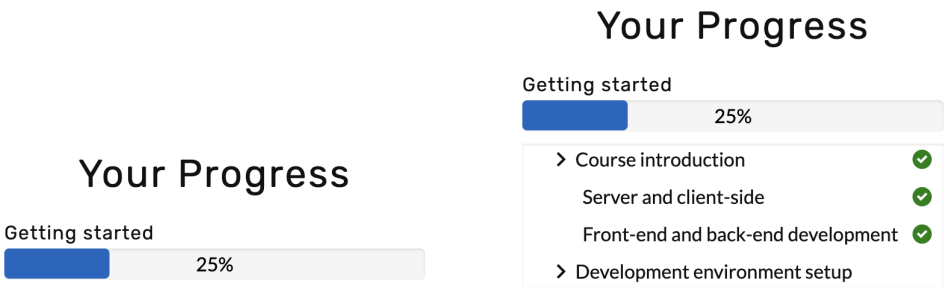


Figure 8.2: Progressbar: normal and expanded state.

8.3.3 The logic implementation

The most time-consuming part of this feature was implementing the logic; how to update and calculate the progression, to be specific. For the most part, the website content contains several courses, and within those courses, there are several topics, followed by lessons, and lastly, several steps within each lesson. Therefore, the progression needs to be monitored and updated for each course, topic, lesson, and step accordingly.

The ideal approach to solving track this for every user would be to have

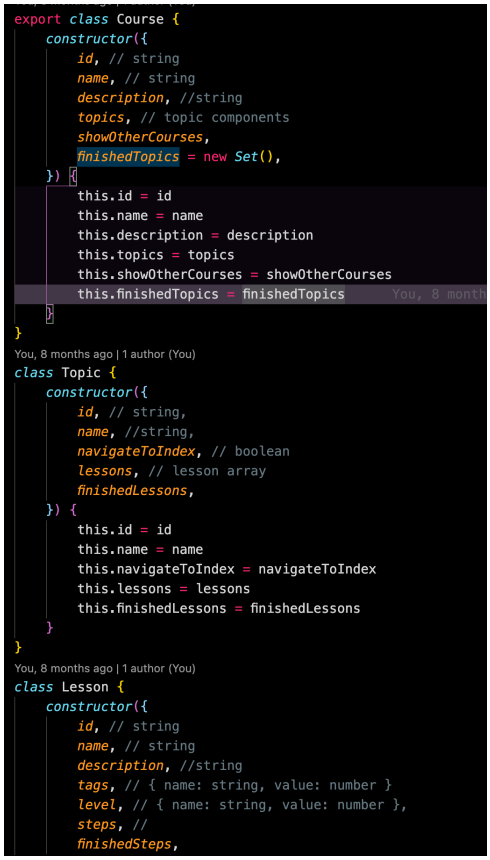


Figure 8.3: A codesnippet showing the data structure.

user credentials and the necessary data that could help save the progression for each unique user. However, this would not only require a lot more work as I need to implement credentials logins and a database storing the data; furthermore, doing this would also involve having to store user data which needs to be done thoroughly and via a UiO server. As I am dealing with a limited amount of time, my alternative option was to use the **local storage** as a way to store and update the progression for the entire website. Local storage is not the perfect solution, but it works well for the goal I want to achieve; simply testing out whether having the option to see progression would help the user. To implement this, I create several class structures for each course, topics, lessons, and steps. These will be rendered as objects whenever the website is loaded, and I would be able to access every object attribute, making it easier to store the data but also easier to calculate its current progression state, e.g., using ***finishedLessons*** attribute.8.3.

```
export const setProgressToLocal = appProgress => {
    if (typeof window !== 'undefined') {
        const parsedAppProgress = appProgress?.map
        (courseProgress => {
            return {
                ...courseProgress,
                finishedTopics: [...courseProgress.
                finishedTopics],
                topics: [
                    ...courseProgress.topics.map(topic => {
                        return {
                            ...topic,
                            finishedLessons: [...topic.
                            finishedLessons],
                            lessons: [
                                ...topic.lessons?.map
                                (lesson => {
                                    return {
                                        ...lesson,
                                        finishedSteps: [
                                            ...lesson.
                                            finishedSteps,
                                        ],
                                    }
                                }),
                            ],
                        }
                    }),
                ],
            }
        })
        const stringified = JSON.stringify
        (parsedAppProgress)
        localStorage.setItem('app-progress', stringified)
    }
}
```

Figure 8.4: A codesnippet showing the data progression being set/updated into local storage.

With the implementation of the progression through the entire website, it is now ready to showcase to the users in the next phase to receive feedback.

Chapter 9

Interview & Survey evaluation

The fifth phase and activity from the DSRM process model 3.1 is to evaluate the resulting artifact, which in this case is to evaluate whether the current state of the application is good enough, but also primarily on what and how to improve the artifact by evaluating the feedback the interview candidates has given in the interviews and surveys.

This phase will give me a good insight into whether the artifact (website) can be improved. If that were to be the case, a new iteration will be start of at phase/activity number 3.

9.1 Data analysis

The feedback from the surveys and interviews has left me with several valuable points that can be focused further on in the next iteration of the DSR cycle [15]. I have completed the interviews and surveys described in chapter 8.2 with nine different users. After going through and analyzing the feedback from these nine interview objects, the result can be divided into several points below; these are things I can focus on to improve the artifact.

9.1.1 User-testing

The user testing tasks (table 8.2) went well in general. The majority of the interview candidates did not have problems going through the user-testing list of tasks 8.2. A few did struggled to start task id 3: Navigate to the JavaScript topic and finish the "Variables" subsection "What are variables" because there are too many topics and subtopics within. It is pretty chaotic and maybe a bit unstructured.

9.1.2 Green check-mark

The check mark was added beside each topic and lesson that appears whenever each topic/lesson is finished (figure 9.1).

Figure 9.1: Check-mark icon appear whenever a topic/lesson is completed.

The green checkmark was not noticed by many right away. This was the feedback from a previously enrolled student familiar with the website and a new user who had never seen the website before. Even though a few noticed it, some of them did not understand right away what that checkmark meant.

Furthermore, a few users mentioned that it is arguable whether the logic

behind this works as it is right now. The reason is that a topic is considered completed if the user has clicked through all the steps within that topic or lesson. Therefore I would agree that it does not always mean that it is finished.

A user mentioned a solution to this would be to have a checkbox at the end of each topic where the user can confirm that they have finished this particular topic/lesson. This solution might work as it would solve the problem of whether or not the topic can be marked as completed. However, it might destroy the seamless workflow where users have to click on additional checkboxes for every topic and lesson they occur. This needs to be looked upon and tested in further iterations.

9.1.3 Progressbar

As mentioned earlier, I have implemented an additional page where users can see their progress so far for the entire website (Figure 8.1). The feedback here was overall great. Many users described that this is an excellent addition to their workflow and is easy to see and understand. Two users described that this would have helped them tremendously, especially one user who said that because she has ADHD, her focus is all over the place. With the progress bar and a page to see and follow her progression, she felt more motivated as it gives her an overview of what she has completed. In addition, this also motivates her to focus on one topic at a time as she can see how close she is to finishing a particular topic. Similar research has been done on these types of situations before. In the article by Cechetti et al.(2019) [3] [2], a case study with an m-Health application for hypertension monitoring where gamification elements such as score system, progress bar, and levels, leaderboard and feedback have been developed and added into the mobile application in which resulted in more engagement and stimulating intrinsic motivation in the participants.

While the majority did like the progressbar and the entire possibility to track your progression. There were a few other users who mentioned that having this overview of their progression can also be demotivating as it gives them an indication that they are far from finishing a topic they

are working on. Especially for topics with many lesson, the percentage showing on the progress bar will move slowly. This aligns a lot with the topic of "the negative and demotivating side of gamification" that I mentioned earlier in chapter 7 and from the article by Yuan Jia, Bin Xu, Yamini Karanam, Stephen Voida (2022) [9].

Further feedback and improvement potential were on the design part of the progress bar. Most of the test-applicant did not understand that it is possible to click on the progress bar to see a more detailed progression of the course. Looking at the figure 9.2, on the left side, you can see the progress bar in a non-expanded form. It is indeed hard for the user to understand that it is clickable. On the right side is a figure displaying the progress bar of a course in expanded form, showing all of its topic and lesson and its progression.

A few suggested adding an indication that it is clickable, e.g. an arrow icon or text “more” beside inside the bar.

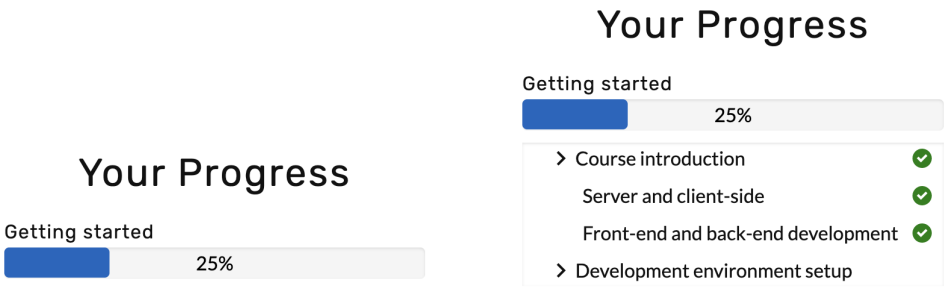


Figure 9.2: Progressbar: normal and expanded state.

9.1.4 A few common comments and citations :

- In general, it is quite intuitive. I could understand the flow of the website after doing it once.
- The navigation between topics and lessons is sometimes a bit confusing. In particular, the next and prev button on a few topics sometimes does not appear or have a different color.

- There is often too much information on each topic, and I feel overwhelmed with the amount of information I need to read to grasp the content. - Candidates 1 and 4
- I think adding gamification would help make the website more motivating and fun, and I enjoy it when a website is interactive.
- I have ADHD and often struggle with keeping track of things. I often find myself jumping between tasks. Having the progress bar does make everything a little easier for me. I can now keep track of my progression and know which topic I can finish first. Therefore, adding more gamification can help make the content and learning more motivating.
- I believe the website has excellent content but lacks quite a bit on a few essential topics such as React. In addition, I do not feel like staying on the website for a long time compared to other sites out there.

9.2 Feedback evaluation

9.2.1 SUS survey feedback

The table below contain feedback from the interview-objects. The columns are the interview-object number, the rows are the statement/questions number and what each interview-object checked on that particular statement.

Table 9.2 shows the answered survey of nine interview-objects. Its interesting to see that the answer of all nine people leaves an common pattern as the majority of the answer are alike across all questions. Most of the feedback are indeed positive, however, there are indeed a few that do struggle with the website. For instance the first interview candidate felt there are many things that they need to learn in order to be confident in using the website *(score of 4 on statement 12)*. Furthermore, even though there are not that high score on the negatives statement, the score here are still not 1 but rather 2 or 3, which indicates that improvements can be done to the website in order to motivate the students.

Statement	**1**	**2**	**3**	**4**	**5**
1. I believe the website motivates me to keep learning and solving different tasks	4	4	3	4	4
2. I feel unmotivated going through the tasks on the website	2	2	1	2	2
3. I think that I would like to use this system frequently	4	5	4	4	4
4. I found the system unnecessarily complex	1	1	1	1	3
5. I thought the system was easy to use	4	4	5	4	3
6. I think that I would need the support of a technical person to be able to use this system	1	1	1	1	1
7. I found the various functions in this system were well integrated	5	3	5	3	4
8. I thought there was too much inconsistency in this system	1	2	2	2	2
9. I believe that most people would be able to learn to use the website very quickly	5	5	4	4	4
10. I found the system very cumbersome to use	1	2	1	3	2
11. I felt very confident using the system	4	4	5	5	4
12. I felt that its necessary to learn and understand a lot of things before i can feel confident in using the website	4	2	1	2	1

Table 9.1: Feedback/result of the survey 8.3. Feedback by candidate number 1 through candidate number 5.

Statement	**6**	**7**	**8**	**9**
1. I believe the website motivates me to keep learning and solving different tasks	4	3	4	3
2. I feel unmotivated going through the tasks on the website	2	2	2	1
3. I think that I would like to use this system frequently	4	4	5	5
4. I found the system unnecessarily complex	1	2	1	3
5. I thought the system was easy to use	4	3	4	5
6. I think that I would need the support of a technical person to be able to use this system	1	2	1	2
7. I found the various functions in this system were well integrated	5	4	4	3
8. I thought there was too much inconsistency in this system	1	2	1	1
9. I believe that most people would be able to learn to use the website very quickly	4	4	4	4
10. I found the system very cumbersome to use	1	1	2	1
11. I felt very confident using the system	4	4	4	5
12. I felt that its necessary to learn and understand a lot of things before i can feel confident in using the website	1	2	2	1

Table 9.2: Feedback/result of the survey 8.3. Feedback by candidate number 6 through candidate number 9.

Looking at the table 9.3 below, I have averaged the feedback of the interview candidate for each statement. We can see, again, although the average score is low on negative statement, the majority of them are still above 1.5 as the averaged score.

	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Averaged score	3.6	1.7	4.3	1.5	4	1.2	4	1.6	4.2	1.5	4.3	1.7

Table 9.3: Averaged feedback of the survey statements.

9.2.2 Potential gamification features feedback

The table below contain feedback from the interview candidates. The columns are the candidate number, the rows are the question number and what the candidate checked on the survey.

Statement	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
1	5	4	5	5	4	4	4	4	4
2	5	4	5	5	5	4	4	4	4
3	2	4	5	4	3	3	4	5	3
4	4	3	5	4	3	3	3	4	5
5	5	5	5	5	5	5	5	5	5
6	4	4	5	4	4	4	4	4	3
7	3	5	5	5	4	5	5	4	4

Table 9.4: Potential gamification features feedback

Looking at the result, we can see that everyone do have high wishes on more features being implemented, which also includes in gamification be-

ing a great addition to the platform and course.

The most wanted and highest wish are Statement number 1, 2, 5, 6, and 7.

- (1) Including animations and figures would make the application more fun to use for me.
- (2) A level system would motivate me to use the application more frequently.
- (5) A feedback-screen after the quiz would motivates me to perform better on the next session.
- (6) A reward system would motivates me to keep doing more quizzes.
- (7) A voting system enhance my trust in the application's content.

As my time is limited, I believe the findings of the interviews and surveys has given us a good insight on why adapting gamification into the course website may help motivates user along many other positive attributes. The findings here can and should be explored further. More iterations need to be executed and more implementation of gamification features needs to be developed.

Part III

Evaluation

Chapter 10

Discussion and further work

10.1 Discussion

In total, 29 interview candidates participated throughout this project, with the first 20 candidates participating in interviews where the focus was on how they experienced the course. The remainder 9 participated in user-testing, surveys, and interviews focusing on gamification. The number of candidates might not be high enough to confirm whether or not gamification might be the absolute best solution for the presented problems. However, the outcome did give us a good indication that gamification does have a positive effect.

Adapting and applying gamification elements to the course website has been quite positive and has helped solve a few issues. Implementing the progression page with an indication of whether a topic is finished or not has received great feedback from several users. Other potential gamification features and elements such as animations/figures, level system, and feedback screens were also highly wished (Table 9.4), although not implemented for the time being.

It should be noted that the result I concluded is only after one iteration of "gamifying" the artifact. There is still a lot of improvement potential; many more features can be implemented, and more research still needs to be done. The gamification framework **Octalysis** has shown to be a good framework that can be adapted into our system and apps. In addition, the

framework has shown to be quite universal, as we have seen in several popular and successful apps out there. However, Octalysis is only one framework out of several out there. In the future, it would be interesting to compare different frameworks and design principles and try to adapt them to the website as a test to see which is the most suitable and give the better result.

There are still many questions that remain to be answered. Is gamification the future of education? Can overuse of gamification elements leads to negative rather than positive outcome? Do these gamification elements suit a platform like fiftythreetwenty or even something within the DHIS2 platforms? Not enough research has been done to draw a clear conclusion. Even though there was mostly positive feedback about the gamification elements presented in the surveys and interviews, it is still not a guaranteed factor whether gamification can significantly affect the user's motivation.

10.2 Further work

Future research should continue to research and explore several features that can be implemented into the website. These features should incorporate the Octalysis design framework and its core drives. Which feature to be implemented should be based on the feedback from users, either directly or indirectly. Additional features can be implemented even though it was not explicitly asked, as it may not be a direct feature that the user can see but rather a support feature, e.g., **user authentication**.

Future research should also continuously apply the DSR methodology cycle, and for each iteration of the improved and extended artifact, it should be tested against the user to find whether the feature and its core drives affect the user positively or negatively.

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