

# Using Gamification to Motivate Self-Regulated Learning in Adults

*Research through Design: Developing a  
Quiz-Based Learning Tool*

Alisa Odincova



Master Thesis  
Informatics: Design, Use and Interaction  
60 credits

Department of Informatics  
The Faculty of Mathematics and Natural Sciences

UNIVERSITY OF OSLO

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<http://www.duo.uio.no/>

Print: University Print Centre, University of Oslo

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# Summary

Over the last decade gamification has been emerging as an engaging technology to promote learning. However, the majority of research on game inspired learning has focused on children and adolescents. In this project I am going to explore what motivational impact gamification of self-regulated learning has on adults in a higher education context.

To explore how adults are motivated by gamified learning, I have conducted research through the design of a gamified quiz application that both supports educational principles and is engaging. Firstly, I have explored theories of gamification, motivation and learning. Then, I have made use of a framework for Interaction Design and the 6D gamification framework by Werbach and Hunter. To collect context-grounded data to act as foundation for my design specifications, I have utilized such methods as interviews, survey, document analysis, prototyping and usability testing.

This project illustrates the practical and theoretical insights into the act of designing a specific solution situated in a higher education context. The findings suggest that there is a demand for gamified solutions among students. Furthermore, results indicate that students can be motivated to study more by using a simple gamified quiz-based tool.



# Acknowledgements

First and foremost, I would like to thank my supervisor Gisle Hannemyr for providing expert advice and guidance during this project. He always kept his office door open whenever I had a question and always steered me in the right direction. His patience and understanding helped me in all the time of writing of this master thesis.

I also would like to thank my co-supervisor Hani Murad for support and encouragement during the writing process.

Additionally, I would like to thank the Department of Informatics at UiO for giving me the opportunity to study and my fellow students for their enthusiasm and willingness to help.

I must express my very profound gratitude to my precious husband that have been loving and supporting me throughout this period.

Finally, I would like to thank my cat Sofia, for approving the good chapters by sleeping on them.

This accomplishment would not have been possible without you all. Many Thanks!

Alisa Odincova





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# 1 Introduction.

Today traditional methods of learning get supplemented by different engaging technologies, including gamification and its various applications. As new technologies exponentially emerge so does “a new way of learning” adapted towards technologies as a new way to share and create information. In turn teachers need to offer innovative learning environments that both include types of learning that students already are doing, as well as aim for better studying experience overall.

According to Jane McGonigal (2011) the collective time humans from all around the globe spent on gaming is 3 billion hours a week. Games feed into genuine human needs, they provide rewards and they engage and inspire while bringing people together (Ibid). These positive characteristics can be used to enhance and promote learning. However, over the past two decades, research in the field of game inspired learning has mainly focused on children and adolescents (Whitton 2014 p.36-39). Nonetheless, adults differ from children in how they are motivated by games and the degree they consider games appropriate in higher education. Though often it is assumed that what works for kids should work for adults, though it might be not the case (Ibid). There is an opportunity to understand how adults can benefit from utilizing game inspired solutions in education. To do that, we firstly need to understand how gamified solutions engage and motivate adults in practice.

In this master thesis project, I explore how to design a gamified quiz application to assist self-regulated learning in the higher education context. For this purpose, I will use a course in Information Architecture and Content Management from University of Oslo as an educational background for the quiz. Further, I present a detailed overview in background context for this research project and my personal motivation. Finally, research questions are discussed in section 1.3 and this chapter concludes with all chapter overview in section 1.4.

## 1.1 Project background

### 1.1.1 Brief introduction to the Information Architecture & Content Management course.

Information Architecture and Content Management (internal code INF3272) is a 10-point course offered at the University of Oslo every spring semester. This course is focused on information architecture theory, its design and practical application with free software Content Managements System Drupal version 7. Students are expected to design and build interactive and responsive websites, as well as understand main concepts, standards and the most commonly used tools in Information Architecture. It is primarily intended for Bachelor students from the Department of Informatics. Prerequisite knowledge for this course is a passed exam in one of 3 courses about interaction design (INF2260, INF4060 or IN2020). Teaching structure consists of 2 academic hours (45 min per hour) of lectures and 2 academic hours of mandatory laboratory exercises every week. Grading of this course is either a pass or a fail<sup>1</sup>.

During laboratory hours students get practical assignments, which are both individual and in groups. Individual assignments are content survey and creation of use cases for course group project. Students create in groups a design document with mock-ups or wireframes, a Drupal 7 website based on chosen project, they also write terms of use and privacy policy, and finally they do a heuristic evaluation of other groups Drupal 7 website. Lectures cover topics relevant to the assignments and offer additional insights into legal concerns, media trends, social media, online communities and information architecture<sup>2</sup>.

During the course the students have access to a special website designated for the course INF3272 (see figure 1). It is developed with Drupal and offers a forum, lecture schedule, links to the course-related literature. Additionally, it also has a student list for the course, student project group overview and functionality to deliver group assignments<sup>3</sup>.

---

<sup>1</sup> "INF3272 - Informasjonsarkitektur Og Innholdsadministrasjon - Universitetet I Oslo". 2017. *Uio.No*. <http://www.uio.no/studier/emner/matnat/ifi/INF3272/index.html> .

<sup>2</sup> Hannemyr, Gisle. 2017. "Diw.Ifj.Uio.No | Informasjonsarkitektur & Innholdsadministrasjon". *Diw.Ifj.Uio.No*. <http://diw.ifi.uio.no/node> .

<sup>3</sup> Hannemyr, Gisle. 2017. "Diw.Ifj.Uio.No | Informasjonsarkitektur & Innholdsadministrasjon". *Diw.Ifj.Uio.No*. <http://diw.ifi.uio.no/node> .

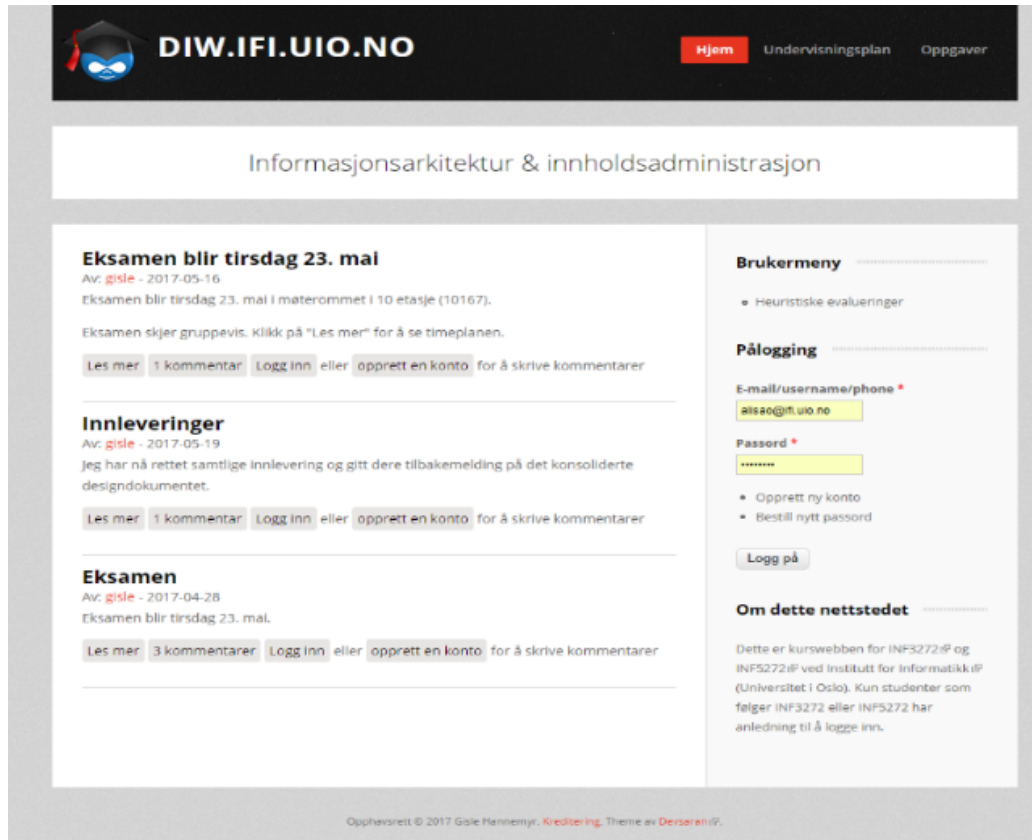


Figure 1. INF3272 Course webpage (Hannemyr, 2017).<sup>4</sup>

## 1.1.2 Content Management System Drupal.

Drupal is a free to use software under the terms of the GNU General Public License, which allows community of over a million users and around 39000 developers to legally copy, distribute and modify Drupal<sup>5</sup>. Nevertheless, Drupal is more than a basic software, it is primarily a content management system (further CMS), that consists of scripts written in PHP to provide a functionality and structure for building modern capability-rich websites with various content (Douglass et. al. 2006 p.3, Byron et. al. 2009 p.1). CMS reduces complexity and time spend to publish, organize, modify or edit web content, as well as simplifies its maintenance (Douglass et. al.2006 p.3, Byron et. al. 2009 p.1). Drupal is also a content management framework (further CMF), which allows to extend Drupal with highly customizable modules (Byron et. al. 2006 p.2). Furthermore, it also has a set of application

<sup>4</sup> Hannemyr, Gisle. 2017. "Diw.IfI.Uio.No | Informasjonsarkitektur & Innholdsadministrasjon". *Diw.IfI.Uio.No*. <http://diw.ifl.uio.no/node> .

<sup>5</sup> "About". 2017. *Drupal.Org*. <https://www.drupal.org/about>

programming interfaces (further API) for custom web application development (Douglass et. al. 2006 p.3).

### **1.1.3 Learning at University of Oslo.**

The department of Informatics at University of Oslo offers various IT services for the students use, like computer rooms, free Wi-Fi, laptop loan service and public library facilities<sup>6</sup>.

Because of this emphasis on technology use at the University of Oslo, students are expected to adapt their studying methods towards technology use. In higher education context, students are also expected to have a mature attitude towards the responsibility over their own studying process. That includes self-reflection, understanding of the learning process and higher motivation to learn. Students are free to choose between the subjects they want to study during the semester, as well as managing own studying schedule. In most cases, lecture attendance is not mandatory and most of the course information is available online for self-study.

## **1.2 Personal Motivation.**

I was enthusiastic when my advisor, Gisle Hannemyr, told me about his idea to create a tool to support learning of his students in one of his decisively simple subjects. This project work explores on how to create a learning tool that assists learning while being fun. According to research done by S. D. Pressman et al. (2009) fun has positive effects on one's psychological and physical well-being. Participants in the study who engaged in more frequent leisure activities reported greater life satisfaction, life engagement, lower depression and even their perceived physical functions got better (Ibid 2009 p.730). Rigmor Mogård, a chief psychologist at Student Health Services at University of Oslo, stated to a student newspaper that 15-20% of all consultations are related to depression, while an additional 10-13% is related to difficulties in studying<sup>7</sup>.

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<sup>6</sup> "Student IT - The Faculty Of Mathematics And Natural Sciences". 2017. *Mn.Uio.No*.

<http://www.mn.uio.no/english/services/it/help/student-it.html>

<sup>7</sup> Faugli, Hilde. 2007. "Studerer Plages Av Angst Og Depresjoner". *Universitas.No*.

<http://universitas.no/nyheter/49759/studerer-plages-av-angst-og-depresjoner>

Depression is known to affect thinking and concentration<sup>8</sup>, both of which are important while learning about complex and difficult subjects. Therefore, in my opinion, occasional fun will have some small accumulative effects on improving both studying and well-being.

Andreasen, et al. (2016) claim that “*Gaming may be an escape strategy to alleviate depression [...]*.” and that other research also supports that claim. Thus, through gamification it will also be possible to at least try to offer some relief from depression. I truly believe that new way of learning happens to be the healthiest one as well.

### **1.3 Research questions.**

My initial premise is that self-regulated self-testing is boring and monotonous for the students. Therefore, to explore how adults are motivated by gamified learning, I am going to develop a gamified quiz application that both supports educational principles and is engaging. In order to do so I am going to explore gamification and various theories of learning and motivation. Then by following the interaction design process, I am going to design and develop a gamified quiz-based application in Drupal.

**Following is the main research question:**

***What motivational impact gamification of self-regulated learning has on adults in a higher education context?***

In order to answer the main research question, I have made following two related sub questions:

- ***How will a simple quiz based gamified tool motivate for learning in a higher education context?***
- ***What ethical considerations do potential users see in a simple quiz based gamified tool?***

---

<sup>8</sup> Parekh, Ranna. 2017. "What Is Depression?". *Psychiatry.Org*. <https://www.psychiatry.org/patients-families/depression/what-is-depression>

## **1.4 Structure of the report.**

### **Chapter 1 Introduction.**

This is an introductory chapter that presents project's background, personal motivation and research questions.

### **Chapter 2 Theory.**

In this chapter I present the underlying theoretical concepts that were used during the design and development of this project, including theories of learning and motivation.

### **Chapter 3 Methodology and Research Methods.**

Methodology chapter offers description of research paradigm, interaction and gamification frameworks as well as the research methods used in this project.

### **Chapter 4 Design process.**

This chapter describes the work that I have done, data collection, design decisions and analysis of findings.

### **Chapter 5 Development process.**

Development process describes the project's practical implementation in Drupal.

### **Chapter 6 Results.**

In this chapter a summary of research results is presented.

### **Chapter 7 Analysis and Discussion.**

Here most important findings are discussed in relation to the research questions and underlying theories. It also mentions practical limitations of this project and scope for further work.

### **Chapter 8 Conclusions.**

This is the summary chapter for practical and theoretical implications.

### **References**

### **Appendix**

# 2 Theory.

The main focus of this project is gamification and its application towards improving motivation in online learning for adults. Therefore, this chapter focuses on what gamification is as well as how exactly it motivates people. Then it gives an overview into various theories of learning.

## 2.1 Defining Gamification.

In the article Gamification: Toward a Definition, Deterding et al. proposed a general definition for the term **Gamification**: “*Gamification is the use of game design elements in non-game contexts.*” (Deterding et al. 2011, p. 2-3). Five main levels of such game design elements are distinguished in the article to be part of this definition (Ibid, p. 3-4):

- **Interface design patterns;**
- **Game design patterns or game mechanics;**
- **Design principles or heuristics;**
- **Conceptual models of game design units;**
- **Game design methods;**

According to Deterding (2011, p. 2) there are two major idea streams about gamification. One of them is to gain influence on everyday life and another is to create experiences to engage “[...] people on an emotional level and motivating them to achieve their goals.” (Burke 2014 p. 16). In additions to the definition proposed by Deterding et. al. I am going to use a definition proposed by Karl Kapp (Kapp 2012 p.10), which is more suited for the learning aspects of this project:

---

*Gamification is using game-based mechanics, aesthetics and game thinking to engage people, motivate action, promote learning and solve problems.*

---

According to Kapp **aesthetics** in this definition imply “[...] engaging graphics or a well-designed experience [...]”, while **game thinking** describes the process of translation of everyday activity into a game story experience (Ibid).

Karl Kapp distinguishes two main types of Gamification: **Structural Gamification** and **Content Gamification**<sup>9</sup>. Kapp defines Structural gamification as “ [...] *application of game-elements to propel a learner through content with no alteration or changes to the content itself.*” In this case content remains unaltered and only the structure is gamified. Contrarily Content gamification is “[...] *application of game elements and game thinking to alter content to make it more game-like.*” (Ibid).

### 2.1.1 Game thinking and Hierarchy of game elements.

In his book *Even Ninja Monkeys Like to Play: Gamification, Game Thinking & Motivational Design* (2015) Andrzej Marczewski proposes a definition for the umbrella term Game thinking. **Game thinking** is defined as “*The use of games and game-like approaches to solve problems and create better experiences.*” According to Marczewski gamification is characterized by having game thinking and game elements as main design goals<sup>10</sup>.

In their books Kevin Werbach and Dan Hunter suggest a framework for generic patterns of game elements employed by Gamification (Werbach and Hunter 2012, Werbach and Hunter 2015). According to them specific game characteristics consist of three main element types in decreasing order of abstraction: **Dynamics**, **Mechanics** and **Components** (Werbach and Hunter 2012, Werbach and Hunter 2015). As illustrated in figure 2 each level in the hierarchy is connected to several higher-level elements.

Werbach and Hunter’s game Element Hierarchy has some similarities to framework from MDA: *A Formal Approach to Game Design and Game Research* (2004) by Robin Hunicke, Marc LeBlanc, Robert Zubek. **Mechanics/Dynamics/Aesthetics (MDA)** framework views game in relation between Rules >System>Fun and therefore also suggests a three-level abstraction (see figure 2). However, terms Mechanics, Dynamics and Aesthetics are defined

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<sup>9</sup> Kapp, Karl. 2013. "Two Types Of #Gamification « Karl Kapp". *Karlkapp.Com*. <http://karlkapp.com/two-types-of-gamification/>

<sup>10</sup> Marczewski, Andrzej. 2016. "Game Thinking – Differences Between Gamification & Games". *Gamified UK*. <https://www.gamified.uk/gamification-framework/differences-between-gamification-and-games/>



with a different meaning from Werbach and Hunters framework. Further are discussed terms Dynamics, Mechanics and Components in detail.

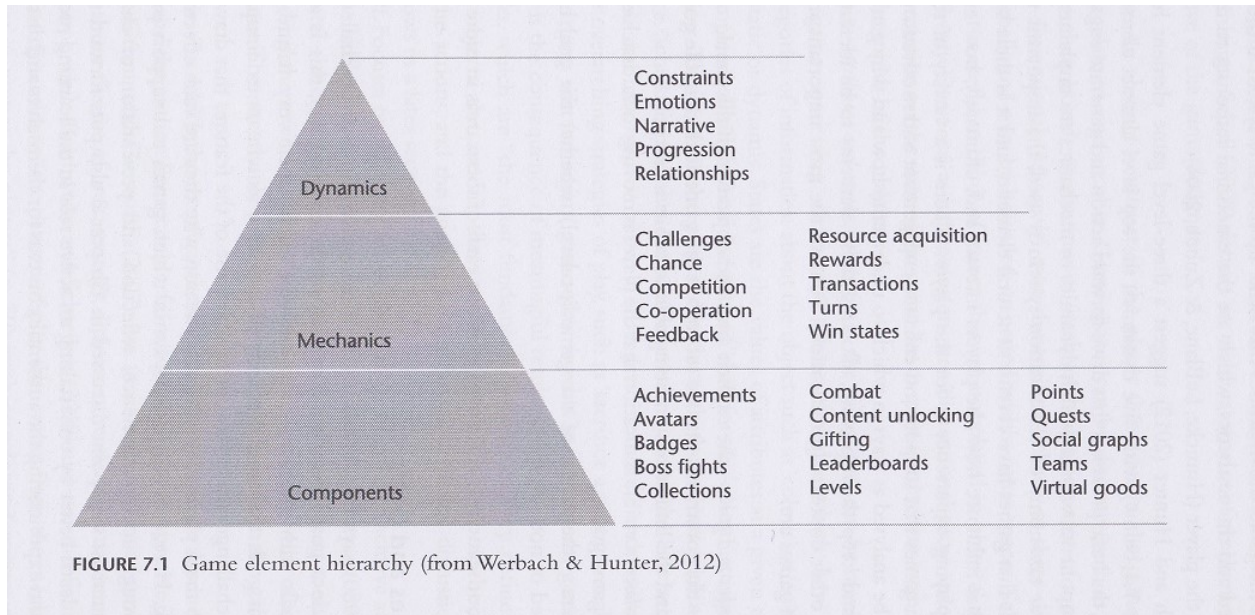


Figure 2. Hierarchy of game elements (Whitton 2014 p. 88).<sup>11</sup>

At the top of the game element hierarchy pyramid (see Figure 2) are **Game Dynamics**, that could be defined as elements providing motivation through high-level features like: **Constraints, Emotions, Narrative, Progression** and **Relationships** (Werbach and Hunter 2012). These features can be viewed as an influence or guidelines for iterative improvement of gamified systems (Werbach and Hunter 2015). Contrarily MDA Framework defines Dynamics as simply “[...] *the run-time behavior of the mechanics acting on player inputs and each other’s output over time.*” (Hunicke, LeBlanc and Zubek 2004). **Emotion dynamics** (see figure 2) in Gamification describe emotional responses to games that are primarily driven by motivation and engage players (Werbach and Hunter 2015). Werbach and Hunter (2015) define the **Game Mechanics** as “[...] *the basic processes that drive the action forward and generate player engagement.*” According to them Mechanics is the practical way to implement one or several Game Dynamics. Werbach and Hunter (2015) offer following description to **Game Components**:

<sup>11</sup> I am referring to Whitton’s version of the diagram because it gives better overview into each element type than the original.

*Game Components are a game's nouns. They are, generally, specific manifestations of the Mechanics, which are in turn manifestations of the Dynamics. Consider them tactics to achieve the goals described by the higher-level elements.*

Typically, games are associated with an unspecific “**Fun**” emotion, however, there also exists a wider range of other human emotions that can be influenced by games. MDA Framework terms these player emotional responses to game interactions as **Aesthetics** and differentiates 8 types of fun as illustrated in table 1 (Hunicke, LeBlanc and Zubek 2004).

Type	Description
Sensation	Game as sense-pleasure
Fantasy	Game as make-believe
Narrative	Game as drama
Challenge	Game as obstacle course
Fellowship	Game as social framework
Discovery	Game as uncharted territory
Expression	Game as self-discovery
Submission	Game as pastime

Table 1. Types of fun from Hunicke et al. 2004 with descriptions by Nicola Whitton (Whitton 2014 p. 116).

Nicole Lazzaro<sup>13</sup> has created four main Fun types affecting players through gameplay and according to her a successful game supports at least 3 types out of four<sup>14</sup>:

- **Hard Fun** - Emotions of accomplishment, frustration and ferocity arising from challenging game mechanics.
- **Easy Fun** - Emotions of wonder, awe and mystery arising from immersion into the casual game world.

<sup>13</sup> Lazzaro, Nicole. 2004. "Why We Play Games: Four Keys To More Emotion Without Story". [Http://Www.Xeodesign.Com/](http://www.Xeodesign.Com/). [http://xeodesign.com/xeodesign\\_whyweplaygames.pdf](http://xeodesign.com/xeodesign_whyweplaygames.pdf)

<sup>14</sup> Lazzaro, Nicole. 2017. "The 4 Keys 2 Fun | Nicole Lazzaro's Blog". [Nicolelazzaro.Com](http://www.nicolelazzaro.com/the4-keys-to-fun/). <http://www.nicolelazzaro.com/the4-keys-to-fun/>

- **Serious Fun** - Excitement and relief arising from the game experience accumulation through serious and meaningful objectives.
- **People Fun** - Social bonding from the experiences of socializing, interacting, and working as a team while playing with others.

Nicola Whitton (2014 p. 116) has differentiated two main aspects of fun as one that is immediate and leads to **pleasure**, while another is leading to **fulfillment** and builds over time. He further summarizes categories of pleasure as **Curiosity, Virtuosity, Nurture, Sociability** and **Suffering** (Ibid p. 117).

In an attempt to understand what makes Multi-User Dungeon (MUD) games enjoyable for different kind of players, Richard Bartle<sup>15</sup> has created abstract player classification theory based on player styles of play. He categorized them into 4 types:

- **Achievers** are players who are success-oriented, they view success in terms of experience points, levels, and wealth;
- **Explorers** are players who focus on interactions with the game world and the exploration of its boundaries;
- **Socializers** are players who play to communicate with other players and are interested in people as opposed to the game itself;
- **Killers** are players who focus on negatively interacting with other players, including taunting, causing distress and attacking other players;

Inspired by the player types proposed by Bartle, Amy Jo Kim<sup>16</sup> has created a Social Action Matrix theory, specifically for gamification (see figure 3). There she categorized users in terms of four key patterns: **Explore, Create, Compete, and Collaborate**. These patterns relate to specific player types, which I also have connected towards types of fun from table 1.

---

<sup>15</sup> Richard A. Bartle: *Players Who Suit MUDs*. (2017). *Mud.co.uk*. Retrieved 29 November 2017, from <https://mud.co.uk/richard/hcds.htm#Bartle> , 1990a

<sup>16</sup> Kim, Amy Jo. 2014. "Beyond Player Types: Kim's Social Action Matrix". *Amy Jo Kim*. <http://amyjokim.com/blog/2014/02/28/beyond-player-types-kims-social-action-matrix/>

- **Explorers** - People in this pattern are motivated by exploration, which is similar to discovery fun. They seek knowledge.
- **Creators** - describes people looking for self-discovery (expression fun) and creation. They seek status and recognition.
- **Competitors** - is about people valuing skill mastery and social challenge. They relate to the challenge and fellowship fun.
- **Collaborators** outline people motivated by a fellowship type of fun, they seek relationship building.



Figure 3. Kim's Social Matrix (2014).

According to Bartle the main advantage of his player type theory is that it works when applied to games<sup>17</sup>. However, in my opinion Bartle player types are not suited for application in educational context. For example, player behaviors typical for the killers such as taunting or insulting others are not acceptable in educational context. Additionally, there is no utilization of the virtual game world in gamification as opposed to serious games (see section 2.6), so explorers can't possibly interact with it, on the other hand in Social Action Matrix theory

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<sup>17</sup> *Player Type Theory: Uses and Abuses* | Richard BARTLE. (2017). *YouTube*. Retrieved 29 November 2017, from <https://www.youtube.com/watch?v=ZlZLbE-93nc>

explorers seek knowledge. Also in INF3272 students are expected to collaborate for study projects (see section 1.1.1), rather than socializing and focusing on people. Finally, creator type from Social Action matrix works well with basic human needs from Self-Determination theory (see section 2.2). Creators can satisfy the need for competence by creating content, the need for relatedness by other people using their content and the need for autonomy by choosing to create for others. Besides, I want students to receive formative assessment of their performance to improve learning (see section 2.4), therefore receiving the game equivalent of grades like points or levels will be demotivating to students (see section 2.4 reference (Nicol and Dick 2005)), as opposed to achievers in MUD games who think that gaining those is fun.

## 2.2 Engaging and Motivating Learners through Gamification.

According to definition of gamification from section 2.1, both engagement and motivation are central to what gamification is. Therefore, this section will explore both concepts.

**Engagement** in online learning can be defined as an “[...] *active participation in e-learning activities to achieve learning goals.*” (Gedera et. al. 2015). Because one engages through motivation, it is both prerequisite and the main fuel for both engagement and successful learning outcome (Ibid). However, what drives humans towards certain behaviors is a complex issue and there are several different scientific approaches towards an explanation. For the purpose of this work motivation will be viewed according to **Self-Determination Theory**.

Self-determination theory (further SDT) can be described as “[...] *a macro-theory of motivation, personality and optimal functioning [...]*” (Deci and Vansteenkiste 2004, p. 23).

There are three essential assumptions that are central to this theory:

- Humans are proactive in a sense that they can master internal and external forces, rather than being controlled by those passively (Ibid p.23).
- Growth, development and integrated functioning are inherent tendencies in humans (Ibid p.24).
- While activity and optimal development are inherent, they require a certain environmental support to actually take place (Ibid p.24).

According to STD basic psychological needs satisfaction with the environment leads to growth, optimal development and psychological health (Ibid). These needs are universal and inherent aspect of all human nature (Ibid). According to Deci and Vansteenkiste (2004 p.24) humans prefer situations that satisfy these needs and shy away from those that do not without specific intent to do so. When these needs are constantly thwarted people develop instead substitutes that offer gratification (Ibid p.30). The degree to which one pursues the satisfaction of these needs can vary according to the environment and personal experience (Ibid).

- **Competence**

Experience of mastery and its effects while engaging with the world or the environment (Ibid p.24).

- **Relatedness**

Describes the human need to belong, to connect with or care for other humans (Ibid p.24)

- **Autonomy**

Rather than independence from others, this need is about feeling the “[...] *the sense of willingness and choice when acting [...]*”, or in other words a free will in accordance with sense of oneself (Ibid p.24).

### **2.2.1 Intrinsic and Extrinsic Motivation.**

Intrinsic motivation describes a type of motivation that comes from within the learner and is essentially an action done for the sake of the activity itself rather than a tangible reward (Kapp 2012 p.52). Cognitive Evaluation Theory (CET), a sub theory of SDT (see section 2.2) has its primary focus on needs for autonomy and competence and their effect on intrinsic motivation (Deci and Ryan 2000 p.58). For example, rewards or a feedback that contributes towards feeling of competence can boost intrinsic motivation. According to CET experience of perceived competence (self-efficacy) has to be due to self-determined behavior to be able to sustain or influence intrinsic motivation positively. Therefore, to achieve a high level of intrinsic motivation one needs to satisfy both autonomy and competence needs (Ibid).

On the other hand, extrinsic motivation concerns a type of behavior affected by law of effect of external factors (Kapp 2012, p. 52-53). In STD (see section 2.2), Organismic Integration Theory (OIT) details the different forms of extrinsic motivation and the contextual factors that regulate these behaviors (Deci and Ryan 2000 p.61). Figure 4 represents a taxonomy of motivation, according to OIT, these types are arranged from left to right accordingly to the intrinsic degree of motivation (Ibid). These types are:

- **Amotivation**

This state can be defined as “[...] *the state of lacking an intention to act.*” (Ibid p.61), it can happen when activity is not valued, by feeling incompetent or due to unwanted outcome.

- **External regulation**

This type of extrinsic behavior is rewarded or external demand contingent, in other words, people feel externally pressured towards it (Ibid, p.61-62).

- **Introjection**

Introjection occurs when a person is regulated towards behavior by contingent self-esteem without fully accepting such regulations as their own, for example to booster own ego, pride or to avoid the guilt (Ibid, p.62)

- **Identification**

This is a more autonomously driven form of extrinsic motivation, where a behavior is accepted as personally important (Ibid.)

- **Integration**

Integration is the most autonomous form of extrinsic motivation, which is very similar to intrinsic motivation in terms of autonomy and self-determination. However, the behavior is done for extrinsic outcome separated from the behavior (Ibid).

A person can adopt any of these motivational types at any time and they are not progress contingent (Ibid p.62-63).

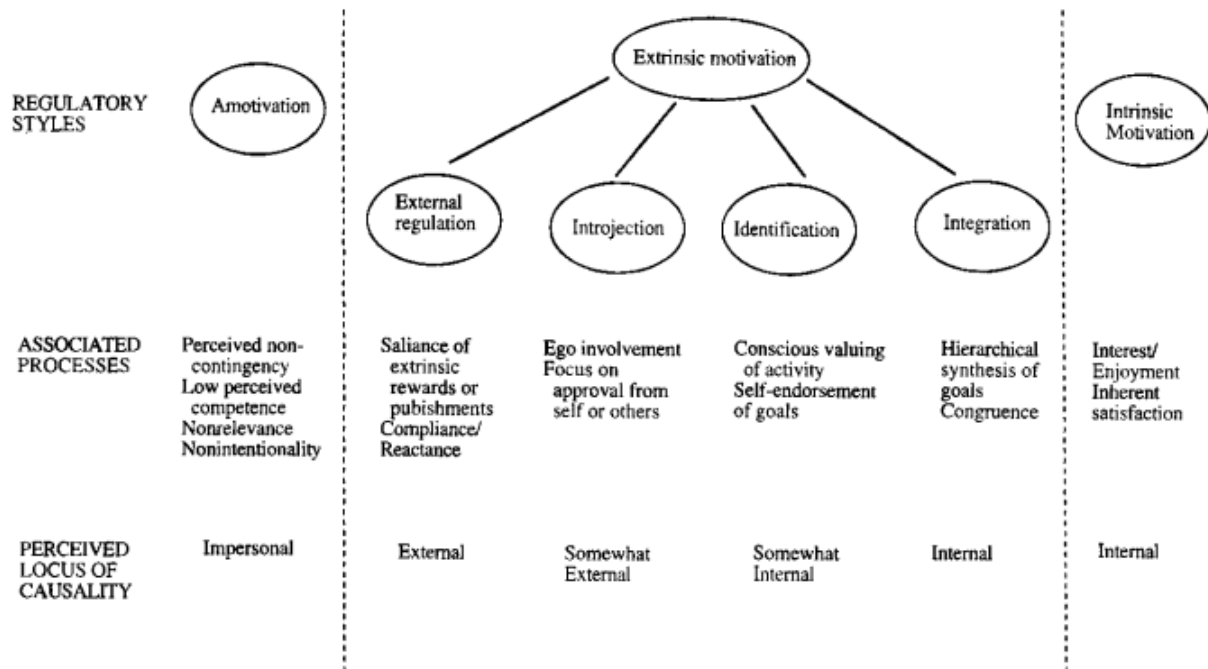


FIG. 1. A taxonomy of human motivation.

Figure 4. Taxonomy of motivation, according to OIT (Deci and Ryan 2000 p.61).

Learning itself is often described as both boring and mostly externally driven venture (Lepper and Malone 1987 p. 223). However, in cases where participation in extracurricular activities is not required, engagement in such is mostly driven by intrinsic motivation (Ibid p.224). According to the research about taxonomy of cognitive intrinsic motivation in learning situations done by Lepper and Malone (1987) some of the factors that increase intrinsic motivations are: optimal level of challenge, cooperation or competition with others and recognition of achievements by others. According to Deci and Ryan (2000 p.60) in the classroom context activity needs to have appeal of novelty, challenge, or aesthetic value for that individual to facilitate intrinsic motivation and apply CET. To motivate students to value and self-regulate educational activities one has to foster the internalization (taking in regulation) and integration (transforming regulation into own). According to Deci and Ryan (Ibid) “[...] the concept of internalization describes how one’s motivation for behavior can range from amotivation or unwillingness, to passive compliance, to active personal commitment.” Therefore, internalization is directly proportional towards engagement. Extrinsic behaviors can be adopted due to a sense of relatedness, for example,



when people feel respected or cared for, it can facilitate internalization (Ibid, p.63). Another factor facilitation internalization according to Deci and Ryan is support for competence (Ibid).

### 2.2.2 Rewards and Motivation.

In Gamification, reward mechanics are used as a recognition of players achieved in-game accomplishments, which is “[...] a benefit given to the player for some action or achievement.” (Werbach and Hunter 2015). Katie Salen and Gabe Zichermann (2004) discuss four types of such rewards (see Table 2):

- **Glory rewards** are types of prestige rewards a player gets with game experience which don't have an effect on gameplay.
- **Rewards of Sustenance** intended to act as gameplay prolongment via various in-game items.
- **Rewards of Access** represent a one-time access that opens new areas or resources.
- **Rewards of Facility** can be either intra-game as new or enhancement of abilities, or extra-game as new mini games (Salen and Zimmerman 2004, Whitton 2014 p.100).

Notably Rewards in Gamification can also be used as **behavior modification** for extrinsic motivation, both as positive reinforcements and as a form of punishment via shaming, point loss, removal of powers, setback and shortened play (Whitton 2014, p. 101). To make different Reward types effective, one employs **reward schedules**:

- **Fixed Ratio** or **Fixed Interval** occurs when rewards are provided at a preselected number of times of behavior or at a fixed amount of time (Kapp 2012 p. 63).
- **Variable Interval Rewards** that occur in a set number of times with regular time interval according to player behavior. (Salen and Zimmerman 2004).
- **Variable Ratio** is when rewards occur irregularly or by chance (Salen and Zimmerman 2004).

Type of reward	Category
Praise	Rewards of Glory
Points	Rewards of glory, sustenance, access and facility
Prolonged play	Rewards of sustenance
A gateway	Rewards of access
Spectacle	Rewards of glory and access
Expression	Rewards of glory
Powers	Rewards of facility
Resources	Rewards of sustenance and facility
Completion	Rewards of glory

Table 2. Categorized reward types adapted from Whitton (2014, p.100).

In gamification **engagement loops** are used to reinforce motivation based on individual user actions by providing feedback (also in the form of rewards) that reinforce further action (Werbach and Hunter 2012).

When designing for gamification one has to understand that emotion dynamics are not addictive by themselves and improperly applied rewards can give unintended effects (Groh 2012 p.41). **The Over Justification Effect** occurs when intrinsic motivation is overtaken and forced into extinction by extrinsic incentives in tasks that were originally associated with high intrinsic motivation (Ibid). Deci, Koestner and Ryan (1999) have conducted meta-analysis of 128 studies to examine effects of extrinsic rewards on intrinsic motivation. Key findings:

- Tangible rewards for task completion affected intrinsic motivation negatively in cases where they were expected or administered in a controlling manner (Ibid p.656).
- When tangible rewards are used to signify performance, intrinsic motivation is affected negatively for people who don't perform well (Ibid p. 657).
- Positive verbal feedback as an affirmation of competence, enhance intrinsic motivation. However, such feedback undermines it if administered controllingly (Ibid p. 657)

- Minimizing control is important both for intrinsic motivation and to promote extrinsically motivated behavior (Ibid p. 658)

Lastly, both intrinsic and extrinsic motivation lead people to perform activities, effects of the reward will depend on the net effects of influence on both types of motivations (Kraut et al. 2012 p.33).

## 2.3 Learning with Computer Tools: A Sociocultural Perspective.

In a sociocultural perspective employment of various tools is an important part of a learning process. According to Vygotsky (1979) the concept of **mediated activity** process (Figure 5) describes “[...] *the real relationship, not the figurative one, that exists between behavior and its auxiliary means.*” (Ibid, p.53). In mediated activity **tools** are external way to influence the change in the object of activity (Vygotsky 1979, p.55), on the other hand, **sign** is internal “[...] *instrument of psychological activity [...]*” (Vygotsky 1979, p.52).

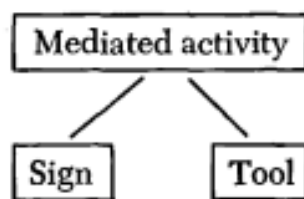


Figure 4

Figure 5. Relationship between sign and tools in a mediated activity (Vygotsky p.54).

This idea of **mediation** conveys that humans control own behavior by using and creating artifacts (Engeström 1999 p.29). Traditionally, human cognition that is achieved by tools mediation is represented by triangle see figure 6, where subject uses medium (mediating artifact) to achieve an object (Cole and Engeström 1993 p.4).

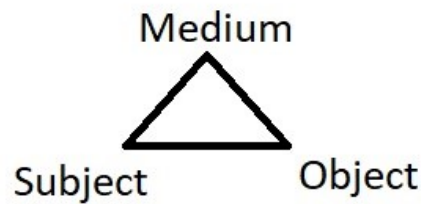


Figure 6. Mediational triangle adapted from Cole and Engeström (1993 p.4).

However, classical mediational triangle does not portray social and collaborative nature of human actions (Engeström 1999 p.30). Engeström expanded this model towards what he called an activity system with 6 related elements (see figure 7):

- **Object-orientedness**

The object is a central issue of an activity system that connects motivated individual actions towards the collective activity (Engeström 1999 p.31).

- **Subject**

Subjects are actors that engage in activity.

- **Community**

Community is essentially a social context of an activity.

- **Mediated artifacts**

Material and symbolic cultural artefacts that regulate interactions between subjects and environment. They store cultural knowledge and change with and experience (Cole and Engeström 1993 p.9)

- **Division of labor**

The relationship between object and community is mediated by division of labor between actors.

- **Rules**

Relationship between subject and community is mediated by rules, which are conventions or guidelines for the activity.

**Activity theory (AT)** proposes to make activity systems (see figure 7) as the central unit of analysis of human behavior (Cole and Engeström 1993 p.8).

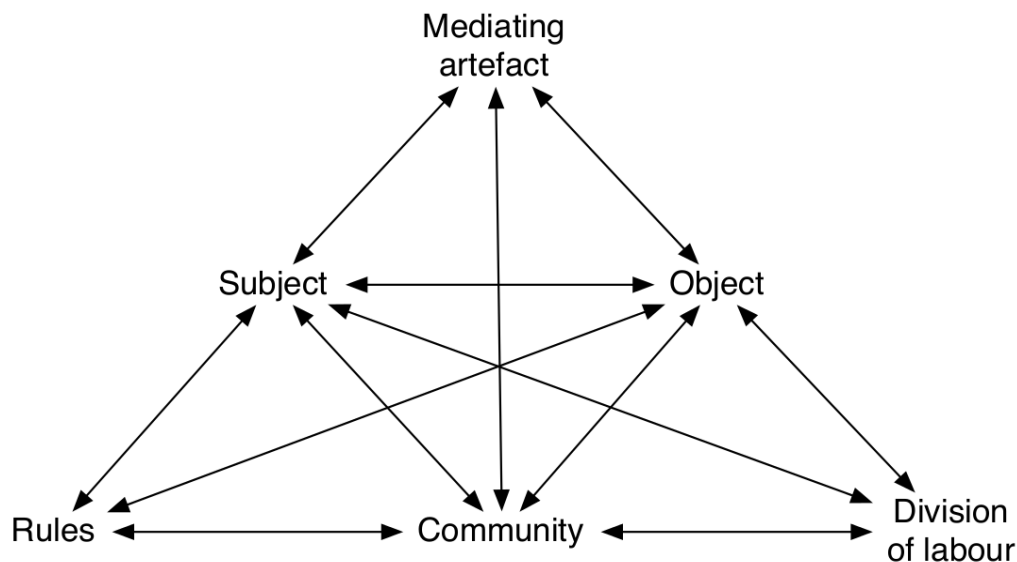


Figure 7. A complex model of activity theory adapted from Engeström (1999 p.31).

Historical evolution of an activity system, where the next system irreversibly builds upon preceding one can be called an expansive circle (Engeström 1999 p.32-33). Expansive circle of the changing activity system functioning represents the cyclical relationship between **internalization** and **externalization**. Expansive circle begins with exclusive emphasis on internalization (Ibid, p.33). Internalization occurs when an individual learns through mediated action and develops individual knowledge through social interaction (Vygotsky 1979, p.56).

Externalization transforms internal activities into the external. In expansive cycle externalization firstly occurs in the form of discrete individual innovations and then as internalization decreases in form of self-criticism, externalization increases until it reaches its peak until solutions for a new form of model are designed and implemented (Engeström 1999 p.33-34). Thereafter internalization again becomes the dominant form of learning and development (Ibid p.34).

According to AT computer tools store knowledge and social practices (as mediated artifacts), which people interact with when they use those tools to perform various activities. However, because the meanings and functions of artefacts like tools are (re)constructed in action, they

are not always used by students as intended. Therefore, reflection prompts and scientific concepts are entities with multiple meanings, that students usually have different opinions about (Furberg 2009 p.397- 400). Tools also can't be viewed as an independent entity, rather they are impacted by the rules and practices of institutional context (Rasmussen et al. 2010).

### 2.3.1 Technology as a scaffold.

Tools developed with the aim of engaging and scaffolding students in scientific inquiry are called '**scaffolds**' (Furberg 2009 p. 397). Instructional Scaffolding is a concept that refers towards "[...] *"scaffolding" process that enables a child or novice to solve a problem, carry out a task or achieve a goal which would be beyond his unassisted efforts.*" (Bruner, Wood and Ross 1976 p. 90). A process that involves a tutor controlling the task elements that are initially beyond child's competence and allowing the child to concentrate on those elements that are within it (Ibid). There are six tutor functions in scaffolding process described by Bruner, Wood and Ross (1976 p. 98), they are:

- **Recruitment**, refers to making the student engaged or motivated to complete the initial task by the tutor.
- **Reduction in degrees of freedom** describes simplification of the task and reduction of steps overall accordingly to the student's competence level.
- **Direction maintenance** is essentially about keeping the child motivated enough to continue a progress towards an initial objective.
- **Marking critical features** is about identifying area of learning according to student's capacity to solve the task. This is very similar to Vygotsky's theory called the **Zone of Proximal Development** (further **ZPD**). According to Vygotsky (1979 p.86) ZPD is an area of learning that can be described as "[...] *the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers.*" ZPD can be applied to assess the student's current level, as well as a prognosis of learner's future state (Vygotsky 1979 p.87). Which in turn makes scaffolding a way to apply ZPD in practice.
- In **Frustration control** working with a teacher should decrease students' anxiety.

- **Demonstration** or showing the ideal solution to the student for imitation.

According to Wood and Wood (1996 p.6-7) effective helping in scaffolding involves two main elements:

- Teacher offering help with difficulties at right timing.
- So-called **fading**, as in to gradually provide less help to boost independence.

The combination of these two elements are defined as '**contingent**' teaching (Wood and Wood 1996 p.7). Practical decisions about next steps in contingent teaching responsive to immediate context are called **domain contingency**. According to Wood and Wood (1996 p.7) such adaptability is problematic for computer-based tutoring. Sometimes learners find novel or unexpected ways to learn, unless the system is capable to evaluate such variations it will treat deviations as an error. Computer systems are driven to provide increasingly specific help, while fading their level of help after each successful step, however, for humans, such progression is mentally demanding (Ibid p.8). As for timing in contingent learning or **temporal contingency**, computers have no way to take into account non-verbal communication means to evaluate the lack of a user's activity (Ibid). Therefore computer-systems cannot ensure such contingency, one has to either offer help regardless or leave it for users to decide (Ibid).

As a tool, Scaffolding technique controls task elements and provides support for a learner to accomplish tasks otherwise beyond their immediate capacity, then leads to the next step by building upon previous activity (Kapp 2012 p. 67). This corresponds to the concepts of **onboarding** and **progression stairs** in gamification (see figure 8). Onboarding (first stair) describes the support and guidance during the introduction of game basics, while progression as the broader structure of activity stairs refers to the gradual growth of game difficulty corresponding to the player's sense of competence. (Werbach et. al. 2012).

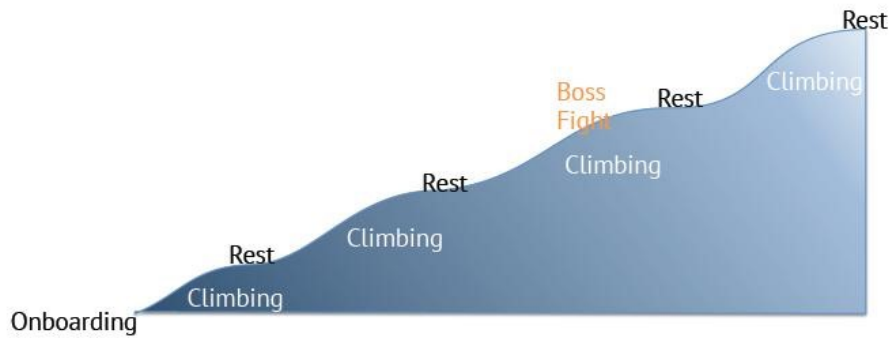


Figure 8. Progression Stairs.<sup>18</sup>

### 2.3.2 Notion of Flow.

**Flow** is a term that can be described as a mental state of full immersion and focus towards engaging into the process of an activity (Kapp 2012 p.71). The concept of flow is popular in interaction design (Rogers et al. 2011 p. 24). Regardless of its application designing for flow is not easy (Kapp 2012 p.71).

As illustrated in figure 9 flow is an ideal state between boredom and anxiety, which can also be related to ZPD (see section 2.3.1) as a state of balance of the student’s level of skill with the task difficulty. Furthermore Csikszentmihalyi (Csikszentmihályi et al. 2001, p.90) describes the state of flow to be very similar to the student’s progression in the ZPD:

*“[...] subjective experience of engaging just-manageable challenges, by tackling a series of goals, continuously processing a series of feedback about the process, and adjusting action based on this feedback.”*

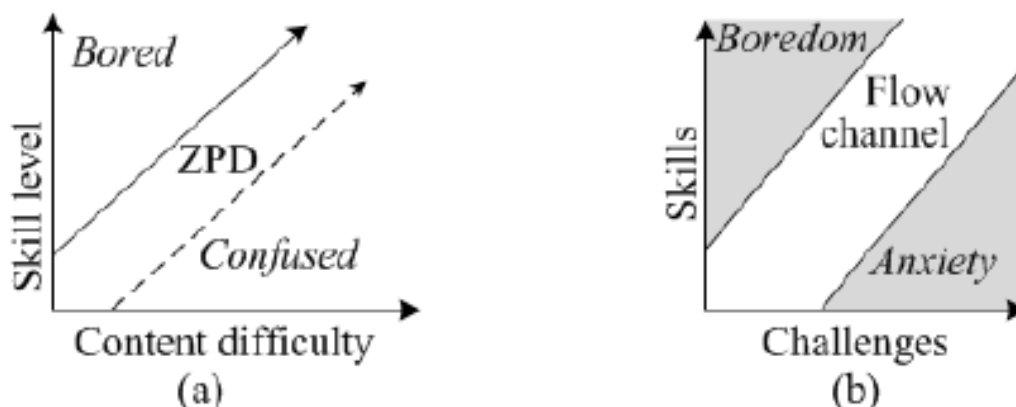


Figure 9. Comparison of Zone of Proximal Development (ZPD) (a) and Flow state (b) (Peeters et al. 2011)

<sup>18</sup> "K. Werbach. Gamification. Lesson 7.4". 2017. Coursera.

<https://www.coursera.org/learn/gamification/lecture/EOCUG/7-4-activity-loops>



According to Csikszentmihályi and Nakamura (2001 p.90) there are several characteristics of this state:

- **deep concentration;**
- **“merging of action and awareness”;**
- **a sense of one’s control;**
- **Intrinsically rewarding;**
- **time passes very quickly;**
- **Individual performance at its full capacity.**

Stephen W. Draper has further expanded the concept of flow into two types’ **u-flow** and **c-flow**<sup>19</sup>. U-flow refers to unconscious management of the activities of the individual, where c-flow is characterized by conscious attention towards the activity (Ibid). Notably a person can momentarily come out of c-flow without it affecting overall state (Ibid). According to Draper the experience of the state of flow requires not just c-flow type, but also an engagement, which is defined by the individual’s values and goals<sup>20</sup>.

According to Schmidt (2012 p.607) there are many possible applications of flow engagement in education, however majority of research about flow is about either children or adolescents (p. 609). Therefore, there is a need for research with broader range of learners (Ibid).

Werbach and Hunter (2012) state that:

*“The psychologist Mihaly Csikszentmihalyi found that people most commonly experienced the feeling of ultimate intrinsic motivation, which he labeled flow, on the job. Activities that address people’s needs for competence, autonomy and relatedness tend to be absorbing, interesting, and fun regardless of the context.”*

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<sup>19</sup> Draper, Stephen W. 1999. "Analysing Fun as A Candidate Software Requirement". *Psy.Gla.Ac.Uk*.  
<http://www.psy.gla.ac.uk/~steve/fun/fl.html>

<sup>20</sup> Draper, Stephen W. 1999. "Analysing Fun as A Candidate Software Requirement". *Psy.Gla.Ac.Uk*.  
<http://www.psy.gla.ac.uk/~steve/fun/fl.html>

However, Csikszentmihalyi<sup>21</sup> refers to flow as an **experience** and states that “[...] *once the conditions are present, what you are doing becomes worth doing for its own sake.*” So rather than being “a feeling of intrinsic motivation”, it is a mental state of enjoyment that also among other things is characterized by intrinsic motivation. I think Werbach and Hunter wrongly considered flow to be an ultimate intrinsic motivation, because according to the Cognitive valuation theory to achieve high levels of intrinsic motivation one has to satisfy needs for autonomy and competence (see section 2.2.1), where autonomy can be related to “*a sense of one’s control*” and competence to “*Individual performance at its full capacity*” characteristics of flow (Csikszentmihalyi and Nakamura 2001). In my opinion Werbach and Hunter also view the flow notion as synonymous to fun. They give fun following description (Werbach and Hunter 2012):

*We are not talking about fun in the sense of fleeting enjoyment, but the deep fun that comes from extended interaction with well-designed games. Think about a time when you were engrossed in a game.*

There is a similarity between flow and fun because both are experienced when the person is not bored and not experiencing anxiety (see figure 9). Nevertheless, fun by itself is not part of definition of flow. It is possible however that an activity that leads to flow also happens to be perceived as fun, but it’s not expected in every situation.

## 2.4 Formative assessment and self-regulated learning.

**Self-regulated learning** is an essential part of studying at University of Oslo (see section 1.1.3). It can be defined as “[...] *an active, constructive process whereby learners set goals for their learning and monitor, regulate, and control their cognition, motivation, and behavior, guided and constrained by their goals and the contextual features of the environment.*” (Nicol et. al. 2005 p.4).

To be able to self-regulate students need to know what kind of performance is a standard of reference, how their current performance relates to it and how to close the gap between them (Ibid p.6). Which requires a **formative assessment** about their learning, which is a type of

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<sup>21</sup> Csikszentmihalyi, Mihaly. 2017. "Flow, The Secret To Happiness". *Ted.Com*.

[https://www.ted.com/talks/mihaly\\_csikszentmihalyi\\_on\\_flow/transcript](https://www.ted.com/talks/mihaly_csikszentmihalyi_on_flow/transcript)

performance-based feedback about the student's present state with specific intent to improve learning (Ibid p. 2).

David J. Nicol and Debra Macfarlane-Dick (2005 p.7-14) have analyzed educational research and proposed following feedback practices to facilitate self-regulation:

- One has to clarify what a 'good' performance is with goals, criteria and expected standards;
- It is important to facilitate development of student's self-assessment skills. Practically it can be done either by reviewing each other's work or by prompting students to reflect on the strengths and weaknesses in their own work.
- External feedback that students receive needs to have sufficient quality in terms of pre-defined criteria, corrective advice, areas for improvement.
- Teacher and peer dialogue can improve learning and facilitate self-regulation.
- Motivation and self-esteem are important to learning, students that receive feedback in terms of grades tend to get less motivation and self-esteem.
- Feedback should function as “[...] a task-performance-external feedback cycle [...]”, where students have opportunities to improve on their performance (close the gap).

Because teachers are better at providing external feedback, they also need to be provided with usable information.

## **2.5 Adult Learning theory.**

Traditional pedagogical models of learning is teacher-directed education, where the learner is submissively following a teacher's instructions (Knowles, Holton and Swanson 2005 p.62). However, adult learners have increasing need and capacity to self-regulate own learning (Ibid p.62). According to Knowles, Holton and Swanson (2005 p.62) the growing gap between such need and the ability to self-regulate, results in tensions, resistance, resentment or rebellion in the adult individual. Therefore, a model for adult learning should support the development of the abilities required for self-direction. Such adult model of learning has six key differences from the pedagogic model (Ibid p.64):

1. Adults have the need to know about why they need to learn something, they also will evaluate the benefits they will gain from learning it and the negative consequences of not learning it (Ibid p.64).
2. Adults have a deep psychological need to be perceived by others as being capable of self-direction (Ibid p.65). Undermining such need will have negative consequences.
3. Because adults have a greater difference in experiences, adult learning places emphasis on individualization of teaching and learning strategies, as well as collaborative activities. However, negative effects of these differences are the mental habits and biases, as well as sensitivity towards rejection of their experience (Ibid p. 66-67).
4. In adults “readiness to learn” evolves as one proceeds through developmental stages. Therefore, timing learning experiences to coincide with those developmental tasks is important. For example, by using such techniques like models of superior performance, career counseling and simulation exercises (Ibid p.67).
5. Adults have a life-centered orientation towards learning, they learn more effectively when knowledge is related towards real life situations (Ibid p.67).
6. Even though adults are responsive towards external motivators like better jobs, internal pressures of motivation are predominant (Ibid p.68).

## **2.6 Serious Games in Education versus Gamification.**

In the book called *Serious Games* by Clark C. Abt (Abt 1970 p. 9) serious games are defined as games with “[...] *an explicit and carefully thought-out educational purpose* [...]”.

According to Michael Zyda (2005) educational serious games involve pedagogical activities to infuse instruction in the story component of the game. Michael Kapp (2012) argues that Serious Games can be regarded as a sub-set of the Gamification concept and therefore a form of gamification itself. However, S. Deterding, D. Dixon, R. Khaled and L. E. Nacke state that Gamification differs from serious games. As illustrated in figure 10 gamification utilizes game elements as opposed to serious games which use games as a whole to solve problems or

motivate users. According to Marczewski serious games are characterized by having virtual world and game play in addition to game thinking and game elements<sup>22</sup>.

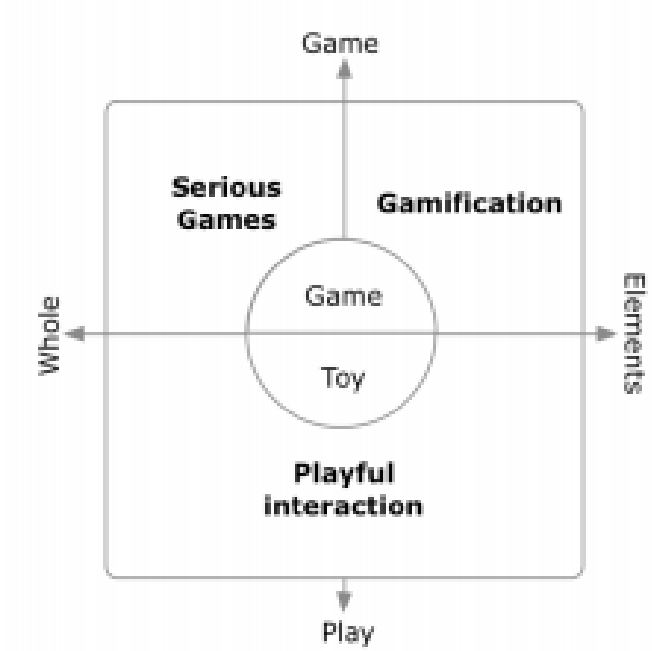


Figure 10. Difference between gamification and serious games (Deterding et al. 2011).

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<sup>22</sup> Marczewski, Andrzej. 2016. "Game Thinking – Differences Between Gamification & Games". *Gamified UK*. <https://www.gamified.uk/gamification-framework/differences-between-gamification-and-games/>



# 3 Methodology and Research Methods.

Methodology chapter briefly presents all the methodology and methods used in this research project, more detailed information about how these methods were practically applied during the design process are available in the next chapter.

## 3.1 Interpretive Research Paradigm.

My research questions are of a nature that indicates that I will use an interpretive research paradigm. **Hermeneutics** is a theory of interpretation and understanding, originated in the study of religious and historical texts (Winograd and Flores 1990, p.27). **Hermeneutic circle** describes the circular character of interpretation, where understanding is an act of interpretation between cultural, historical or literary contexts of text and interpretation (Winograd and Flores 1990, p.28). This also means that there are no right or wrong assumptions about the world, but rather researcher's personal experience and insights into particular practical knowledge that is well-written and shared with others to test, criticize and derive common value intersubjectively (Walsham 1993, p.6-7). Because the interpretive researchers main focus is the meaning itself, it allows “[...] *producing an understanding of the context of the information system, and the process whereby the information system influences and is influenced by the context.*” (Walsham 1993, p. 4-5).

## 3.2 Research through Design.

**Research through Design (RtD)** is “[...] *a research approach that employs methods and processes from design practice as a legitimate method of inquiry.*” (Zimmerman et al. 2010 p.310). This scientific approach is focused on how the future “[...] *could and should be based on an empathic understanding of the stakeholders, a synthesis of behavioral theory, and the application of current and near current technology.*” (Zimmerman and Forlizzi 2017 p.169). Practically it can be a type of development work, like customizing technology to do something and then communicating results (Frayling 1993 p.5). Such developed products, environments, services or systems are called **artefacts** (Zimmerman et al. 2010 p.314).

The main focus of RtD is to produce new and valuable knowledge without expecting others to reproduce the same result by following the exact same process (Zimmerman and Forlizzi

2017 p.168). **Design knowledge** in particular stems from people's ability to design, the process of design and the products that embody design attributes (Cross 1999 p.5-6). Because RtD is not a formalized approach, there are no standardized method to document such knowledge (Zimmerman et al. 2010 p.310). According to Zimmerman, Stolterman and Forlizzi (2010 p.313) RtD approach leads to two types of design theory:

- **Theory on design**, which is essentially a knowledge about human activity of design.
- **Theory for design**, which is the development of theory as an improvement to a practice of design. Such theory can take on many forms, including conceptual frameworks, guiding philosophies and various design implications.

Additionally, artefacts are also an implicit theoretical contribution to the theory for design, which represent “[...] designers’ understanding of the current state, including the relationships between the various phenomena at play therein, and the description of the preferred state as an outcome of the artifact’s construction.” (Zimmerman et al. p.314).

### 3.2.1 Interaction Design.

I have chosen to use an interaction design approach because it is mainly concerned with practice of designing a product that helps users to achieve their goals and allows for use of different techniques and methods (Rogers et al. 2011, p. 9, 317). **Interaction design** is essentially about “[...] designing interactive products to support the way people communicate and interact in their everyday and working lives.” (Ibid). Interaction design process is an iterative repetition of four basic activities that support and supplement each other (Ibid p. 15, 318), as illustrated in figure 11:

1. **Establishing requirements** and identifying user needs.
2. **Designing alternatives** of solutions, according to activity 1 specifications.
3. **Prototyping** to communicate and assess designs.
4. **Evaluating** designs.



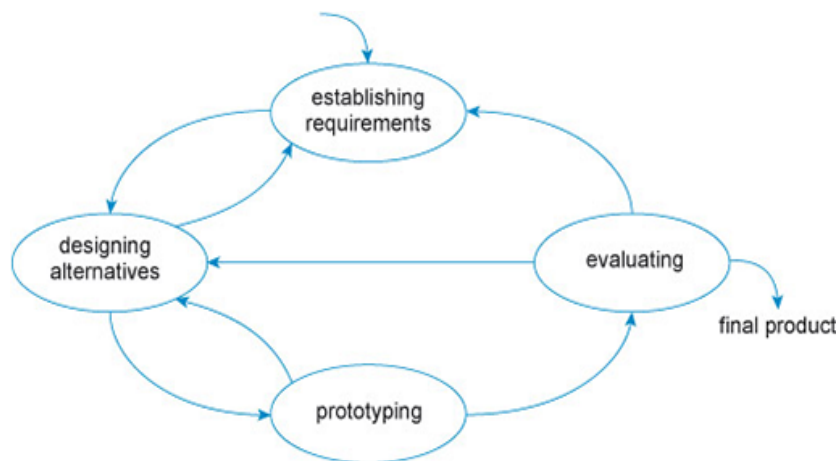


Figure 11. A diagram representing relationships between four main activities of the interaction design process (Rogers et al. 2011 p. 332).

Involving users throughout the design process can facilitate better understanding of context in which students learn and reveal incorrect assumptions about what intended user-group needs (Rogers et. al. 2011 p.16).

### (1) User Experience.

Since users direct the development in interaction design (Rogers et. al. 2011, p.318), user experience plays an important role in interaction design objectives (Ibid p.13). Such objectives can be classified as usability or experience goals (Ibid. p.18). Usability goals are concerned with the criteria that describe the functional use of the system (Ibid p. 19-21), such as:

- **Effectiveness** – how good the product is for the intended use.
- **Efficiency** – how good the system is to support and carry out user tasks.
- **Safety** – ensures that the users are protected from dangerous conditions or situations by not allowing users to make serious errors and providing the means to fix them. Another aspect of such criteria can be data safety of personal identifiable information.
- **Utility** – refers to the system degree of providing useful functionality.
- **Learnability** – is concerned with ease of learning the system.
- **Memorability** – is about how easy is to remember the use of the system, once learned.

**User Experience Goals** on the other hand are focused upon how subjective interaction with the system feels like to the users, for example, some of the desirable aspects are helpful, motivating, rewarding and emotionally fulfilling (Ibid p.23). The relationship between usability and experience goals are often directly proportional, it's important to carefully consider various combinations and their compatibility or impact on each other when designing (Ibid p.25).

## **(2) Gamification Framework.**

Even though I have chosen to follow Interaction design process, there are design process frameworks that are more specific towards gamification. There are several generic frameworks nonspecific to business and that are influenced by SDT (see section 2.2) in particular:

- A framework for Success<sup>23</sup> by DiTommaso.
- A method to apply gamification as a motivational tool (Francisco-Aparicio et al. 2013).
- 6D framework by Werbach and Hunter 2012).
- Sustainability of Gamification Impact (SGI) (AlMarshedi et al. 2015).

Further, I have checked if those frameworks are additionally related towards flow and user experience as presented in table 3.

In my opinion DiTommaso (2011) framework is too game and player-centered to be used in my project. He refers to "game" instead of gamification in his framework. Besides, he calls the users as players and proposes to look at the gamification through psychological

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<sup>23</sup> DiTommaso, Dustin. 2011. "PLAY OR BE PLAYED: THE". *Slideshare.Net*.

[https://www.slideshare.net/DiTommaso/beyond-gamification-architecting-engagement-through-game-design-thinking/3-PLAY\\_OR\\_BE\\_PLAYED\\_THE](https://www.slideshare.net/DiTommaso/beyond-gamification-architecting-engagement-through-game-design-thinking/3-PLAY_OR_BE_PLAYED_THE)

DiTommaso, Dustin. 2011. "Geekend 2011 - Beyond Gamification: Architecting Engagement Through Game Design". *Youtube*. <https://www.youtube.com/watch?v=JLyo-oNReBk>

lenses proposed by Jesse Schell (2008), intended for game designers to look through at games to improve gaming experience. I think this type of approach would be more beneficial for serious games.

Firstly, as opposed to Werbach and Hunter's Game Element Hierarchy and MDA framework (see section 2.1.1), Francisco-Aparicio et al. method (2013) views game in terms of game core, game engine and game interface. Where game core are the elements that characterize the nature of the game, game engine processes those representations and game interface is responsible for final appearance. When applying gamification, they only look only at the game core in terms of game mechanics, storyline and user experience. Secondly, their gamification design process is influenced by Human-Computer Interaction (HCI) principles and consists of two iterative processes: context analysis from User-Centered Design (UCD) framework and implementation of gamification. However, in my project I am focusing on the practice of designing a gamified learning tool in a wider scope human use and its implications. Therefore, in my opinion, it is best to apply their gamification framework on its own, rather than in addition to Interaction design framework.

Main goal of Sustainability of Gamification Impact (SGI) framework is to increase the sustainability of desired gamification impact (AlMarshedi et al. 2015). However, in my project I am exploring what kind of impact gamification yields, rather than focusing on sustaining such impact. Additionally, SGI framework utilizes Pink's drive motivation elements (2011), which I don't use in my project. Finally, SGI framework does not have practical application steps so I can't use it for my design decisions.

Therefore, I am going to use Werbach and Hunter's 6D framework (2012), which is also based on SDT motivation theory and also places importance on user experience similar to Interaction design process. Even though there is a difference in our understanding of the flow (See section 2.3.2), it does not influence my design. Besides, I am also using Werbach and Hunter's Game Element Hierarchy in my definition of gamification. Therefore, in my opinion it fits my project best out of all four frameworks.

Werbach and Hunter's 6D framework (2012) consists of six steps:

1. **Define business objectives.** This step is concerned with end goals and specific positive results.

2. **Delineate target behaviors.** In this step desired player behaviors are described, as well as how the system should support and give feedback on those.
3. **Describe your players.**
4. **Devise your activity loops.** Here one plans on how to motivate players using engagement and progression loops, how to engage new players and how to encourage further action.
5. **Don't forget the fun.** Aspects that are intrinsically motivating are identified.
6. **Deploy the appropriate tools.** This step is concerned with identifying relevant game elements and specific feedback, rewards and reinforcements.

	<b>Flow (section 2.3.2)</b>	<b>Basic needs from SDT (section 2.2)</b>	<b>User Experience (section 3.2.1)</b>
<b>A framework for Success<sup>24</sup></b>	Not mentioned	Explicitly mentioned in the framework.	Not mentioned
<b>6D (Werbach and Hunter 2012)</b>	See section 2.3.2 for the discussion about their view on the flow.	Underlying motivational approach.	Explicitly mentioned in the framework.
<b>SGI (AlMarshedi et al. 2015)</b>	Explicitly mentioned in the framework.	Explicitly mentioned in the framework.	Framework is focused on user's purpose, relatedness and competence.
<b>Francisco- Aparicio et al. method (2013)</b>	Not mentioned	Explicitly mentioned in the framework.	Usability goals as underlying approach.

Table 3. Framework summary.

<sup>24</sup> DiTommaso, Duston. 2011. "PLAY OR BE PLAYED: THE". *Slideshare.Net*.

[https://www.slideshare.net/DiTommaso/beyond-gamification-architecting-engagement-through-game-design-thinking/3-PLAY\\_OR\\_BE\\_PLAYED\\_THE](https://www.slideshare.net/DiTommaso/beyond-gamification-architecting-engagement-through-game-design-thinking/3-PLAY_OR_BE_PLAYED_THE)

DiTommaso, Dustin. 2011. "Geekend 2011 - Beyond Gamification: Architecting Engagement Through Game Design". *Youtube*. <https://www.youtube.com/watch?v=JLYo-oNReBk>

### 3.3 Research methods.

Several research methods were employed in this project. The main purpose of using these techniques is to gather applicable and context-grounded data, which will act as a foundation of specific requirements for this particular design project (Rogers et. al. 2011 p. 222).

Participants of the research that fit intended user profile and which are used to gather data from are called **population sampling** (Ibid p. 223). Due to the nature of the master thesis work and its time constraints, main research will be with an available population of the target user group rather than preselected, which is called **convenience sampling** (Ibid p. 224).

#### 3.3.1 Interviews.

A research interview as a conversational technique is “[...] *an interview whose purpose is to obtain descriptions of the life world of the interviewee with respect to interpreting the meaning of the described phenomena.*” (Kvale 1997, p.5-6). Thus, such dialog has some structure and a purpose (Ibid, p.6). Based on how much structure the interviewer uses during the interviews, they can be divided into three main groups: **unstructured**, **structured** and **semi-structured** (Rogers et. al. 2011 p. 228).

I have conducted semi-structured interviews during my research project, because they give more flexibility to the interviewer to probe for some answers and deviate from others, while following pre-planned interview question script (Ibid p.229-230). Totally I have conducted 1 interview with a teacher, 2 interviews during prototyping and 9 interviews during usability testing with my intended user group, which are students. Interviews were conducted in public places like university or a café.

The topic of a qualitative interview is typically about the subject’s experience of the everyday world and their relation to it. The goal of the researcher is to obtain specific, detailed descriptions, to interpret and understand their meaning (Kvale 1997 p. 30-31). In HCI interview is a good source for focused investigation about such issues like user needs, practices and concerns; it also acts a bond between developers and users (Lazar et. al. 2010 p. 178,180). However, both interviews and their transcription are a time-consuming technique (Rogers et. al. 2011 p. 227, 261). By using audio recording the interviewer can save some time while transcribing only relevant parts of the interview for the analysis (Rogers et. al.

2011 p. 227). During my interviews I have made audio recordings with my iPhone, these recordings are only available in my phone and not uploaded online. This should ensure audio data safety and ethical considerations, after transcriptions these audio files were deleted.

Due to the private nature of the interview inquiry some ethical issues might arise, therefore it is common to follow certain practices (Rogers et. al. 2011 p. 224). **Informed consent** is a written or oral contract, in which the subject is informed of the study's purpose, possible risks, benefits or consequences and confirms subject's voluntary participation, agreement to release identifiable information or possible confidentiality clause (Kvale 1997 p.153-154). Informed consent form template and signed consent forms used during this research project are available in Appendix A.

There are five main methods of qualitative interview meaning analysis. **Meaning condensation** describes shortening meanings of the interviewees into much shorter formulations. **Meaning categorization** involves coding the statements into categories. **Narrative structuring** has its focus on transforming interview story into the narrative with a structure and a plot. **Meaning interpretation** provides context for the subject statements, facilitating overall text expansion. **Generating meaning through ad hoc methods** is used to quantify or present commonsense meanings through figures, charts, numbers, text and their combinations (Kvale p. 192-193). Interview transcripts that were made by applying meaning condensation are available in Appendix B.

### **3.3.2 Observation.**

Observation is a data gathering technique used during product development, during which users are observed in a controlled environment while performing specific tasks (Rogers et al. 2011 p247). It is used to understand the user's goals and context during early stages, and as an evaluation method at later stages (Ibid). Observation depends on individual interpretation by the observer about what has been seen, therefore not everyone sees things same way or finds the same things meaningful (Suri 2011 p.18).

Even though observation is essential to design, what the projects makes out of observation is more important than what is observed (Suri 2011 p.32). Observation can vary by the degree of participation by the observer. A passive observer does not take part in the activities or the environment, where the participant observer is will engage in social activities (Rogers et al.

2011 p251). During usability testing I have actively observed 8 students, summary of my observation is available in section 6.2.

Because it is hard for people to accurately explain what or how they do things, observation allows to gather detailed insight into user activities (Rogers et al. 2011 p248). Sometimes people want to be cooperative, but they lack understanding about what the designer is concerned with while doing observation and can act in unusual ways (Button and Sharrock 2009 p.85).

### 3.3.3 Questionnaires.

Questionnaire (or a survey) is a data gathering technique to collect users opinions about specific defined questions which is very similar to a structured interview, however, the interviewer is not present during the answering process and users self-administer (Lazar et. al. 2010 p. 100). Web-based questionnaires are cheap, accessible and widely used as an easy convenience sampling method (Rogers et. al. 2011 p. 244, Lazar et. al. 2010 p. 100). The response to the questionnaires depends on how well the questions are worded, how motivated people are to answer them and what type of the questions or response types are used (Rogers et. al. 2011 p. 238). As opposite to in-depth personal focus of the interviewing, surveys are intended to skim over issues of a larger population (Lazar et. al. 2010 p. 101). Because availability of users is an important concern, surveys also will be used to collect data from students unavailable for interviewing in person.

### 3.3.4 Document analysis.

In my project I have used a method called **Document analysis**, which is a “[...] *systematic procedure for reviewing or evaluating documents [...]*” (Bowman 2009 p.27). I have employed this method to analyze various text documents from INF3272 course web page (see section 1.1.1) because of advantages, like availability to the public domain, furthermore cost and time efficiency (Ibid p.31). Document analysis is essentially an iterative process of “[...] *compressing many words of text into fewer content categories based on explicit rules of coding[...]*” (Lazar et. al. 2010 p. 285). Where **coding** describes the process of making comparisons, developing new concepts and grouping the data into categories (Lazar et. al.

2010 p. 289-290). In total I have analyzed 40 documents from lectures and 7 assignment descriptions.

### 3.3.5 Prototyping.

Prototyping and usability testing (see next section 3.3.6) methods are central to interaction design development process (described in section 3.2.1).

Prototyping can be defined as a “[...] *use of experimental methods to help gain experience needed for constructing usable software.*” (Budde et. al. 1992, p.6). It involves producing and experimenting with early application versions, called prototypes. Prototyping can be applied as a communication tool between users and developers during the development process. As well as a method for gaining experimental experience, clarification of relevant specifications and basis for decision making. (Budde et. al. 1992, p. 6-9). Prototypes are often used to illustrate a tangible idea, provide a foundation for subsequent prototypes and installation-free demonstration of technical restrictions or feasibility of the future application system. (Budde et. al. 1992, p.38.) They vary in materials, resolution detail and scope (Rogers et. al. 2011, p.398).

Goals of prototyping can be exploratory, experimental or evolutionary. **Exploratory prototyping** is used to clarify requirements and examine various design options. Low-fidelity prototypes are simple, low-resolution and cheap modifiable versions intended for exploration at early development stages (Rogers et. al. 2011 p. 392). **Low-fidelity prototype** medium examples include sketches for the storyboarding or interface design (Rogers et. al. 2011 p.393). **Experimental prototyping** is focuses on technical implementation of the development goals (Budde et. al. 1992 p.39). **High-fidelity prototypes** are high resolution prototypes used in experimental prototyping to implement high detail functionality resembling the final product to illustrate specifications, to evaluate or test interactions with the user's (Rogers et. al. 2011 p. 396). Finally, **evolutionary prototyping** is a continuous prototype adaptation process towards changing constraints until the final product is achieved ((Budde et. al. 1992 p.39, Rogers et. al. 2011 p. 399).

In so-called **horizontal prototyping** several specific parts or functions of the system are built with little detail, while in **vertical prototyping** a complete detailed implementation of a selected part or a few functions of the whole system takes place. Vertical prototyping is



usually applied to experiment on the functionality or implementation aspects of the system, while horizontal practically focuses more on human computer interfaces (Budde et. al. 1992 p.39, Rogers et. al. 2011 p. 398).

During this project I have created low-fidelity prototypes in the form of six wireframes and a high-fidelity prototype, which was a developed website with some of the intended functionality. Figure 12 presents a comparison of those two.

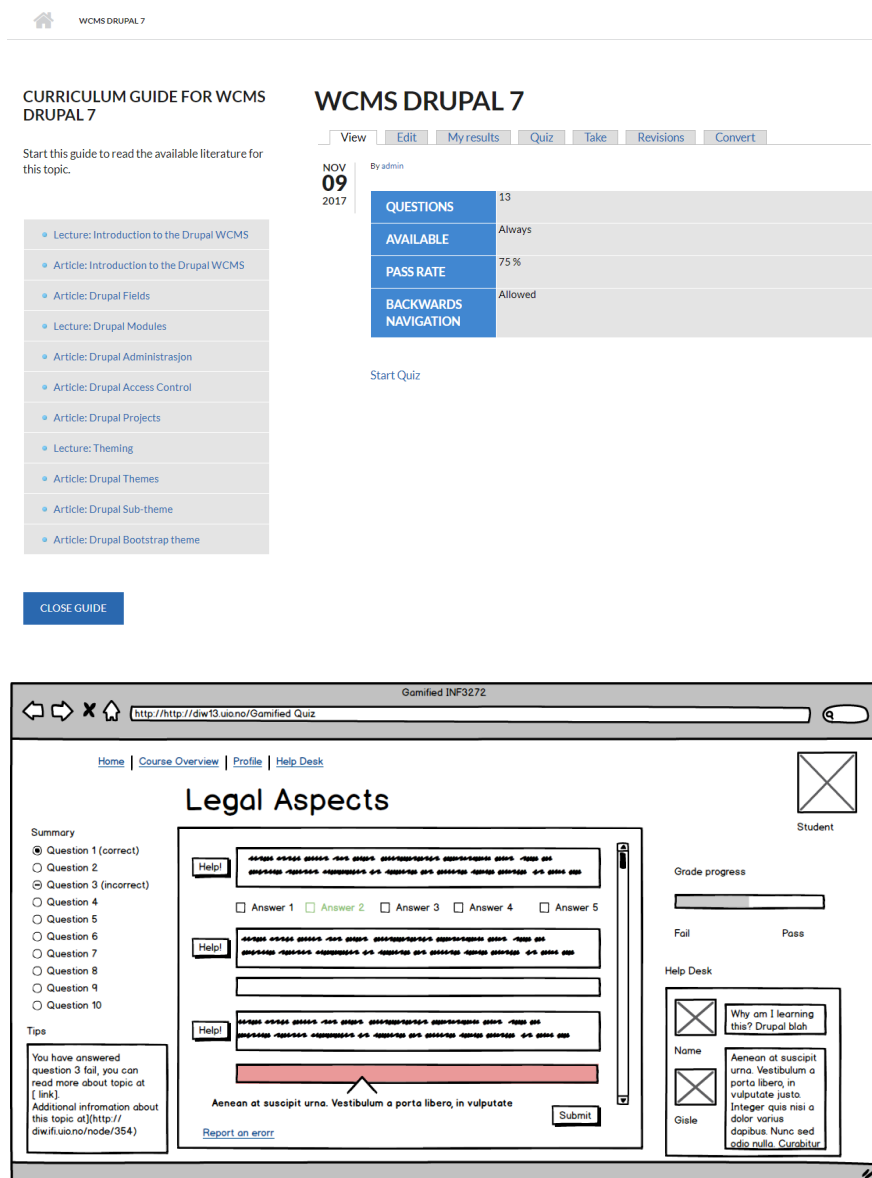


Figure 12. High- (top) and low-fidelity (bottom) prototypes from this project.

### 3.3.6 Usability testing.

Even though usability testing is intended primarily for evaluating usability of a product, it is in fact closely associated with other research methods like observation or interviews (Lazar et. al. 2010 p. 254, Rogers p. 476-477). Furthermore, it can be fully regarded by itself as a method that utilizes methodical triangulation to research interfaces (Lazar et. al. 2010 p.252, Rogers et. al. 2011 p. 477). Usability testing can be used to evaluate both low and high-fidelity prototypes, however, typically is used at a later developmental stage (Lazar et. al. 2010 p. 252, 255). So-called **Wizard-of-Oz method** for **formative testing** is essentially a paper simulation of the functionality to research how the interface is perceived by the users (Lazar et. al. 2010 p. 276, 260). While **summative testing** happens with high-fidelity prototypes to evaluate the design choices made (Lazar et. al. 2010 p. 260).

There are three main categories of usability testing: expert-based, automated and user-based (Lazar et. al. 2010 p. 256). **Expert-based tests** are done by third party interface experts that can find more obvious interface functionality flaws, while **user-based testing** involves representative users with deeper understanding of tasks. There are several types of expert reviews, most common are: heuristic review, consistency inspection and a cognitive walkthrough (Lazar et. al. 2010 p.257). **Heuristics** involve a short set of interface rules, **consistency inspection** is concerned with the consistency of a layout, language, terminology throughout series of a webpages. Lastly **cognitive walkthrough** involves the expert role-playing users and their tasks (Lazar et. al. 2010 p.257). In **user-testing** it is accessible to involve between 5 and 12 users for usability testing (Rogers et. al. 2011 p.477). User-tests usually consist of various tasks given to the users, interviewing their opinions and various data collections associated with the product use (Ibid). Self-explanatory **automated testing** involves a software testing the application and measuring certain statistics (Lazar et. al. 2010 p. 258-259).

# 4 Design process.

This chapter is structured according to Interaction Design Framework discussed in section 3.2.1. Instead of separating data gathering from analysis, design iterations consist of data gathering steps with their immediate analysis and following design decisions.

In this chapter I give a detailed account of what I have done to answer my research questions, how I approached data gathering and what design decisions I have made based on data analysis. My research questions are:

- *What motivational impact gamification of self-regulated learning has on adults in a higher education context?*
  - *How will a simple quiz based gamified tool motivate for learning in a higher education context?*
  - *What ethical considerations do potential users see in a simple quiz based gamified tool?*

## 4.1 First Iteration of Establishing requirements.

The first iteration is focused upon defining problem space in terms of context. As opposed to second iteration that focuses more on user needs, in this section I define initial project requirements.

### 4.1.1 Initial interview with the course teacher.

Because the idea for this particular project was suggested by my supervisor Gisle Hannemyr (who teaches INF3272), it was quite logical to ask him further about what he had in mind. My goal was to broadly investigate the goals of the project and what is expected from a student knowledge-wise in his course. Therefore, I have used the interview as a data gathering method at this step. I have written consent form (Appendix section A.a) to ensure that ethical guidelines are followed and have taken audio recording with the permission during the interview. A signed consent form is available in the Appendix section A.b.

Following **interview question guide** with possible follow up questions was used for the initial **semi-structured interview** (see section 3.3.1):

- Why are you teaching this particular course at university of Oslo?
- What do you think is the most basic knowledge that students should acquire during your course?
  - What would an average C student know?
  - What would be the most advanced knowledge for an A student for example?
- Why did some student fail the course?
- In your opinion, what topic were the most difficult for students?
- How was your lecture attendance during the course this year?
- Do you think some that some students lack motivation to come to lectures?
- Did some students have trouble with group work?
- Were there any other particular problems with assignment deliveries?
- How did you think to use this student learning project?
  - What is the desired end result, in your opinion, of this type of feature?
  - What would you consider a fail for this particular project?
- If this project could solve a problematic issue for you what would it be?

Afterwards, I have performed **meaning condensation** (see section 3.3.1) while transcribing the interview. This transcription is available in the Appendix section B.a.

#### **Key findings from the interview:**

- No correlation between lecture attendance and failing the exam.

- Overview over course requirements for different type of students ranging from the lowest grade to the highest is presented in the next section 4.1.2 (see Figure 14).
- There is a need for general teaching analytics to pinpoint most difficult areas of the course.
- Students are intended user group.
- Students complain about understanding the assignments.
- Students don't understand the hidden complexity of the course.
- The project is intended as voluntary fun leisure experience for the course students.
- Feedback on students' progress and learning should be kept private.

#### **4.1.2 Analysis of learning goals.**

From the initial interview described in the previous section it became clear that one of the main goals for the project is to support student self-regulated learning of the course content. Therefore, I have used document analysis method (described in section 3.3.4) to organize main theoretical concepts from the available lecture slides. As illustrated in figure 13 I have identified two main topics called **Information Architecture** and **WWW Content Tools**, that branch out in 3 subtopics each.

During the initial interview (section 4.1.1) I have explicitly asked questions designed to define what kind of knowledge student should learn loosely based on 3 different grade levels: A (best), C (average) and E (minimal for a pass). A summary of those learning goals is available in Figure 14.



Figure 13. Main theoretical concepts from the course INF3272. (See appendix section D.c for full page image)

Type of Students Knowledge			Study Goal
Minimal	Average	Best	
			grade A (best)
		Theming ( mobile responsive framework not looking like bootstrap.)	
		Security	grade C (average)
		All the key terms	
		From Prortotyping Into drupal graphical interface	
		Terminology and taxonomy of web publishing.	
		Drupal GUI: Blocks: turn on and turn off & create new blocks	
		Drupal GUI: create new content types	
		Functional website with Drupal.	
		Drupal: bootstrap-like Sub Theme .	grade E (minimal knowledge for a pass)
		Concept of Information Architecture (IA)	
		Drupal Taxonomy	
		Drupal Navigation	
		Users and User Behaviours	
		CMS	
		Content & Users & Context	
		Designing for user experience	

Figure 14. Learning goal summary.

### 4.1.3 Initial requirements.

Based on previous two sections I have made a summary of initial requirements presented in table 4. I have divided requirements into experience and usability goals, as well as site objectives.

Type of requirement	Description	Source
Experience goal	fun	Initial interview
Experience goal	pleasurable	Initial interview
Experience goal	rewarding	Initial interview
Usability goal	effectiveness	Interaction design
Site objective	Teacher analytics for problematic learning areas	Initial interview
Site objective	Provide a feedback to students	Initial interview

Table 4. Initial requirements summarized.

Further, I have reviewed project objectives according to steps 1 and 2 in 6d gamification framework (see section 3.2.1).

1. **Project objectives:** Project objective summaries overall end goals of the project.

- Assist students in self-regulated learning.
- Provide self-assessment for students.
- Provide analytics for the teacher to pinpoint problematic areas for students.
- Make this type of learning experience fun.
- Motivate students to take tests more often.

2. **Target behaviors:** Summarized user behaviors that I want to promote are presented in table 5.

Target Behavior for students	Corresponding system objective	Measuring metrics / Feedback
------------------------------	--------------------------------	------------------------------

Taking tests repeatedly	Motivate students to take tests more often.	Progression percentage and feedback via achievements.
Having fun	Make this type of learning experience fun.	Achievements.
Learn what is expected during the course	Provide knowledge assessment for students	Progression percentage and Corresponding grade as a feedback

Table 5. Summarized user behaviors.

## 4.2 Second Iteration of Establishing requirements.

Second design iteration focuses on emphasizing with users, in this case student's needs and problems. During this step I will compose a more detailed description of the intended user group. This corresponds to step 3 in the 6d gamification framework (see section 3.2.1), which is called "*Describe your players*".

### 4.2.1 My initial assumptions and considerations.

There are several key assumptions that I am making based on project's context (see section 1.1.3) and common sense:

- Students are **intrinsically motivated** to pass the INF3272 course that they have chosen. Because the course is not mandatory, therefore they needed to choose it based on needs for competence and autonomy (see section 2.2 and 2.5)
- Students are self-regulating their own learning, by reading curriculum and / or by coming to the lectures.
- Students come from a wide variety of backgrounds, which is common to most universities open to international students.
- Students that have already taken the course can have bias associated with experiences during the course.

Secondly, there are three key assumptions based on adult learning theory (see section 2.5):

- Students need to know why they have to learn something.



- Students need to know how knowledge relates to real-life situations.
- Students have a higher need for autonomy.

#### 4.2.2 Applying Kim's Social matrix.

According to Kim's Social Action Matrix (section 2.1.1) there are four main user types:

- **Explorers** are learning-oriented students, that want to explore learning domains and gain deep knowledge.
- **Creators** are experience-oriented students, which want to express themselves and gain recognition of their experiences or contributions.
- **Competitors** are goal-oriented students that want to overcome intellectual challenges.
- **Collaborators** are social activity-oriented students, which value social contact and human interaction.

Furthermore, I have made a design decision not to implement following gamification elements:

- **Direct Competition mechanics.**

I do not feel that direct competition between these user types is appropriate in this type of learning project context. Their ultimate goal is to pass the course, rather than challenging their peers. They are also encouraged to work in groups during the course so personal rivalry might create unnecessary tensions in the project groups.

- **Leaderboards.**

This particular project is not about comparing individual performances. Instead of leaderboard an application could offer some other form for neutral feedback about how a student relates to others. Leaderboards require certain user mass to function, but participation in this project is voluntary. I don't know whether there will be enough users to create a fully functional leaderboard without it being overly demotivating or competitive. Besides, according to initial interview (see 4.1.1), student's progression feedback should be kept private so public leaderboard would be directly opposite of that requirement.

### 4.2.3 Updating requirements.

Based on previous two sections I have updated a summary of initial requirements presented in table 6.

Type of requirement	Description	Source
Experience goal	fun	Initial interview
Experience goal	pleasurable	Initial interview
Experience goal	rewarding	Initial interview
Usability goal	effectiveness	Interaction design
Site objective	Teacher analytics for problematic learning areas	Initial interview
Site objective	Provide a feedback to students	Initial interview
Site objective	Support autonomy of choice	Section 4.2.1
Site objective	Should support contributions	Section 4.2.2
Site objective	Should support exploration	Section 4.2.2
Site objective	Should provide some challenge	Section 4.2.2
Site objective	Should support social collaboration	Section 4.2.2

Table 6. Summary of updated requirements.

## 4.3 Low-fidelity Prototyping.

This subchapter is dedicated towards producing and experimenting with possible solutions based on user requirements. Section 4.3.1 corresponds to step 4 in the 6d gamification framework (see section 3.2.1) and is concerned with abstract engagement and progression loops. Section 4.3.2 presents rewards in the form of achievements (corresponds to step 5 and 6 in 6d gamification framework from section 3.2.1) and finally section 4.3.3 presents most practical prototypes in the form of wireframes. This subchapter concludes with an evaluation of suggested solutions.

### 4.3.1 Devising activity loops.

**Main engagement loop** (see section 2.2.2) for this project consists of three consecutive steps:

- Motivation.

Students are intrinsically motivated to assess own knowledge.

- Action.

The student takes quiz.

- Feedback.

Students get feedback in form of performance feedback, how it relates towards goals (that are represented by grade) and reward in form of achievement. Which should motivate students to improve in certain areas.

As for **progression stairs** (see section 2.3.1) for this particular project I have divided user activities into three abstract consecutive steps:

**Onboarding:** The first quiz that a player takes is introductory and gives a general feel of functionality.

**Intermediate:** Student can choose among two main topics to complete the quizzes.

**Expert:** Student gains additional topics and more freedom once he completed two previous steps. He also can help fellow students by answering questions.

As for designing a **scaffold**, the system should be able to adjust the difficulty based on the student's responses (see section 2.3.1). The student should be recruited through **onboarding**, then the questions should be adjusted and hints given in cases where the student keeps struggling, finally a demonstration and a link to the literature should be offered when a student is stuck. After this stage the system should decrease control and gradually limit the hints, until the student is capable to proceed on his own. This process corresponds to each step in the progression stairs, students is lifted up where he stays at a certain plateau then again is prompted to heighten the difficulty. This should represent a practical **ZPD** implementation (see section 2.3.1).

#### 4.3.2 Establishing reward structures.

I have created several achievements based on requirements (see section 4.2.3) and user types (see section 4.2.2). Achievements G, J, I, K, L are hidden (see section 2.2.2) to prevent the decrease of intrinsic motivation in people who don't perform well. Achievements from B to F are repeatable to motivate people to do certain actions multiple times. Even though some achievements are created with certain user types in mind (see section 4.2.2), all students have the possibility to earn all of the achievements, which is also an achievement. Table 7 presents an achievement overview that lists trigger condition, achievement's internal id, if the achievement is hidden or repeatable t, and finally a type of student it is primarily intended for.

Even though I am giving achievements to explorers, I assume that these achievements will unlock extra content for them to explore as a reward of access (see section 2.2.2). As for competitors, they will get prompts from the system displaying other possible achievements to further improve their performance.

<b>User action as triggering condition</b>	<b>id</b>	<b>Hidden</b>	<b>Type of Student</b>	<b>Repeatable</b>
Test every single topic	A	NO	Explorer	NO
Find a mistake in the question	B	NO	Creator	YES
Answer every single question correct in one test	C	NO	Competitor	YES
Help a fellow student by answering his question	D	NO	Collaborator	YES
Follow a link for extra literature	E	NO	Explorer	YES
Submit own question	F	NO	Creator	YES
Answer every single question correct on the first try	G	YES	Competitor	NO
Help 5 fellow students	H	NO	Collaborator	NO
Explore all links & all tests	I	YES	Explorer	NO
Create most additional questions during the semester	J	YES	Creator	NO

Answer every single question correct in all of the tests	K	YES	Competitor	NO
Help the most fellow students during the semester	L	YES	Collaborator	NO
Take a first test	M	NO	All	NO
Pass every single test	N	NO	All	NO
Take a single test 5 times	O	NO	All	NO
Take all tests 10 times	P	NO	All	NO
Collect every possible achievement	R	Yes	All	NO

Table 7. Summary of the achievements.

Further every single achievement is presented in detail as table (see table 8).

<b>Achievement ID</b>	<b>Title</b>	<b>Description</b>
Achievement A	Exploration, check!	Take a test in every single topic.
Achievement B	Catch them all!	Submit a mistake in the question.
Achievement C	Know Thy Topic!	Answer every single question correct in one test.
Achievement D	Helping hand.	Help a fellow student by answering his question
Achievement E	Why? Because it's there!	Follow a link for extra literature
Achievement F	I know better!	Submit own question.
Achievement G	Nailed it!	Answer every single question correct on the first try
Achievement H	Medic	Help 5 fellow students.
Achievement I	What a long trip it's been!	Student explored all links and all tests.
Achievement J	Resourceful	Student that contributed the most.

Achievement K	Look at me! I am awesome.	Student answered all questions correct in every test.
Achievement L	Epic Social Life.	The most helpful student.
Achievement M	You did it! Kind of.	Take a first test.
Achievement N	Now that's an achievement!	Pass every single test
Achievement O	Practice makes perfect.	Take a single test 2 times.
Achievement P	Brutally Dedicated.	Take a single test 5 times.
Achievement R	Overachiever.	Student has earned every single achievement.

Table 8. Achievement description summary.

### 4.3.3 Wireframing.

Because I have chosen to follow the gamification definition by Kapp (see section 2.1), aesthetics plays an important role in my design. I have chosen to follow a simple color scheme with **black and white contrast**, because:

- Firstly, colorful representations typically associated with games. However, I want to gamify a learning tool so the colors could be distracting and could associate with serious games which are closer to full games than gamification (see section 2.6).
- Secondly, some students might have dyslexia therefore by utilizing **colorful overlays for background and text** I could potentially help them read, however if everything is colorful those overlays would not work. Same applies for students who tired of reading and colorful overlay could alleviate visual stress of reading for too long. Color sensitivity is very personal so there should possible to choose between multiple colors for better comfort and readability.

Then I have used MyBalsamiq for prototyping to create wireframes.

- Wireframe A is structured accordingly to suit requirements from section 4.2.3 and progressions stairs s from section 4.3.1. It supports player autonomy to some degree and gives an overview into the course content. Navigation is based on the main theoretical concept diagram from section 4.1.2. Additionally, it has an example of tips for scaffolding from section (4.3.1)

- Wireframe B presents gamified quiz functionality, like tips, quick help desk and progress based on achieved grade.
- Wireframe C represents possible Student Profile for logged in user. It has progress feedback for each topic, overall progress and which topic is most problematic based on correct answer percentage. Student profile also showcases achievements and shows latest answered student questions from help desk.
- Wireframe D is intended for the course teacher. He has overall statistics for quizzes that present most problematic areas according to site requirement from 4.2.3 and offer links to review or edit problematic questions. Help desk has a Question and Answer functionality, where the teacher can answer student questions.

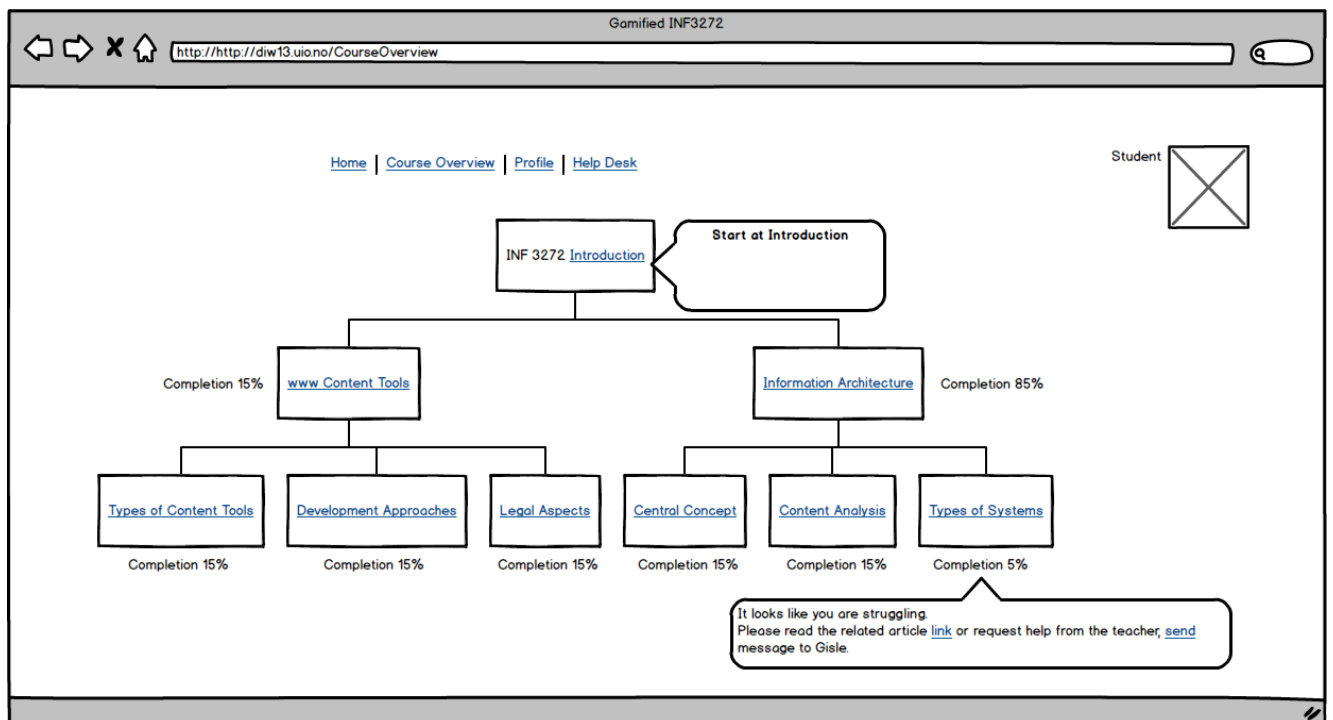


Figure 15. Wireframe A (See Appendix section D.c for a full-page image).

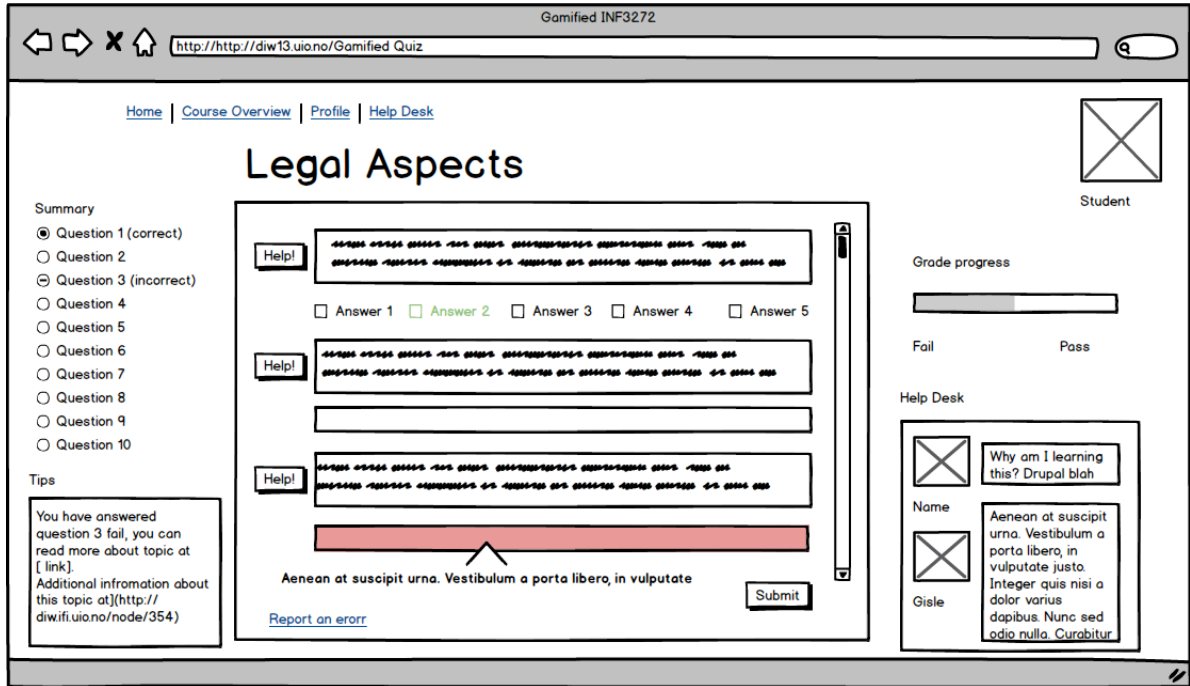


Figure 16. Wireframe B (See Appendix section D.c for a full-page image).

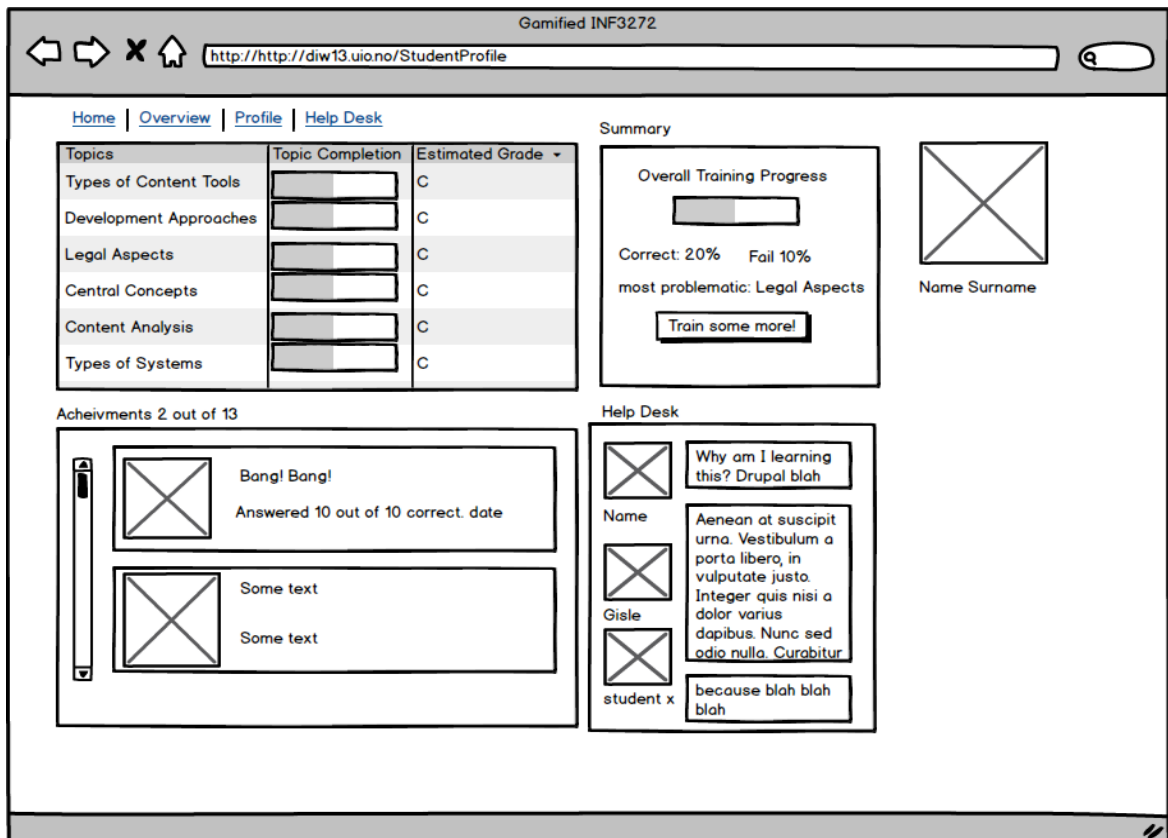


Figure 17. Wireframe C (See Appendix section D.c for a full-page image).





Figure 18. Wireframe D with pink color tint (See Appendix section D.c for a full-page image without color tint).

#### 4.3.4 Evaluating Wireframes & Making Changes.

To evaluate wireframes, I have conducted semi-structured interview with 2 students. I have specifically found a student that has taken the course, and one that hasn't. This was done to find out how a person who hasn't a prior idea about the course would understand the concepts, as well as how the one that already has prior experience with the subject would perceive the wireframes. This also was a practical decision, since due to circumstances I had to develop this project in one semester instead of two, so to manage the time accordingly I will spend more time on evaluation of developed high fidelity prototype rather than on low-fidelity wireframes.

During the interview I have explained the general idea of the project, then showed the images of wireframes and used following question guide, inspired by Jennifer Winter<sup>25</sup>:

<sup>25</sup> Winter, Jennifer. 2017. "31 Questions Every Designer Should Ask When Testing Prototypes | UserTesting Blog". *UserTesting Blog*. <https://www.usertesting.com/blog/2015/05/13/31-questions-every-designer-should-ask-when-testing-prototypes/>

- *After project explanation: What functionality do you expect from this type of quiz application?*
- *Do you understand this wireframe? Can you describe what you think you are able to do here?*
- *Is this wireframe similar to what you expected to see or is there anything missing?*
- *In your opinion do any features seem strange or unnecessary?*
- *If you could change any features what would you change?*
- *Will you use this application when it's finished?*

I have taken audio recording during the interview with my phone. Interview consent forms and transcriptions after meaning condensations are available in Appendix A.b and B.b.

**Key findings from the interview with person A** (anonymized according to consent):

<b>Wireframes A</b>	<b>Wireframe B</b>	<b>Wireframe C</b>	<b>other</b>
Needs better visual way to pinpoint lacking knowledge areas.	Answers shouldn't be given, student should look for them on their own.	Feedback aspects should be moved over to the wireframe A.	There is a need for an additional page called Results.
Achievements or some of them should be visible here.	This slide needs onboarding features	Student's performance should be compared to the average of all students' performance.	Slides are not tied together enough.
		There is no clear purpose for this page.	

Table 9. Summary of the interview with person A.

Changes based on the interview:

- **Wireframe A**

I have moved feedback and achievements functionality from wireframe B to wireframe A. Now completion is shown in terms of three color-coded criteria, which are: red for needs work (quiz not passed), yellow for average (passed) and green for good (top score). In

addition to pass or fail exam prediction, I have added the feedback on how the students compare to average student performance. Students also can see their achievement progress on the course overview page.

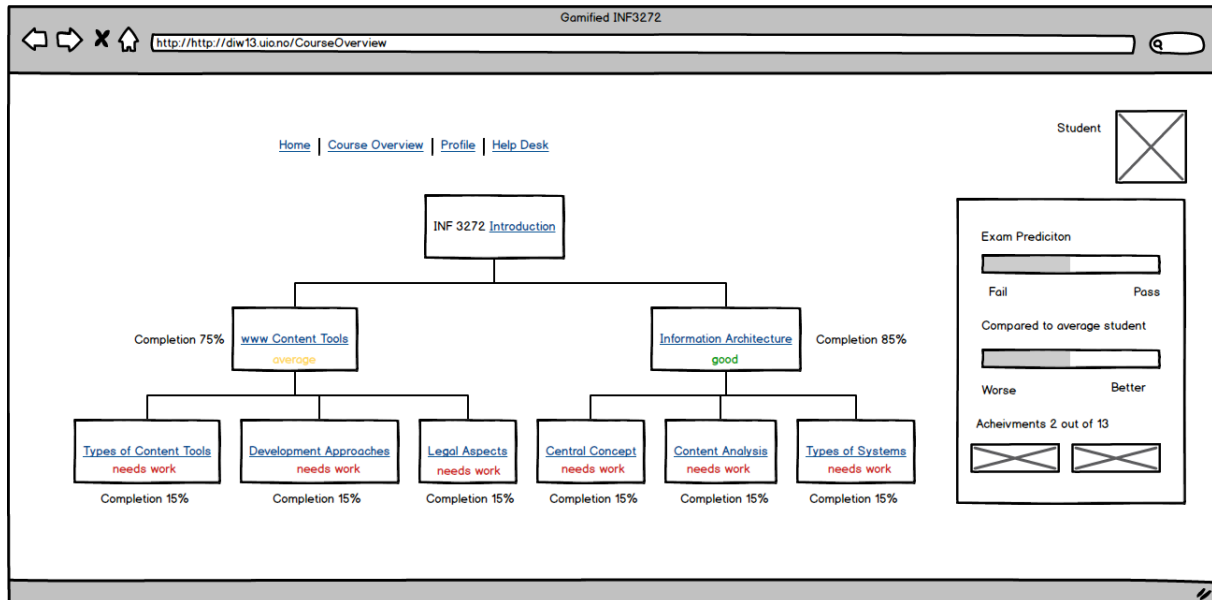


Figure 19. Updated Wireframe A (See appendix section D.c for a full-page image).

- **Wireframe B**

I have made wireframe B more readable, because the student had some trouble understanding the wireframe.

- **Wireframe C**

I have scrapped student profile and considered setting up a new page called Results, which would show summary of all test results. I have done so because student profile functionality was confusing to the student and probably wouldn't have been used as intended. This page would show various quiz related statistics in graphs based on quizzes performance, what practically can be shown will depend on the more practical development of the application.

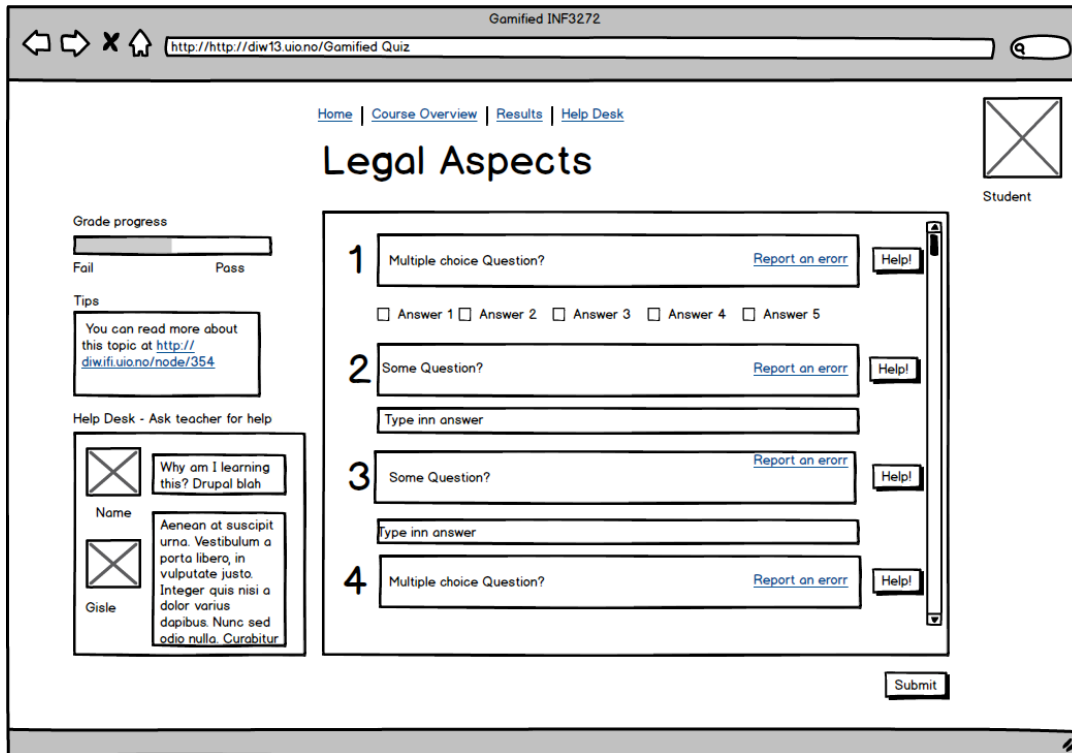


Figure 20. Updated wireframe B (See Appendix section D.c for a full-page image).

**Key findings from the interview with a student, who has taken the course in spring semester 2017:**

- Help button on wireframe B was unclear in terms if it was for the quiz or for the application itself, she prefers help for the application to be presented as tips.
- Ease of use is important for students who are focusing on studying.
- Not all students have understood which topics the inf3272 course consisted of, it is important to have additional information regarding topics and subtopics on wireframe A.

Based on these two interviews, it became clear to me that memorability and utility goals (see section 3.2.1) are also important for the learning application. Thus, I have updated requirements the final time before starting the development, presented in chapter 5.

Type of requirement	Description	Source
Experience goal	fun	Initial interview

Experience goal	pleasurable	Initial interview
Experience goal	rewarding	Initial interview
Usability goal	effectiveness	Interaction design
Usability goal	memorability	Interaction design
Usability goal	utility	Interaction design
Site objective	Teacher analytics for problematic learning areas	Initial interview
Site objective	Provide feedback to students	Initial interview
Site objective	Support autonomy of choice	Section 4.2.1
Site objective	Should support contributions	Section 4.2.2
Site objective	Should support exploration	Section 4.2.2
Site objective	Should provide some challenge	Section 4.2.2
Site objective	Should support social collaboration	Section 4.2.2

Table 10. Summary of the final requirements.

## 4.4 Usability testing of developed hi-fidelity prototype.

This section takes place after chapter 5 has concluded. To evaluate the high-fidelity prototype, I have prepared an interview and a survey. Usability testing was divided into several parts:

1. Firstly, students read and signed consent forms (Appendix section A.b).
2. Secondly, they could use a test user or create their own.
3. Afterwards, they proceeded to onboarding part of the prototype (see section 5.6).
4. Then optionally they could take a full test for any given topic.
5. After checking achievements, they were given a survey to fill out.
6. Finally, I had interviewed them by using interview guide.

I have written following **interview question guide** for usability testing, also inspired by Jennifer Winter<sup>26</sup>:

- Was anything confusing while testing the prototype?
- Was navigation understandable?
- Do you get a feeling that this application was designed for students?
- Did you manage to do everything you wanted to do?
- Will you use this kind of application in the future?
- Did you like the achievements?
- Would you like to add some other aspects to the prototype?

Additionally, I have created following questions for the interview:

- This application uses gamification mechanisms to motivate students to learn:
- Do you think that you should have been specifically informed about that out of ethical concerns?
- What do you think about using gamification to support self-regulated learning?
- Do you think that game inspired applications are acceptable in a higher education context?
- Do you think that gamification motivates you more compared to the normal type of learning?

I also made a survey in Google Forms with questions to specifically map engagement, fun and motivation (See figure 21). Because the application was made available as a website online, it

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<sup>26</sup> Winter, Jennifer. 2017. "31 Questions Every Designer Should Ask When Testing Prototypes | UserTesting Blog". *UserTesting Blog*. <https://www.usertesting.com/blog/2015/05/13/31-questions-every-designer-should-ask-when-testing-prototypes/>

was possible for students to evaluate it remote<sup>27</sup>. Therefore, interview questions were also available in the form of survey, for those students that couldn't or didn't have enough time to do whole testing face to face. I have also observed students during evaluation when it was possible as a participant observer (see section 3.3.2).

Not all students were speaking English, so in some cases I did interviewing in Norwegian and then translated the transcription into English. I have taken audio recording during interviews, anonymized transcriptions with **meaning condensation** (see section 3.3.1) are available in the Appendix section B.c.

As an additional incentive to students were offered chocolates for participation in usability testing, however, some of them did not require any. This was partly because usability testing took place in November, a hectic time when most students are busy preparing for exams and finishing courses. For practical reasons I also had a computer with a mouse available for users with preset test user credentials. Some of the students opted to do testing on their own computers, testing on a mobile phone was also possible. Most of the testing took place at Ole-Johan Dahls building, where the Department of Informatics is located.

The results of this testing will be presented in chapter 6, followed by the discussion in chapter 7.

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<sup>27</sup> Try the prototype at <http://inf3272gamifiedkqzba7qxyj.devcloud.acquia-sites.com/> (user: test password: 123) Valid until 11.12.2017.

After using the prototype I felt motivated to learn.

	1	2	3	4	5	
Strongly disagree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Strongly agree

Which of the following qualities describe your experience with the prototype?

	A lot	Some	Neutral	not much	None at all
Engaging	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Motivating	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Fun	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Enjoyable	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Helpful	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Cognitively stimulating	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Challenging	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Frustrating	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Boring	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Demotivating	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Rewarding	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Any other experiences with the prototype that you would like to share?

Your answer

Figure 21. Survey in Google Forms for usability testing.



## 5 Development process.

Development process started after section 4.3 in the previous chapter. In this chapter I work more closely with Drupal technology (see section 1.1.2) to practically implement features of my design from section 4.3.4.

In section 4.3.4 I have defined a list of requirements for this application. However, the first version of high-fidelity prototype is not yet a fully functional final application (section 3.3.5), so not all requirements will be fulfilled. For this iteration I am focusing only on main functional features like quiz and quiz related achievements. Therefore, I have further revised requirements (section 4.3.4) and achievement lists (section 4.3.2) to reflect this.

Type of requirement	Description	Source
Experience goal	fun	Initial interview
Usability goal	effectiveness	Interaction design
Usability goal	memorability	Interaction design
Usability goal	utility	Interaction design
Site objective	Support autonomy of choice	Section 4.2.1
Site objective	Should support exploration	Section 4.2.2
Sie objective	Should provide some challenge	Section 4.2.2

Table 11. Requirements for the high-fidelity prototype.

Achievement ID	Title	Description
Achievement C	Know Thy Topic!	Answer every single question correct in one test.
Achievement E	Why? Because it's there!	Follow a link for extra literature
Achievement G	Nailed it!	Answer every single question correct on the first try
Achievement K	Look at me! I am awesome.	Student answered all questions correct in every test.
Achievement M	You did it! Kind of.	Take a first test.

Achievement N	Now that's an achievement!	Pass every single test.
Achievement O	Practice makes perfect.	Take a single test 2 times.
Achievement P	Brutally Dedicated.	Take a single test 5 times.

Table 12. Achievements implemented in the high-fidelity prototype.

## 5.1 Developing with Drupal.

Drupal core has certain system requirements to be able to install and run on a personal computer<sup>28</sup>, which are:

Disk space of minimum 15 Megabytes for the core, and minimum of 60mb for an installation with multiple modules and themes.

- A web server that supports the PHP programming language.
- A database server.
- A recommended version of PHP is 5.4 or higher.

I have used a free application called Acquia Dev Desktop to run and develop a Drupal website locally on my computer, as well as host it online in Acquia Cloud. Its installation package includes the following components<sup>29</sup>:

- Apache HTTP web Server version 2.4.17 for web server functionality;
- Percona Server for MySQL Database management system;
- PHP language support for Drupal;
- A command-line shell and scripting interface Drush for Drupal;
- In-browser database management tool phpMyAdmin to handle the administration of MySQL over the web;

<sup>28</sup> "Overview". 2017. *Drupal.Org*. <https://www.drupal.org/docs/7/system-requirements/overview> .

<sup>29</sup> "Acquia Dev Desktop | Acquia Help Center". 2017. *Docs.Acquia.Com*. <https://docs.acquia.com/dev-desktop> .

- XMail Server for direct email sending on Windows;

A full list of all used Drupal core extensions is available in Appendix section D.b.

## 5.2 Basic Setup of Gamified INF3272 website.

I have chosen to use a free Bootstrap based Drupal theme called Scholarly Lite, which was specifically designed for educational purposes<sup>30</sup>. It has a clean look which makes it easier for the user to navigate. Additionally, I have used with minor modifications Terms of Use and Privacy Policy texts generated by a free online generator<sup>31</sup>. Both texts are available in Appendix sections E.a and E.b.

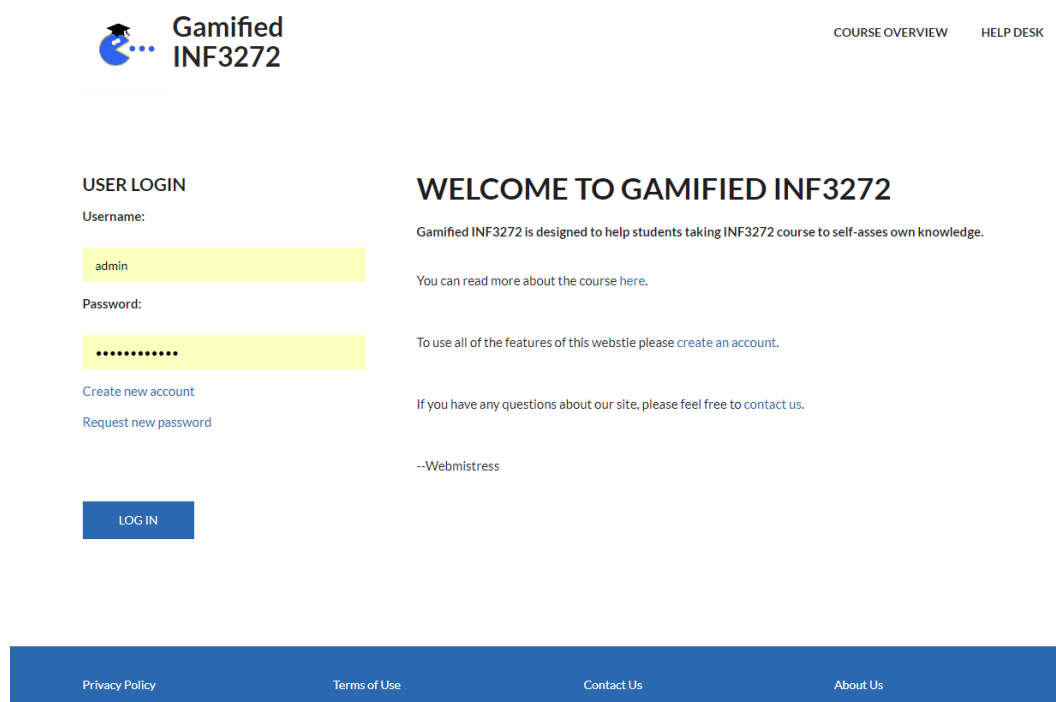


Figure 22. Anonymous user viewing the front page with custom login block (see section 5.6) (See Appendix section D.c for a full-page image). Help desk is a forum page.

## 5.3 Creating Quizzes.

<sup>30</sup> "Scholarly Lite". 2017. *Drupal.Org*. [https://www.drupal.org/project/scholarly\\_lite](https://www.drupal.org/project/scholarly_lite) .

<sup>31</sup> "Termsfeed". 2017. *Termsfeed*. <https://termsfeed.com/> .

I have used Drupal Quiz module to create quizzes, which was specifically designed to be used as a self-learning program<sup>32</sup>. The Quiz module supports following question types (Ibid):

- True or false
- Multiple choice
- Short answers
- Long answers
- Scale
- Question directions
- Matching
- Drag and drop (as additional module<sup>33</sup>).

The use of this module substantially speeded up the development of this project. Quiz module has the functionality to randomize questions, provide configurable feedback, create result data stored in a database, as well as the functionality to allow multiple attempts per user and build upon multiple attempts<sup>34</sup>. Even though I didn't choose to implement contributions and teacher analytics for implementation in the initial high-fidelity development, they are available in the quiz module by default. It is possible for authenticated users to add questions and for administrators to view overall quiz statistics for all users. Additionally, the Quiz module also has flexible feedback system that allows to give feedback both during and after the quiz<sup>35</sup>. After specifying the settings (see figure 23 for illustration), it is possible to use it as a feedback supporting ZPD, however the full functionality of a scaffold requires additional development (see sections 2.3.1 and 4.3.1).

Quizzes were named and created based on Wireframe A from section 4.3.4. I have written around 10 questions per quiz and manually set the up to be used in the quizzes based on course INF3272 curriculum. The questions used in this project are available in Appendix

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<sup>32</sup> "Quiz". 2017. *Drupal.Org*. <https://www.drupal.org/project/quiz>

<sup>33</sup> "Quiz Drag and Drop". 2017. *Drupal.Org*. [https://www.drupal.org/project/quiz\\_ddlines](https://www.drupal.org/project/quiz_ddlines)

<sup>34</sup> "Quiz". 2017. *Drupal.Org*. <https://www.drupal.org/project/quiz>

<sup>35</sup> "Quiz". 2017. *Drupal.Org*. <https://www.drupal.org/project/quiz>

section D.a. During the creation of these questions it became apparent that subtopics “Development approaches” and “Types of Content Tools” were redundant with main topic “WWW Content Tools”, therefore “Development approaches” subtopic was removed and “Types of Content Tools” was renamed into “WCMS Drupal7”. The same situation occurred with “Information Architecture” topic and subtopic “Central Concepts”, the latter was removed (see figure 24).

Finally, with a module called Guidance<sup>36</sup>, I have created a list with links for each topic, containing available links with literature used for the quiz.



Figure 23. Specifying feedback for an answer in multiple choice question.

<sup>36</sup> "Guidance". 2017. *Drupal.Org*. <https://www.drupal.org/project/guidance>



## CURRICULUM GUIDE FOR WCMS DRUPAL 7

Start this guide to read the available literature for this topic.

- Lecture: Introduction to the Drupal WCMS
- Article: Introduction to the Drupal WCMS
- Article: Drupal Fields
- Lecture: Drupal Modules
- Article: Drupal Administrasjon
- Article: Drupal Access Control
- Article: Drupal Projects
- Lecture: Theming
- Article: Drupal Themes
- Article: Drupal Sub-theme
- Article: Drupal Bootstrap theme

CLOSE GUIDE

## WCMS DRUPAL 7

View Edit My results Quiz Take Revisions Convert

NOV  
09  
2017

By admin

QUESTIONS	13
AVAILABLE	Always
PASS RATE	75 %
BACKWARDS NAVIGATION	Allowed

Start Quiz

Figure 24. Quiz module start page with the curriculum Guidance (See Appendix section D.c for a full-page image).

## 5.4 Developing Course Overview functionality.

This chapter describes practical implementation of Wireframe A from section 4.3.4.

Originally, I have used a Panels module<sup>37</sup>, which divided the content into three columns and created some navigation functionality by using simple html and CSS style code as illustrated in figure 25. However, there was no simple way other than coding a custom module to implement the feedback functionality of Wireframe A representing quiz completion.

Additionally, the size of panel columns was too small for the intended purpose. Therefore, I proceeded to the development of independent module instead. The code for the first version is available in Appendix E.

<sup>37</sup> "Panels". 2017. *Drupal.Org*. <https://www.drupal.org/project/panels>

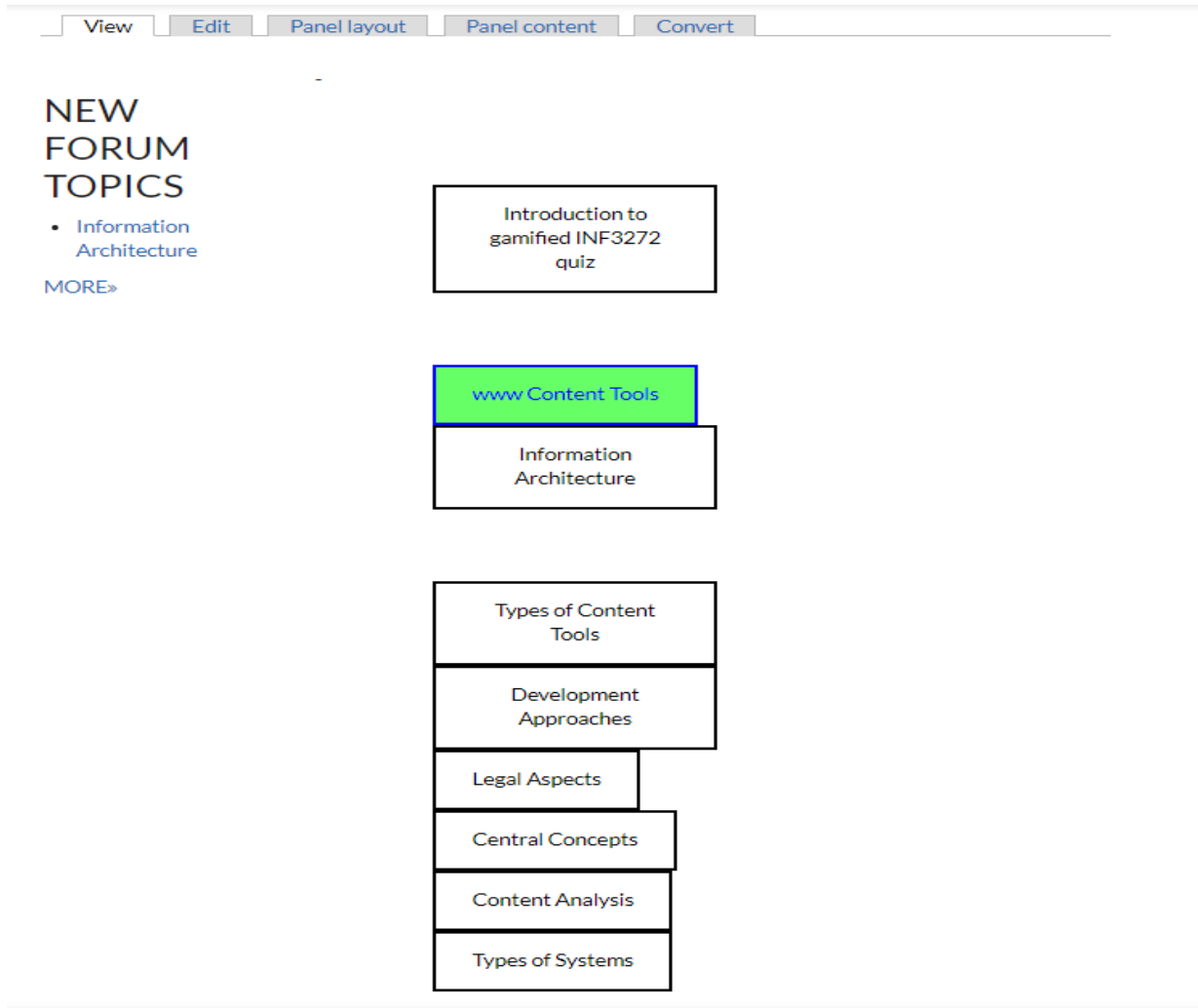


Figure 25. First version of Course Overview.

To achieve hierarchical structure in the second version, I had to create **my own custom Drupal module** called “**courseoverview**”. In this module I have used an SVG-based (Scalable Vector Graphics) JavaScript library called Treant.js to make the “courseoverview” look as a tree structured chart<sup>38</sup>. I have defined such tree structure by coding **my own JavaScript (overview.js)**. Treant.js is dependent on another library called raphael.js, which is used for drawing vector shapes in the browser based on JavaScript code<sup>39</sup>.

<sup>38</sup> "Treant.Js - Javascript Library For Drawing Tree Diagrams". 2017. *Fperucic.Github.Io*. <http://fperucic.github.io/treant-js/>

<sup>39</sup> Baranovskiy, Dmitry. 2017. "Raphaël—Javascript Library". *Dmitrybaranovskiy.Github.Io*. <http://dmitrybaranovskiy.github.io/raphael/>.

To make this hierarchical view to also display the status of the students' progress, I styled the view by using CSS with different CSS classes for how far the student have progressed with the quizzes. Based on Wireframe A:

- Color red indicates that a quiz is not passed;
- Orange/Yellow indicated that the quiz is passed (75% score or better);
- Green indicates that all questions in the quiz had been answered correct (100%).

In addition to **my own CSS file overview.css**, I also used a CSS example file from Treant.js, called treant.css.

All the JavaScript files (Treant.js, raphael.js and **overview.js**) are included in the **Drupal custom module created by me “courseoverview”** together with two CSS files: **overview.css** and treant.css. See Appendix E section c ii for the module code.

The Drupal module “courseoverview” consists in addition to JavaScript and CSS files of another two files **coded by me: courseoverview.info** and **courseoverview.module**.

**courseoverview.info** is a file which offers a description of the module that the Drupal then uses in its internal module system.

**courseoverview.module** is a PHP script which is run on sites where the module is activated. In addition to the **help** and **block\_info hooks**<sup>40</sup>, this PHP script implements the block\_view hook, which is the main part of the module. There a student's progress is fetched from the quiz module (**function getUserResults(\$userId)**) and is displayed in the hierarchical view by building a custom html and JavaScript string, which is then returned together with the

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<sup>40</sup> In Drupal term **hooks** refer to places where code can be executed by triggering an action in Drupal core code. The hook conformism constitutes a major part of the Drupal API, because all custom modules interact with the Drupal core through such hooks.

Read more at "Understanding the Hook System for Drupal Modules". 2017. *Drupal.Org*.  
<https://www.drupal.org/docs/7/creating-custom-modules/understanding-the-hook-system-for-drupal-modules>



attached JavaScript and CSS files as part of the designated block. See figure 26 for illustration of the second version of the course overview. See appendix E for the code.

**Gamified INF3272** COURSE OVERVIEW HELP DESK

COURSE OVERVIEW

## COURSE OVERVIEW

View Edit Access control Convert

### WELCOME TO THE INF3272 COURSE OVERVIEW.

The course consists of two main topics "Information Architecture" and "WWW Content Tools". Choose the main topic or subtopic to access your knowledge.

Green represents a passed quizz with all answers correct (100%)  
Yellow represents a passed quizz with some answers correct (75%)  
Red represents that you havent passed the quiz yet (below 75%)

Be aware that INF3272 course has a hidden complexity, please read the [pensum](#) before attempting the quiz.

```
graph TD
    INF3272[INF3272] --> WWW[WWW Content Tools]
    INF3272 --> IA[Information Architecture]
    WWW --> WCMS[WCMS Drupal 7]
    WWW --> LA[Legal Aspects]
    IA --> CA[Content Analysis]
    IA --> TS[Types of Systems]
```

Topic	Subtopic	Status
WWW Content Tools (Finished)	WCMS Drupal 7	Finished
	Legal Aspects	Finished
Information Architecture (Passed)	Content Analysis	Passed
	Types of Systems	Not completed

Figure 26. Second Version of the Course Overview (See appendix D section c for full-page image).

## 5.5 Developing Achievements.

Initially thought about using an Achievements module for Drupal<sup>41</sup>. However, I decided that it would be simpler to code my own achievements module, besides, I intentionally did not want to create leaderboards (see section 4.2.2).

<sup>41</sup> "Achievements". 2017. Drupal.Org. <https://www.drupal.org/project/achievements> .

The achievements module “`aoachievements`” is simpler than the overview module, because it does not use JavaScript or CSS. It queries the database to get a report of a user's progress and maps the progress to the achievements. So, the only files that **I have coded** for the “`aoachievements`” module are `aoachievement.info` and the `aoachievement.module`. The “.info” file gives information about the module to Drupal and the “.module” file is running the actual achievement script. This achievement script queries the database with the logged in users userid and builds up a HTML list (<ul>) with list items (<li>) with achievements. This list is then returned as part of the `block_view hook`. And then the achievements list is displayed on the pages where the module is activated as a block as illustrated in the figure 27. See appendix E for the code.

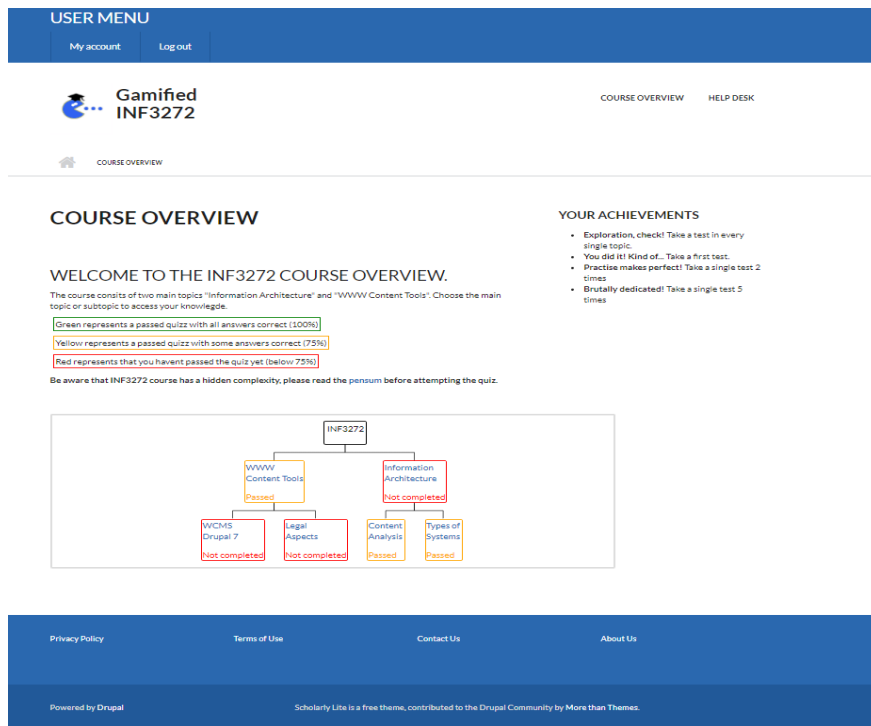


Figure 27. Course overview with implemented achievements (See Appendix section D.c for a full-page image).

## 5.6 Setting up the Onboarding.

To create an introduction tour, it was important for me that user would go to course overview page after login automatically. However, trigger action did not work with core supplied login

that is placed in the block<sup>42</sup>. I had to create custom login similar to the original as a workaround to trigger specific actions, in this case go to the specific URL. The code that I have used a slightly modified code, originally proposed by nickname: metalman as solution to named bug<sup>43</sup>.

Further, I have added an additional link called introduction to the Course overview and advised new users to start there (see figure 28). This link goes to a Quiz page where the introductory quiz is available (see figure 30). This quiz consists of 5 questions, designed to introduce the functionality from five main question types from the quiz module: true/false, short answer, multiple choice, drag and drop and matching. Matching is a final question in this quiz and users are asked to match question types with their descriptions (see figure 31).

## WELCOME TO THE INF3272 COURSE OVERVIEW.

The course consists of two main topics "Information Architecture" and "WWW Content Tools". Choose the main topic or subtopic to access your knowlegde. **First time user please start at Introduction.**

Green represents a passed quizz with all answers correct (100%)

Yellow represents a passed quizz with some answers correct (75%)

Red represents that you havent passed the quizz yet (below 75%)

Be aware that INF3272 course has a hidden complexity, please read the [pensum](#) before attempting the quiz.

## COURSE OVERVIEW

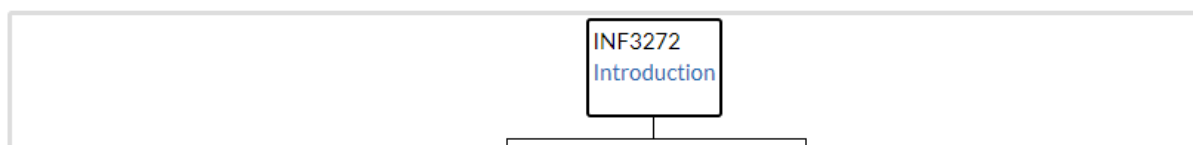


Figure 28. Introduction link at the course overview page.

<sup>42</sup> "Trigger "User Logging In" Doesn't Work With Action "Forward To URL"". 2017. *Drupal.Org*.

<https://www.drupal.org/project/drupal/issues/286668>

<sup>43</sup> "Trigger "User Logging In" Doesn't Work With Action "Forward To URL"". 2017. *Drupal.Org*.

<https://www.drupal.org/project/drupal/issues/286668>

## INTRODUCTION TO GAMIFIED INF3272 QUIZ

This is an introductory guide to the external literature guides.

- Please click on start to view the example links.
- Then click on links, notice that links are marked as viewed after you click on them
- **The guide will stay open until you close it.**

✔ Start at: [Course Overview](#)

◦ Go back to: [Introduction to gamified INF3272 quiz](#)

CLOSE GUIDE

On the left of the introductory page (see figures 29 and 30) the user finds a guide with the links, which introduce the guide with links functionality that is further used in other quizzes to guide users towards external literature links that they can study to improve on quiz performance. When clicking on the links the user is taken to those pages without leaving the tab and the guide stays open until closed. It is advised to use the guide before proceeding to the introductory quiz, however it is not mandatory.

Figure 29. Introductory guide with the links.

INTRODUCTION TO GAMIFIED INF3272 QUIZ

View Edit My results Quiz Take Revisions Convert

NOV 13 2017 By admin

QUESTIONS	5
ATTEMPTS ALLOWED	Unlimited
AVAILABLE	Always
PASS RATE	75 %
BACKWARDS NAVIGATION	Allowed

Start Quiz

INTRODUCTION TO GAMIFIED INF3272 QUIZ

This is an introductory guide to the external literature guides.

- Please click on start to view the example links.
- Then click on links, notice that links are marked as viewed after you click on them
- **The guide will stay open until you close it.**

✔ Start at: [Course Overview](#)

✔ Go back to: [Introduction to gamified INF3272 quiz](#)

CLOSE GUIDE

Figure 30. Introduction link at the course overview page (See Appendix D section D.c for a full-page image).

# INTRODUCTION TO GAMIFIED INF3272 QUIZ

[View](#) [Edit](#) [My results](#) [Quiz](#) [Take](#) [Revisions](#) [Convert](#)

Page 5 of 5

## QUESTION 5

This question type is called Matching, because you are matching between questions and predefined set of answers. Sometimes there is a penalty for guessing, which happens when you match incorrectly at first and then change your mind.

In this type of question you choose an answer between predefined choices.

multiple choice question

In this type of question you drag labels to hotspot circles to answer

drag and drop questions.

In this type of question you type short answer.

short answer question

In this type of question you match questions with answers.

matching

In this type of question you can choose between true or false as an answer.

true/false question

You lose points by selecting incorrect options. You may leave an option blank to avoid losing points.

This is the last question. Press Finish to deliver your answers

[BACK](#) [LEAVE BLANK AND FINISH](#) [FINISH](#)

Figure 31. Final matching question in the introduction quiz (See Appendix D section D.c for a full-page image).

## 5.7 Further development.

The Quiz module ("Quiz" 2017) that I have used "as is" due to time constraints, has two main shortcomings:

- There were error messages in cases where the matching and multiple-choice questions were edited after their creation. For some reason they did not update properly and either generated strange errors or scored correct answers incorrectly from time to time. I have found no solution to this bug, however, creating an identical new question is a functional workaround.
- The start quiz button is not visible enough and is redundant with "take" tab. It is advisable to revise start the quiz button by making it more obvious and to remove the tab (or vice versa). Also, the names of the tabs should be more self-explanatory.

Another important functionality for learning, that I didn't have time to implement is customizing quiz module to support ZPD, which would include adjusting difficulty

automatically based on students' performance, and enabling demonstrations, hints and help options during the quiz (see section 4.3.1).

It is also possible to use in the future another achievements module to improve upon achievements, by making them graphical<sup>44</sup>. There are still achievements that I have not implemented in the first high-fidelity prototype (see table 8 section 4.3.2). Further, it would be very helpful to create a rating system for the questions and to create contribution system, so that both questions and quality control is crowdsourced by the students themselves. Since it is an application designed for the students, it would be most logical that the students in the INF3272 should continue to improve it by themselves. This also would allow to adapt questions towards changes in the subject. See also chapter 6 section 6.4 for other improvements suggested by the students during usability testing.

Free Acquia Cloud hosting will expire after 30-day free trial, so it would be most beneficial to move the system to University hosting. There are also multiple limitations for the free version of Acquia Cloud<sup>45</sup>. Additionally, I have used Drupal version 7 for this development because the INF3272 course is about Drupal version 7, however, Drupal version 8 core has guided tour API module, that is useful as onboarding functionality<sup>46</sup>. Because it would guide the user, though the various components of the interface and elements, like achievements. It could also illustrate a workflow and give explanations for various quiz functions.

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<sup>44</sup> "Achievements". 2017. *Drupal.Org*. <https://www.drupal.org/project/achievements>

<sup>45</sup> "Getting Started with Acquia Cloud Free | Acquia Help Center". 2017. *Docs.Acquia.Com*. <https://docs.acquia.com/acquia-cloud/free>

<sup>46</sup> "Tour: Guided Tours Of The Website". 2017. *Drupal.Org*. <https://www.drupal.org/docs/8/core/modules/tour/overview>

# 6 Results.

To read how the usability testing took place see section 4.4.

There were 9 students that participated in the usability testing. Their responses were anonymized and students were numbered from 1 to 9 in random order. Transcriptions of the interviews are available in the Appendix section B.c.

## 6.1 Results of interviewing.

Key points that all of the students had a unanimous opinion about:

- All of the students found that the navigation is understandable.
- All of the students understood that the application was designed for the students.
- All of the students would use the gamified application in the future if available.
- All of the students managed to do what they wanted to do with the application (though student 9 didn't understand how the literature guide (figure 29) works, see Appendix B.c).
- All students considered gamification acceptable in higher education (see section 6.1.4 for the description of differences between student opinions).

Other:

- Four students reported initial confusion that disappeared quickly as they got more familiar with the application. The source of confusion in all cases was the quiz module. **(See section 6.4 table 16 reference [1] for details about improvements based on this statement).**
- Two students (8 and 6) stated that leaderboards would make them less motivated and in turn the gamified application less appealing.

### 6.1.1 Student's opinions regarding achievements.

7 out of 9 students liked the achievements, one didn't notice them and one meant that liking them depended on the mood or the context. One out of 7 students that liked achievements showed big excitement towards the achievements, three students related achievements towards being engaged in fun activities. Finally, one of those 7 students mentioned achievement as both goal to achieve and a reward.

### 6.1.2 Student's opinions about ethical concerns.

I have summarized student's ethical stance based on their positive, neutral or harmful outlook on the ethical issues of gamification (see table 13). Nonetheless majority of the students did not consider any issues to have particular importance. There students expressed their concerns about leaderboards in particular, one of those would like to consent for his information to be public in any way. One student was concerned with how their results data is used or stored.

Positive	Neutral	Harmful	Students
Gamification is not a harmful deception			9
	Specific disclosure is not a necessity or of any importance		8, 7, 3, 2, 1
		If any information is shared publicly in leaderboard an informed consent is required	8
There are no ethical issues if it is a method to learn			8 and 6
	Student don't need to use real names		7 and 1
	Would like to be informed about Leaderboards		6 and 4
	Some people view disclosure as a necessity		5
		If the student's results data is used it should be disclosed how it is stored, analyzed or its usage	4

Table 13. Summary of the student's opinions about the ethical concerns.



### 6.1.3 Student’s opinions regarding Gamification and self-regulated learning.

I have summarized student’s opinions based on their positive, neutral or negative outlook on the gamification of a self-regulated learning (see table 14).

Positive	Neutral	Negative	Students
Makes studying easier			1,5,8
Has a positive outlook or excited about the possibility			1, 2, 3
Self-regulation is impossible without			4
Useful			5,6
The competition encourages better effort in studying		Urge to compete or collect achievements might overshadow reflection and understanding of what is learned	7 and 6
Motivating to study			8,5,7
If addicted towards a game, the game is study related		Student might get addicted to games	5
Fun	Old learning methods are boring		5,6,9
More Mobile than books			7
	Student dislikes old methods		9

Table 14. Students opinions regarding Gamification and a self-regulated learning.

### 6.1.4 Student’s thoughts about acceptance of gamified applications in higher education.

Even though all students viewed gamification as acceptable, there were differences in their opinions. Student 8 thinks it does not always fit with the subjects and can’t be used in every single situation. Student 7 thinks that acceptance depends on the design of the gamified application. In student 4 opinion higher education is the best context to apply gamification because of student’s high autonomy and self-regulation. According to student 6 gamification should be more acceptable and taken seriously:

- Because it allows different kind of interactions between students and course material.
- New and novel learning methods have a positive outcome on motivation.

Finally, student 9 has a more practical approach and thinks that whatever works is fine.

### **6.1.5 Motivational impact of gamification.**

Students had different opinions about motivation. Students 1, 5, 6 and 9 has agreed that gamification motivates them more than normal types of learning. Students 4 and 8 stated explicitly that instant feedback from gamification was important for their motivation. On the other hand, student 3 meant it was as motivating as any other good learning method. For student 7 motivation depended more on the subject or the mood. Finally, student 2 had no opinion on the matter.

## **6.2 Observation summary.**

I observed 8 students out of 9 that participated in usability testing. Some students seemed to be more confident with application than others. Several were more adventurous and tried to click on every possible tab or link, while others carefully read every single text before proceeding. Students also were different in how they attempted the quizzes, some tried honestly to answer questions while others just skipped over.

## **6.3 Survey results.**

All 9 participants have reported that the prototype motivated them to learn (see figure 32), 4 of them strongly agreed and 5 agreed.

### After using the prototype I felt motivated to learn.

9 responses

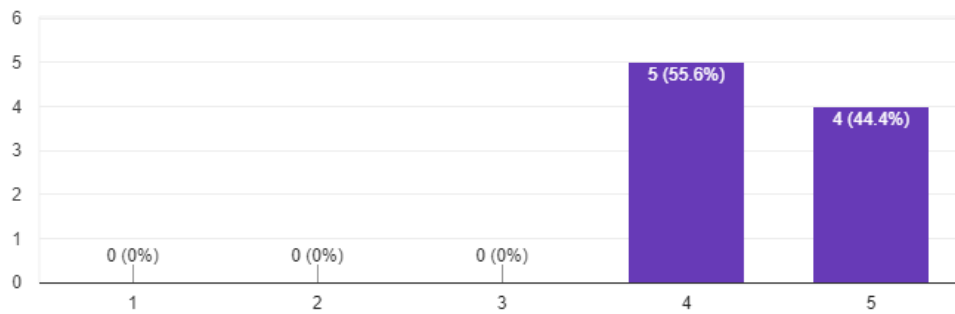


Figure 32. How motivated to learn the students felt on a scale from 1(Strongly disagree) to 5(Strongly agree) after using the prototype.

I have summarized student responses regarding students experience with the prototype in table 16. The majority of the students reported a positive experience with the prototype:

- Engaging: a lot, according to 3 students, and some, according to 4 students.
- Motivating: a lot, according to 3 students, and some, according to 6 students.
- Fun: a lot, according to 5 students, and some, according to 6 students.
- Helpful: a lot, according to 4 students, and some, according to 3 students.
- Cognitively stimulating: a lot, according to 2 students, and some, according to 7 students.
- Challenging: a lot, according to 7 students, and some, according to 4 students.
- Rewarding: a lot, according to 3 students, and some, according to 5 students.

One student has found the experience somewhat frustrating, two students found it a little frustrating and two thought that it wasn't frustrating at all. According to 5 students it was a little bit boring and two thought that it wasn't boring at all. Six students reported that it wasn't demotivating at all, while two thought that it was a little bit demotivating as illustrated in the table 15 below.

Experience qualities	A lot	Some	Neutral	Not much	None
Engaging	3	4	2	-	-
Motivating	3	6	-	-	-
Fun	5	3	1	-	-
Enjoyable	3	6	-	-	-
Helpful	4	3	1	1	-
Cognitively stimulating	2	7	-	-	-
Challenging	7	2	-	-	-
Frustrating	-	1	4	2	2
Boring	-	-	2	5	2
Demotivating	-	-	1	2	6
Rewarding	3	5	1	-	-

Table 15. Summary of student's experiences with the prototype.

Students reported following other experiences:

*“Drag n drop was fun!”*

*“Overall very quick to finish. I did not understand at first what the consequences of clicking doubtful are. Maybe a tooltip would tell me if I loose points? I would notice the achievements easier if they had some css (border f.ex.)”* (see section 6.4 table 16 reference [2] for details about improvements based on this statement).

*“interesting to play with the site and the prototype despite little to no knowledge of the course”*

*“Spelling-errors. Assumptions about the premise of certain questions. Ambiguous questions. Unnecessarily long question texts. Some correct answers could be inferred by context.”* (see section 6.4 table 16 reference [3] for details about improvements based on this statement).

All Survey responses are available in appendix C.

## 6.4 Possible improvements to the application based on student suggestions.

I have summarized improvements proposed by students in the table 16. The majority of the students would like to see Quiz module improved.

<b>Reference In text</b>	<b>Improvement</b>	<b>Type of improvement</b>	<b>Source</b>	<b>Comments</b>
[1]	Drag and drop questions need better directions.	Quiz questions	Student 1	See section 7.3.2 for the discussion
	Leaderboard as a tool to compare themselves to other students	Functionality	Students 1&7	See section 7.3.3 for the discussion
	Ccs border around achievements block	aesthetics	Student 4, survey	See section 7.3.1 for the discussion
	Long answer types of questions	Quiz questions	Student 3	It is already included in the quiz functionality (see section 5.3), which I didn't utilize in the high-fidelity prototype because they require manual scoring.
	Leaderboard to see how badly the others did	Competition aspect	Student 4	See section 7.3.3 for the discussion
[2]	Explanation of the doubtful option in quiz	Quiz	Students 4&8, survey	See section 7.3.2 for the discussion
[1]	Quiz usability (help, hints, directions etc...)	Quiz	Students 3, 7, 5, 2, survey	such options like help, hints and directions were present in my wireframes, but not implemented in high-fidelity prototype due to time constrains (see section 4.3.3).
	Better quality images in drag and drop type of questions	aesthetics	Student 5	See section 7.3.1 for the discussion
	Colors	aesthetics	Student 5	Option for color overlays was present in my wireframes, but not implemented in high-fidelity prototype due to time constrains (see section

				4.3.3) and see section 7.3.1 for the discussion
	Quiz “start” button is invisible	Quiz Visual elements	Student 6	Proposed as a further improvement in section 5.7
	Make quiz tabs more self-explanatory	Quiz Visual elements	Student 8	Proposed as a further improvement in section 5.7
[1]	More explanations for actions in quiz	Quiz	Student 8, survey	See section 7.3.2 for the discussion
	To see which achievements are possible to unlock	Achievements	Student 8	This was present in my wireframes, but not implemented in high-fidelity prototype due to time constraints (see figures 17 and 19).
[3]	Precision of language in formulations of some questions	Quality control	Student 9, survey	See section 7.3.2 for the discussion
[2]	More questions	functionality	Student 4	Proposed as crowdsourcing in section 5.7
[3]	Spelling control	Quality control	Student 9	See section 7.3.2 for the discussion
	Achieve minimalism by removing functionality aspects and visual elements	Aesthetics	Student 9	See section 7.3.1 for the discussion

Table 16. Summary of the possible improvements to the application.

# 7 Analysis and Discussion.

In this chapter I discuss my findings in relation to research questions (see section 1.3) and underlying theories of learning and gamification (see chapter 2).

My main research question was:

*What motivational impact gamification of self-regulated learning has on adults in a higher education context?*

To answer the main question, I have created two sub questions:

*How will a simple quiz based gamified tool motivate for learning in a higher education context?*

*What ethical considerations do potential users see in a simple quiz based gamified tool?*

In order to answer these three questions, I have chosen Research through Design approach (see section 3.2), where I have designed a gamified quiz application by following Interaction design and 6D gamification frameworks (see section 3.2.1). I have used several practical methods common in Interaction design: interview, survey, prototyping, document analysis and usability testing to collect my context based data for this design project. Because I have chosen interpretive research paradigm (see section 3.1), the interview was my main method for gathering subjective people's opinions about their opinions about motivation and experiences with the prototype (see section 3.3.1).

Further, I discuss and reflect on my findings in more detail.

## 7.1 Motivating students through Gamification.

The discussion about motivating students through gamification, relates to my following research questions:

- *What motivational impact gamification of self-regulated learning has on adults in a higher education context?*
  - *How will a simple quiz based gamified tool motivate for learning in a higher education context?*

On one hand students had different opinions about what exactly motivates them (see section 6.1.5) and on the other all students reported that they felt motivated after using the prototype (see section 6.3). But is it really true that gamification motivates student's more than other types of learning? Five students out of nine stated that gamification is more motivating than classroom learning (see section 6.1.5). Two of them explicitly stated that instant feedback is the main factor in their reasoning. This corresponds well with self-regulated learning theory, which emphasizes the importance of performance-based feedback (section 2.4 reference (Nicol and Dick 2005)).

Another possible explanation for why students view gamification as more motivating, may be the novelty of this method in a higher education context. This agrees with the Cognitive evaluation theory (section 2.2.1 reference (Deci and Ryan 2000)), according to which appeal of novelty has a positive effect on intrinsic motivation.

It can also be supposed that gamification seems more motivating in cases where old methods are not supporting student needs. According to Self-determination theory when basic human needs are not met, humans develop substitutes that offer some gratification (section 2.2 reference (Deci and Vansteenkiste 2004)). Student 9 in particular, has expressed that traditional methods are ill performing, rigid and boring, therefore gamification is “a decent fix” (see Appendix section B.c). This choice of words implies that gamification for this student is a substitute that fixes some issues that the student has with the older methods.

Another important issue is that computer tools are not independent entities as corroborated by Activity theory (section 2.3 reference (Rasmussen et al 2010)), in learning context, such applications will be heavily influenced by the subject or contents of the course and overall practices at the University. This point is extended by student 7 opinion that motivation depends more on the course itself (see section 6.1.5). There is also another side of interdependence, in this case the prototype and the gamification are viewed as one entity, rather than separate issues, therefore students feel motivated because they like the prototype as a whole. Which is supported by the fact that student had more positive experiences with the prototype than negative (see section 6.3).

It is a widely accepted that different people are motivated by different things, including the gamification of learning. These different types of people can be distinguished by four main types: Explorers, Creators, Competitors and Collaborators (see section 2.1.1 reference (Kim



2014)). I have also used this particular user type's distinction in my design (see section 4.2.2). It is also possible to see some of these types in the students that I have interviewed based on their interviews (see the Appendix section B.c), survey (see section 6.3) and my observations from section 6.2. Student 4 belongs to a competitor type, because the student wanted to "win" over others and see how badly they did on the leaderboards. Student 6 wanted to explore all the quizzes and to accumulate knowledge thus this student was an explorer type. Student 9 was very focused on the content of the quizzes and improve those aspects, which would place the student into creators category. There also was a major difference between how these types of students viewed leaderboards in relation to motivation. For example, Student 6 directly stated that leaderboards would be demotivating (see the Appendix section B.c), contrastingly Student 7 viewed competition as encouraging to study (section 6.1.3). The same was true for differences in how achievements were perceived, because not all students liked or noticed the achievements (see section 6.1.1). Another example is that some students found the prototype a little bit boring in the survey (see section 6.3), possibly because achievements did not appeal to them personally. Of course, another possible explanation for this boredom is the lack of balance between difficulty and student's performance, which is illustrated by the flow and ZPD comparison in figure 9 (see section 2.3.2). Finally, I observed how different were the students when they proceeded with the prototype (see section 6.2) while some read instructions, others freely explored it, which also might indicate different user types and that probably some users will not read tips and instructions, therefore some other forms of help to guide them are necessary.

It is also possible that gamification increases motivation because students are already somewhat intrinsically motivated to study according to my initial assumption (see section 4.2.1), maybe if they weren't the effect of gamification could be different.

Additionally, it is possible that students felt overall motivated because of the positive experiences that they had with the prototype. In the survey (see section 6.3) students reported engaging, fun, enjoyable and rewarding experiences. Two students reported slight demotivation, which possibly was related to the difficulty of the quizzes, because the majority of students considered the overall experience to be very challenging. Another possible explanation for students experiencing demotivation is the feeling of low perceived competency, according to the Organismic Integration theory (see section 2.2.1 reference (Deci and Ryan 2000)).

### **7.1.1 Gamification in Higher Education context.**

All students that I have interviewed considered gamification as acceptable in higher education and would use gamified applications if available (see sections 6.1 and 6.1.4). Most of the students talked about gamification being a useful method that makes studying easier or is motivating. Student 4 expressed that higher education is the best place to apply gamification (see section 6.1.4). There might be some truth in that, because students expected to self-regulate and have much more freedom of choice (see section 1.1.3), than for example in the work environment. This autonomy of choice is very important for personal growth and motivation, according to Self-determination theory (see section 2.2 reference (Deci and Vansteenkiste 2004))

Some of the students had raised certain concerns in regards to gamification. On one hand Student 5 considered gamification to be similar to serious games and was concerned with game addiction as a negative aspect, on the other the student thought that being addicted to study related game is actually a positive outcome (see section 6.1.3). Because serious games are closely connected to education, it might be common for the students to mix this concept with the gamification (see section 2.6 for the discussion about the differences between serious games and gamification). There also was a concern voiced by another student that an urge to play or to collect achievements might overshadow the learning aspects (see section 6.1.3). However, student 8 viewed achievements as study goals to work forward (see Appendix section B.c), so well-designed achievements as a goal for good performance will facilitate self-regulation nevertheless (see section 2.4 reference (Nicol and Dick 2005)).

### **7.1.2 Conclusions.**

While my population sample is too small to draw any firm conclusions, the responses indicate that students can be motivated to study more even by using quiz-based tool that is very simple visually. On one hand it is indicative that all students viewed gamification as acceptable and will use it in a higher education context, on the other some concerns in regards to gamification were raised and more research is needed to determine how to address issues like game addiction and overbearing game elements through design.

## **7.2 Ethical implications of gamification.**

There is a need for discussion about ethical considerations in relation to any new technology for learning. This relates to my research question:

*” What ethical considerations do potential users see in a simple quiz based gamified tool? ”*

Even though the majority of the students had a neutral stance regarding the ethical implications of gamification (see section 6.1.2). Some students expressed concern about their personally identifiable information. Students 7 and 1 thought that it would be best to have anonymous names while using the application, while in student 8 opinion if identifiable information like real name is shared in a public leaderboard then informed consent is required. Though according to students 4 and 6 simply being informed about leaderboards is enough. It was my key design decision not to implement leaderboards in my design (see 4.2.2), however, it is possible to make an opt in and out function for a leaderboard if such functionality added in the future based on students improvement suggestions (see section 6.4) , as well as make a special disclosure about the public leaderboard through privacy policy.

Another key consideration, according to the student 4 is the disclosure about how the student’s results data is stored or used. This disclosure can also be added in the privacy policy. Finally, any personally identifiable information should be handled according to the Norwegian law (personopplysningsloven).

While students had certain ethical concerns related to personally identifiable information or student’s results data, these concerns can be addressed through careful design and privacy policy formulations.

## **7.3 Further improvements of the prototype.**

It is possible to conclude that the high-fidelity prototype’s functionality was good overall, because all of the students understood the navigation and managed to do with the prototype what they wanted (see section 6.1). Additionally, the majority of the students described the experience with the prototype as positive (see section 6.3). Further the improvement aspects suggested by students in section 6.4 are discussed in more detail.

### **7.3.1 Aesthetics.**

According to the gamification definition by Karl Kapp (see section 2.1 reference (Kapp 2012)), aesthetics plays important role in engagement and user experience. According to students (see section 6.4) there was a need for better quality images in drag and drop type of questions, which also should be crowdsourced by the students themselves as proposed in section 5.7. Student 5 wanted to see more colors, which is possible with color overlays that I envisioned for my design (see section 4.3.3), additionally color also can be introduced by making achievement's graphical images as mentioned in section 5.6.

Additionally, students mentioned a CSS border around the achievements block, which can be added during further development. Finally, Student 9 proposed a minimalist style, which in my opinion is already present in the high-fidelity prototype.

### **7.3.2 Improvements to the quiz module.**

The majority of the issues that student had with the prototype were related to the Quiz module (see section 6.4). I had to use the Quiz module as is due to time restraints, even though it had issues with bugs and usability (see section 5.7). There is a need for some quality control for the issues like spelling or formulations of the questions according to the survey and student 9 (see sections 6.3 and 6.4), which I have proposed should be done by the students themselves in the future (see section 5.7).

Additionally, because some students reported initial confusion with the prototype (see section 6.1), a guided tour (see section 5.7 for the discussion) that would show the different functions of the prototype and quiz functionality would be useful as onboarding (see section 2.3.1). Because some functions in a quiz like doubtful had no explanations(see section 6.4), there should be a special tooltip container with explanatory text, which can be simply implemented with CSS.

In the survey one of the students commented that some correct answers could be inferred from the context (see section 6.3). However, this actually was intentional in the matching questions (see section 5.6 ). For example, in figure 31, the context acts like demonstration (see section 2.3.1) and by reading such descriptions students also repeats learned material.

### **7.3.3 Additional game elements for gamification.**

There was some disagreement between students regarding leaderboards, some students wanted this game element (students 1 and 7 as feedback, and 4 as competition), however others directly opposed (student 8 and 6) (see sections 6.1 and 6.4). Additionally, there were ethical concerns in relation to the leaderboards, see previous section 7.2 for the discussion. In my opinion the function that tells a student how their performance relates to the average performance is better suited for this type of the project than the leaderboard (see 4.2.2).

## **7.4 Practical limitations of this project.**

The major limitation of this study was a time factor. Normally a master thesis this size is done over two semesters, however, due to circumstances I had to complete it in one semester. Obviously, when I had less time I had to prioritize and choose the most practical approaches to get things done. For example, in the design process I have chosen to make initial assumptions about the students instead of spending time interviewing them and talking to the user group (see section 4.2). This was sort of a gamble, since I could have gone completely wrong way about the prototype, because I didn't have a fact-based picture about what the students wanted from the gamification. I think the reason why this gamble worked out well is because gamification is a novel approach, so students don't have that much of prior expectations to begin with.

Another limitation was limited experience in coding Drupal modules and no prior PHP knowledge. This substantially limited the complexity of a high-fidelity prototype, obviously I could only do the most doable solutions. Developing everything from scratch takes a lot of time, which I didn't have. So, I had to utilize shortcuts and workarounds as much as I could. Therefore, I used the quiz module, which was great solution practically, but requires improvements that were beyond the scope of my technical ability (see section 5.7).

Time factor also affected my data collection, more precisely, it affected how I transcribed the interviews, since transcription of interviews takes a lot of time, and I have only transcribed shortened and condensed versions of what the people said (see section 3.3.1). Which also means that there is a possibility that I have missed on some issues simply because I didn't notice them when initially transcribing.

Another consideration is actually my chosen user group, which were students at the department of informatics. Because the students had a strong technical background, they

weren't affected by me observing them and had an idea what does a testing of prototype implies. So, they tried everything by themselves, without being overwhelmed or requiring a lot of support. I think that students with less technical background would have a harder time understanding what gamification is or maybe even how to use the prototype. It would be interesting to see what kind of effect a gamification has on someone who has no prior knowledge about it. Nevertheless, bachelor students from the department of informatics are in fact the intended user group for this project.

Finally, due to usability testing being done in November, a hectic time amidst preparations for the exams, and only 9 students participated in the usability testing. Therefore, there is a limited representability of such small sample.

## **7.5 Scope for further work.**

Although the data seems to support that gamification is highly motivating for adults in higher education context, different research methods, including bigger population sampling, would be beneficial to continue to explore effects of gamified learning on adults.

Through analysis of my findings I have concluded that there is a need to further research how to address gamification issues like game addiction and overbearing game elements through design (see section 7.1.1).

Another possible research directions that I didn't have time to conduct could be:

- How to design graphical representations of achievement's to be engaging (discussed in section 7.3.1).
- How to design gamified crowdsourced quality control systems (see section 5.7).
- How to design for ZPD, which I have discussed it in the section 4.3.1, however, because I used the quiz module as is, this requires further development (see section 5.7).
- How to design guiding and support for users who like to explore on their own and don't read instructions or hints (discussed in section 7.1).
- How to design color overlays for dyslexia and visual stress relief (discussed in section 4.3.3).

## 8 Conclusion.

My main aim in this study was to address how gamification motivates self-regulated learning in adults. I have done so by research through the design of a gamified quiz-based tool.

Accordingly, the first major contribution are the practical insights into the act of designing a specific solution situated in the higher education context. During the making of the prototype artefact I have faced opportunities and constrains, implications of theoretical knowledge and confronted the realities of the Drupal technology. By developing, I have also gained a practical understanding about how to implement gamification to increase motivation in students. Finally, I have learned that gamification has a positive impact on motivation in a higher education context. The results from usability testing suggest that there is a demand for gamified solutions among students.

Working with a free software like Drupal has been both challenging and rewarding. On one hand, there was a lack of a quality control and in some cases documentation, on the other there was an availability of premade code and freedom to adapt it towards own use. I also found Drupal frustrating at times, because there were not enough documentation or support for beginner developers. The learning curve is quite steep, so when people do develop they assume they don't need to document a basic thing about how to actually use their modules practically. If you need to extend Drupal core functionality, you need to do so by means of a rigid API.





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# Appendix

## A. Consent Forms

### a. Consent Form Template.

#### INFORMED CONSENT FORM FOR MA THESIS

**Date:**

**Study Topic:** Gamification of Learning & Instruction.

**Researcher:** Alisa Odincova, MA candidate, Graduate Program in Informatics: Design, Use, Interaction.  
Department of Informatics. University of Oslo.

**Purpose of the Research:** Educational purposes.

**What You Will Be Asked to Do in the Research:** You might be asked to participate in the interviews, surveys or to evaluate design solutions.

**Risks and Discomforts:** I do not foresee any risks or discomforts from your participation in this particular research.

**Voluntary Participation:** Your participation in the study is completely voluntary and you may refuse to answer any question or choose to stop participating at any time.

**Withdrawal from the Study:** You can stop participating in the study at any time, for any reason, if you so decide.

**Confidentiality:** All information you supply during the research will be held in confidence and, unless you specifically indicate your consent, your name will not appear in any report or publication of the research.

**Questions about the Research:** If you have questions about the research in general or about your role in the study, please feel free to contact Alisa Odincova, Telephone number: +4796018615, email: [alisao@ifi.uio.no](mailto:alisao@ifi.uio.no), MA candidate in Informatics: Design, Use, Interaction at Department of Informatics. University of Oslo, Gaustadalléen 23 B 0373 Oslo Norway, email: [administrasjon@ifi.uio.no](mailto:administrasjon@ifi.uio.no).

If you have any questions about this process, or about your rights as a participant in the study, please contact Supervisor Gisle Hannemyr at Department of Informatics University of Oslo Postboks 1080 Blindern 0316 OSLO, e-mail: [gisle@ifi.uio.no](mailto:gisle@ifi.uio.no).

#### Signed Consent Statement:

I consent to participate in MA candidate project conducted by Alisa Odincova. I have understood the nature of this project and wish to participate. My signature below indicates my consent.

**I allow for my real name to be used in the report:** Yes No  
(please draw a circle around the answer)

Signature  
Participant

Date

Signature      —

Date

## b. Signed Consent forms

### INFORMED CONSENT FORM FOR MA THESIS

Date:

**Study Topic:** Gamification of Learning & Instruction.

**Researcher:** Alisa Odincova, MA candidate, Graduate Program in Informatics: Design, Use, Interaction. Department of Informatics. University of Oslo.

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**I allow for my real name to be used in the report:** Yes No  
(please draw a circle around the answer)

**Signature** gisle **Date** 2017-09-14  
Participant

**Signature** [Signature] **Date**  
Researcher



**INFORMED CONSENT FORM FOR MA THESIS**

**Date:** 24-10-2017

**Study Topic:** Gamification of Learning & Instruction.

**Researcher:** Alisa Odincova, MA candidate, Graduate Program in Informatics: Design, Use, Interaction. Department of Informatics. University of Oslo.

**Purpose of the Research:** Educational purposes.

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**I allow for my real name to be used in the report:** Yes  No   
(please draw a circle around the answer)

**Signature** [Redacted]  
Participant

**Date** 24-10-2017

**Signature** [Handwritten]  
Researcher

**Date** 24-10-2017

**INFORMED CONSENT FORM FOR MA THESIS**

**Date:** 8-11-2017

**Study Topic:** Gamification of Learning & Instruction.

**Researcher:** Alisa Odincova, MA candidate, Graduate Program in Informatics: Design, Use, Interaction. Department of Informatics. University of Oslo.

**Purpose of the Research:** Educational purposes.

**What You Will Be Asked to Do in the Research:** You might be asked to participate in the interviews, surveys or to evaluate design solutions.

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**I allow for my real name to be used in the report:**  Yes  No  
(please draw a circle around the answer)

**Signature**   
Participant

**Date** 8-11-2017

**Signature**   
Researcher

**Date** 8-11-2012

**INFORMED CONSENT FORM FOR MA THESIS**

Date: 15/11-17

**Study Topic:** Gamification of Learning & Instruction.

**Researcher:** Alisa Odincova, MA candidate, Graduate Program in Informatics: Design, Use, Interaction. Department of Informatics. University of Oslo.

**Purpose of the Research:** Educational purposes.

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**I allow for my real name to be used in the report:**  Yes  No  
(please draw a circle around the answer)

**Signature** [Handwritten Signature] **Date** 15/11-17  
Participant

**Signature** [Handwritten Signature] **Date**  
Researcher

**INFORMED CONSENT FORM FOR MA THESIS**

Date: 19-11-17

**Study Topic:** Gamification of Learning & Instruction.

**Researcher:** Alisa Odincova, MA candidate, Graduate Program in Informatics: Design, Use, Interaction. Department of Informatics. University of Oslo.

**Purpose of the Research:** Educational purposes.

**What You Will Be Asked to Do in the Research:** You might be asked to participate in the interviews, surveys or to evaluate design solutions.

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**Signed Consent Statement:**

I consent to participate in MA candidate project conducted by Alisa Odincova. I have understood the nature of this project and wish to participate. My signature below indicates my consent.

**I allow for my real name to be used in the report:** Yes  No   
(please draw a circle around the answer)

Signature \_\_\_\_\_  
Participant

Date 19/11/2017

Signature \_\_\_\_\_  
Researcher

Date

**INFORMED CONSENT FORM FOR MA THESIS**

**Date:** 14.11.17

**Study Topic:** Gamification of Learning & Instruction.

**Researcher:** Alisa Odincova, MA candidate, Graduate Program in Informatics: Design, Use, Interaction. Department of Informatics. University of Oslo.

**Purpose of the Research:** Educational purposes.

**What You Will Be Asked to Do in the Research:** You might be asked to participate in the interviews, surveys or to evaluate design solutions.

**Risks and Discomforts:** I do not foresee any risks or discomforts from your participation in this particular research.

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(please draw a circle around the answer)

**Signature** Participant David Kulezko

**Date** 14.11.17

**Signature** Researcher 

**Date**

**INFORMED CONSENT FORM FOR MA THESIS**

**Date:** 14. 11. 2017

**Study Topic:** Gamification of Learning & Instruction.

**Researcher:** Alisa Odincova, MA candidate, Graduate Program in Informatics: Design, Use, Interaction. Department of Informatics. University of Oslo.

**Purpose of the Research:** Educational purposes.

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**Signature** Robin Pedersen  
Participant

**Date** 14 nov 2017

**Signature** [Handwritten Signature]  
Researcher

**Date**

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## **B. Interview Transcriptions.**

### **a. Initial interview with the course teacher.**

Question (Q): Why are you teaching this particular course at university of Oslo?

Gisle has personal interest in particular web design. He felt that Design group at Department of Informatics (UiO) should have some web design course.

(Q): What do you think is the most basic knowledge that students should acquire during your course?

He referenced particular slides with his teaching goals. Students need to understand:  
the concept of Information Architecture (IA).  
Context, users and information aspects and their relations.  
User experience can be designed by information architecture.  
Users, user behaviors and how to organize things so that users find information easily.  
Practical knowledge is important too. CMS with Information architecture. Drupal from Information architecture perspective: taxonomy, navigation. Drupal is boring, but good for teaching information architecture.

(Q): What would an average C student know?

Explain all the key terms, understand the terminology and taxonomy of web publishing.  
Basic knowledge about prototyping: paper, wireframes etc. all prototyping tools are ok.  
Should be able to translate prototypes into Drupal graphical interface. Not theming or modules.  
Blocks: turn on and turn off & create new blocks, create new content types, through graphical interface (not code) and get those things together into functional website.  
Sub Theme bootstrap-like.

(Q): What would be the most advanced knowledge for an A student for example?

Theming (not from scratch) mobile responsive framework not looking like bootstrap.  
Security. Very few can create own modules, but it's not a goal of the course.

(Q): Why did some student fail the course?

No idea why they failed, didn't have basic knowledge about key concepts. No grades in the course, but if it was graded most are c or better. Last year students who failed did it by huge margin, they said "we misunderstood what have been required". They failed all the questions, probably read all the wrong stuff. Failed to explain "content, users and context" "graph which is the most basic term that is repeated most during the course.

(Q): In your opinion what topic were the most difficult for students?

Need more details to pinpoint most difficult. Most have little prior knowledge so mostly it is equally difficult. However, he doesn't really know, needs build in teaching analytics to have the data to tell that.

(Q): How was your lecture attendance during the course this year?

Do you think some that some students lack motivation to come to lectures?

No monitoring of attendance, students who failed were at all lectures.

(Q): Did some students have trouble with group work?

Some frictions within groups, because not all did the work. They weren't allowed to take exam.

(Q): Was there any other particular problems with assignment deliveries?

Students complain about understanding assignments all the time. Hard to please everybody.

(Q): How did you think to use this student learning project?

Used for pleasure, fun, immersive experience. Feedback for students themselves, not as assessment tool

(Q): What is desired end result in your opinion for this type of feature?

Achievement, "explosions or fireworks".

(Q): If this project could solve a problematic issue for you what would it be?

Students doesn't understand hidden complexity

## **b. Interviews for Wireframe Evaluation.**

### **i. Interview with the Student A**

Question (Q): After project explanation: What functionality do you expect from this type of quiz application?

Student expects this application to assess whether or not he is prepared, and to be alerted about the hidden complexity.

Wireframe A

(Q): Do you understand this wireframe? Can you describe what you think you are able to do here?

Student describes logged in instance, course and different aspects broken down into sub subjects. Student liked that this wireframe most because it was easy and simple.

(Q): Is this wireframe similar to what you expected to see or is there anything missing?

Student thinks that it needs better visual way to pinpoint lacking knowledge areas.

It is fair course overview, however student was concerned with the case when someone done all tests and still failed the exams.

Wireframe B

(Q): Do you understand this wireframe? Can you describe what you think you are able to do here?

The student found this slide difficult to understand the purpose of this slide, can't connect different areas together. However, he liked progress bar. Doesn't understand what he is supposed to do.

(Q): Is this wireframe similar to what you expected to see or is there anything missing?

Achievements or some of them should be visible on slide A. Would like to see how the student compares to average students' performance.

(Q): If you could change any features what would you change?

Move feedback aspects over to the wireframe A. Make it less confusing

Wireframe C

(Q): Do you understand this wireframe? Can you describe what you think you are able to do here?

Student described answers, legal aspects, questions, understood that he has to select the correct answer. Different types of questions were difficult to understand and something was missing, because there was no apparent connection. Student understood the wireframe, but not its purpose.

(Q): Is this wireframe similar to what you expected to see or is there anything missing?

Result page is missing.

(Q): In your opinion do any features seem strange or unnecessary?

Answers shouldn't be given, so that students learn on their own.

(Q): If you could change any features what would you change?

Not tied together enough.

(Q): Will you use this application when it's finished?

The student will use the application and considers it's cool

## **ii. Interview with the Student B**

Question (Q): After project explanation: What functionality do you expect from this type of quiz application?

The student expects it to have easy interface and similar to something he/she already knows. On the pc student expects to be able to use it with a mouse.

Wireframe A

(Q): Do you understand this wireframe? Can you describe what you think you are able to do here?

The student tried to describe it, but he/she didn't understand that content tools were also a part of the course and thought that Information architecture was the main topic to learn about, while content tools were part of functionality.

(Q): Is this wireframe similar to what you expected to see or is there anything missing?

It was as the student expected.

(Q): In your opinion do any features seem strange or unnecessary?

Nothing.

(Q): If you could change any features what would you change?

It's fine.

Wireframe B

(Q): Do you understand this wireframe? Can you describe what you think you are able to do here?

The student understood the functionality of the wireframe.

Is this wireframe similar to what you expected to see or is there anything missing?

It was as expected.

In your opinion do any features seem strange or unnecessary?

Nothing seemed strange.

If you could change any features what would you change?

The student considered help button unclear, if it was for the quiz or for the application. Help for the website she envisions as a tips.

(Q): Will you use this application when it's finished?

The student will use the application once it's finished.

## C. Interviews for Usability testing.

### i. Student 1

Question (Q): *Was anything confusing while testing the prototype?*

The student has found drag and drop questions slightly confusing, rest was intuitive according to the student.

(Q): *Was navigation understandable?*

Student agreed.

(Q): *Do you get a feeling that this application was designed for students?*

Student said that it was understandable that it was designed for the students because there was specified particular course and course overview equally conveyed the course contents.

(Q): *Did you manage to do everything you wanted to do?*

Student expressed they managed to do everything, except he/she didn't try to take the course again.

(Q): *Will you use this kind of application in the future?*

The student strongly mentioned that he/she will use this kind of application in the future.

(Q): *Did you like the achievements?*

The student has excitedly agreed.

(Q): *Would you like to add some other aspects to the prototype?*

Student would like to have a leaderboard of the achievements or points. Though mainly as a tool to compare themselves to other students.

*This application uses gamification mechanisms to motivate students to learn:*

(Q): *Do you think that you should have been specifically informed about that out of ethical concerns?*

The student thought that how one does in the system should be somewhat anonymous. Other than that student doesn't see specific disclosure as a necessity or of any importance.

(Q): *What do you think about using gamification to support self-regulated learning?*

It is a lot easier than forcing her/himself to go through sets of questions over and over again.

(Q): *Do you think that game inspired applications are acceptable in higher education context?*

The student was excited about the possibility to have some.

(Q): *Do you think that gamification motivates you more compared to normal type of learning?*

The student had agreed.

## ii. Student 2

(Q): *Was anything confusing while testing the prototype?*

It was confusing for the student in the beginning because he/she didn't understand what they were supposed to do. But once he/she realized it's a quiz, it became fine.

(Q): *Was navigation understandable?*

It was easy for the student.

(Q): *Do you get a feeling that this application was designed for students?*

Student got the feeling that it was designed for the students.

(Q): *Did you manage to do everything you wanted to do?*

The student wasn't sure.

(Q): *Will you use this kind of application in the future?*

Student said that many courses already use some type of quiz applications.

(Q): *Did you like the achievements?*

The student didn't notice the achievements.

(Q): *Would you like to add some other aspects to the prototype?*

Student didn't have any suggestions.

*This application uses gamification mechanisms to motivate students to learn:*

(Q): *Do you think that you should have been specifically informed about that out of ethical concerns?*

Student didn't think it was an issue.

(Q): *What do you think about using gamification to support self-regulated learning?*

Student was very positive about using the gamification.

(Q): *Do you think that game inspired applications are acceptable in higher education context?*

The student thought that gamified application is absolutely acceptable.

(Q): *Do you think that gamification motivates you more compared to normal type of learning?*

The student didn't have an opinion about that.

## iii. Student 3

(Q): *Was anything confusing while testing the prototype?*

The quizzes didn't have enough guidelines and guidance.

(Q): *Was navigation understandable?*

Student has understood the navigation.

(Q): *Do you get a feeling that this application was designed for students?*

Student has understood that the application was designed for the students.

(Q): *Did you manage to do everything you wanted to do?*

Student expressed that they managed to do everything.



(Q): *Will you use this kind of application in the future?*  
The student will use this type of application in the future.

(Q): *Did you like the achievements?*  
Student agreed.

(Q): *Would you like to add some other aspects to the prototype?*  
Student would like to add long answer type of quiz questions.

*This application uses gamification mechanisms to motivate students to learn:*

(Q): *Do you think that you should have been specifically informed about that out of ethical concerns?*  
Student has answered “No”.

(Q): *What do you think about using gamification to support self-regulated learning?*  
Student has answered “Yes”.

(Q): *Do you think that game inspired applications are acceptable in higher education context?*  
Student has answered “Yes”.

(Q): *Do you think that gamification motivates you more compared to normal type of learning?*  
Student thinks that gamification is it a very good learning method.

#### **iv. Student 4**

(Q): *Was anything confusing while testing the prototype?*  
The doubtful feature of the quiz was confusing.

(Q): *Was navigation understandable?*  
The navigation was understandable because of the diagram in the course overview.

(Q): *Do you get a feeling that this application was designed for students?*  
The student got the feeling that it was designed for the students because of the course code and text elements, that students are used to read.

(Q): *Did you manage to do everything you wanted to do?*  
The student said “yes”.

(Q): *Will you use this kind of application in the future?*  
The student will use this kind of application in the future.

(Q): *Did you like the achievements?*  
Student would like to see a css border around achievement block like with course overview.

(Q): *Would you like to add some other aspects to the prototype?*

It would be fun for this student to add leaderboards to see how badly the others did.

*This application uses gamification mechanisms to motivate students to learn:*

(Q): *Do you think that you should have been specifically informed about that out of ethical concerns?*  
Students thought that he/she should have been informed in cases when there were leaderboards or if the students results data was used in any way, if stored and how, if they are analyzed in any way.

(Q): *What do you think about using gamification to support self-regulated learning?*  
Student stated that there is no other way to do self-regulated learning, other than gamification.

(Q): *Do you think that game inspired applications are acceptable in higher education context?*  
Student thinks that higher education is the best context to apply game inspired applications, because students are generally more trusted to self-regulate and get more autonomy, than in work environments.

(Q): *Do you think that gamification motivates you more compared to normal type of learning?*  
Instant feedback is very important to this student's motivation.

## **v. Student 5**

(Q): *Was anything confusing while testing the prototype?*  
For this student It wasn't difficult rather unknown at first, but the student got very fast used to the prototype.

(Q): *Was navigation understandable?*  
The navigation was understandable and gave a good overview.

(Q): *Do you get a feeling that this application was designed for students?*  
The student understood that the application is intended for students and thinks it looks very good.

(Q): *Did you manage to do everything you wanted to do?*  
The student only tested two quizzes, but it worked well.

(Q): *Will you use this kind of application in the future?*  
If such application was available for the subject that he/she is taking, the student would use it to train for the exam.

(Q): *Did you like the achievements?*  
The students thought that achievements were a lot of fun.

(Q): *Would you like to add some other aspects to the prototype?*  
The student would improve upon quiz usability as well as adding better images and maybe some colors.

*This application uses gamification mechanisms to motivate students to learn:*  
(Q): *Do you think that you should have been specifically informed about that out of ethical concerns?*  
In student's opinion it is necessary for some people.

(Q): *What do you think about using gamification to support self-regulated learning?*  
The student thinks that in his/her case the such applications like prototype, would be very useful.

(Q): *Do you think that game inspired applications are acceptable in higher education context?*  
Student thinks game inspired applications are fun and if a student gets addicted to the game, it is good that such game is related to the subject.

(Q): *Do you think that gamification motivates you more compared to normal type of learning?*

The student thinks that gamification is a good solution, it is much better than sitting at home alone and is more motivating and easier. Sometimes the student has trouble finding things online, however this prototype had all the relevant literature in one place.

## vi. Student 6

(Q): *Was anything confusing while testing the prototype?*

As the student was using the prototype in the beginning he/she needed to read text to understand, but as he/she proceeded it became less confusing.

(Q): *Was navigation understandable?*

The student said “yes”.

(Q): *Do you get a feeling that this application was designed for students?*

The student got the feeling that it was for the students because of the course description and guide links.

(Q): *Did you manage to do everything you wanted to do?*

The student couldn't explore other quizzes because he/she had time constraints and because it would be hard for the student to complete all quizzes due to lacking knowledge about the course. But it would be interesting for this student to learn the subject anyways.

(Q): *Will you use this kind of application in the future?*

The student would use this kind of application if it was for any of the courses he/she is taking. In student's opinion it is a fun way to practice for the tests and exam. It will be very useful to use it to summarize after the course and during the course to test understanding after the lectures.

(Q): *Did you like the achievements?*

Student liked the achievements because they brought fun aspect to the prototype.

(Q): *Would you like to add some other aspects to the prototype?*

According to the student the start quiz button was invisible compared to the guide buttons and should be made more visible.

*This application uses gamification mechanisms to motivate students to learn:*

(Q): *Do you think that you should have been specifically informed about that out of ethical concerns?*

The student feels that it is obvious that the application is designed for learning and is attempt of gamification of learning. For this student leaderboard would make this application less motivating, because now it is oriented towards self-regulated learning. But for students who like and used to leaderboards it might be motivating. If there is a leaderboard the student would like to be informed about that.

(Q): *What do you think about using gamification to support self-regulated learning?*

The student feels that urge to simply get the achievements and everything right, might overshadow reflection and understanding of what is being learned. Even though the achievement and application were fun.

(Q): *Do you think that game inspired applications are acceptable in higher education context?*

According to this student it should be more acceptable because it allows for different type of interaction between students and the course material. Traditional methods of learning like reading and making notes has become stale and static, so introducing new and novel aspect would have positive outcome on the motivation. Because it would be beneficial it should be taken seriously.

(Q): *Do you think that gamification motivates you more compared to normal type of learning?*

Personally, for this student it is a “yes”, while normal ways are boring and hard to get started with.

### **vii. Student 7**

(Q): *Was anything confusing while testing the prototype?*

Everything was clear for the student.

(Q): *Was navigation understandable?*

The student said: yes.

(Q): *Do you get a feeling that this application was designed for students?*

It was for clear for the student, because there where article links and questions related to course content.

(Q): *Did you manage to do everything you wanted to do?*

The student managed to everything.

(Q): *Will you use this kind of application in the future?*

If accessible then the student would use.

(Q): *Did you like the achievements?*

Yes and no, for this student it depended on the subject they took quiz in.

(Q): *Would you like to add some other aspects to the prototype?*

The student would like to have hints for the questions.

*This application uses gamification mechanisms to motivate students to learn:*

(Q): *Do you think that you should have been specifically informed about that out of ethical concerns?*

No. even if there were leaderboard it wouldn't matter, because one could use it to see how he is compared to others. Besides student don't need to use real name, if there was a real name used it would concern more those who care what others think.

(Q): *What do you think about using gamification to support self-regulated learning?*

The student thinks it's a cool idea, because it motivates and “wakes up the sparkle” for the competition and one probably would do better effort on the quiz.

(Q): *Do you think that game inspired applications are acceptable in higher education context?*

It depends on how the game design or the application is created, “flying talking unicorn” explaining the staff would be ridiculous, though maybe some people would be more intrigued.

(Q): *Do you think that gamification motivates you more compared to normal type of learning?*

According to the student motivation depends on the subject and the mood, however gamification could motivate and is also more mobile than a book, so one could use the application on the smartphone (multitasking).

### **viii. Student 8**

(Q): *Was anything confusing while testing the prototype?*

The student was a bit confused with extended literature guide in the introductions, but it made more sense with other quizzes. The student also was expecting the course overview to be a home page.

(Q): *Was navigation understandable?*

The student would change quiz tabs names to “take quiz” and “view quiz results”. The student clicked on take button assuming it was for taking the quiz but he/she wasn't 100% sure.

(Q): *Do you get a feeling that this application was designed for students?*

The student said: yes.

(Q): *Did you manage to do everything you wanted to do?*

The student managed to do everything even in cases when he wasn't sure about some actions.

(Q): *Will you use this kind of application in the future?*

The student will use this kind of application if he is taking a course where it is available.

(Q): *Did you like the achievements?*

The student liked the achievement and though it would be nice to see which achievement he hasn't achieved yet, so that he could work towards achieving them. They give the student a nice reward.

(Q): *Would you like to add some other aspects to the prototype?*

The student would like to have some way of communicating with the teacher.

*This application uses gamification mechanisms to motivate students to learn:*

(Q): *Do you think that you should have been specifically informed about that out of ethical concerns?*

The student doesn't think that there is an ethical issue if the application is available as a method to learn, however if scores or other student information is used in public leaderboard then the student should be able to give consent. In student's opinion the leaderboard might discourage some people from using the application.

(Q): *What do you think about using gamification to support self-regulated learning?*

Student thinks it helps more than normal way of just having various links to read, because tests and rewards would help him to actually read all of those links.

(Q): *Do you think that game inspired applications are acceptable in higher education context?*

In student's opinion it is acceptable, though it can't be used in every single situation and not always fit with the subject.

(Q): *Do you think that gamification motivates you more compared to normal type of learning?*

For this student it was very motivating to get self-tested and see the feedback, that gives opportunity to check what one is supposed to know.

## **ix. Student 9**

(Q): *Was anything confusing while testing the prototype?*

This student wishes for more precision of language in the formulations of some questions.

(Q): *Was navigation understandable?*

In this student's opinion It could have been more elegant by having less visual elements.

(Q): *Do you get a feeling that this application was designed for students?*

This student thinks that it is for anyone willing to learn and that a specific course is a barrier towards outsider participation.

(Q): *Did you manage to do everything you wanted to do?*

There was a "return to courses" button (or similar) that didn't work. It gave the student a green "checked" symbol.

(Q): *Will you use this kind of application in the future?*

The student said: yes.

(Q): *Did you like the achievements?*

The student didn't achieve anything, but thinks that tracking progress in that way was good.

(Q): *Would you like to add some other aspects to the prototype?*

Nothing that a student can think of, student advised to remove aspects according to UNIX philosophy.

*This application uses gamification mechanisms to motivate students to learn:*

(Q): *Do you think that you should have been specifically informed about that out of ethical concerns?*

The student doesn't regard gamification as a harmful deception.

(Q): *What do you think about using gamification to support self-regulated learning?*

Student likes self-regulated learning and thinks Gamification is a good idea, because the student is sick of wasting time with ill-performing lecturers.

(Q): *Do you think that game inspired applications are acceptable in higher education context?*

In student's opinion whatever the method works should be used, regardless of silly connotations.

(Q): *Do you think that gamification motivates you more compared to normal type of learning?*

According to the student the normal type of learning is rigid and boring, therefore gamification is a conceivably decent fix.

# C. Usability testing survey responses.

18.11.2017

Usability testing of developed hi-fidelity prototype.

## Usability testing of developed hi-fidelity prototype.

Participation is voluntary and anonymous.

After using the prototype I felt motivated to learn.

	1	2	3	4	5	
Strongly disagree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	Strongly agree

Which of the following qualities describe your experience with the prototype?

	A lot	Some	Neutral	not much	None at all
Engaging	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
Motivating	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Fun	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Enjoyable	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Helpful	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Cognitively stimulating	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Challenging	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Frustrating	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>
Boring	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
Demotivating	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>
Rewarding	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

<https://docs.google.com/forms/d/1kxNYf4TxuW4YHXe7hgG6PFdpWjVaisFFf2m94Bgsww/edit#responses>

1/18

Any other experiences with the prototype that you would like to share?

Drag n drop was fun!

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## Usability testing of developed hi-fidelity prototype.

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After using the prototype I felt motivated to learn.

	1	2	3	4	5	
Strongly disagree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	Strongly agree

Which of the following qualities describe your experience with the prototype?

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Motivating	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Fun	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Enjoyable	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Helpful	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
Cognitively stimulating	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Challenging	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Frustrating	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
Boring	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
Demotivating	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
Rewarding	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Any other experiences with the prototype that you would like to share?

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After using the prototype I felt motivated to learn.

	1	2	3	4	5	
Strongly disagree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	Strongly agree

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Helpful	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Cognitively stimulating	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Challenging	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Frustrating	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
Boring	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>
Demotivating	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>
Rewarding	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Any other experiences with the prototype that you would like to share?

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	1	2	3	4	5	
Strongly disagree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	Strongly agree

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Fun	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
Enjoyable	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
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Cognitively stimulating	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Challenging	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Frustrating	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
Boring	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
Demotivating	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>
Rewarding	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

### Any other experiences with the prototype that you would like to share?

Overall very quick to finish. I did not understand at first what the consequences of clicking doubtful are. Maybe a tooltip would tell me if I loose points? I would notice the achievements easier if they had some css (border f.ex.)

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After using the prototype I felt motivated to learn.

	1	2	3	4	5	
Strongly disagree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	Strongly agree

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Motivating	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
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Enjoyable	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Helpful	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Cognitively stimulating	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Challenging	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Frustrating	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
Boring	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
Demotivating	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>
Rewarding	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Any other experiences with the prototype that you would like to share?

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After using the prototype I felt motivated to learn.

	1	2	3	4	5	
Strongly disagree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	Strongly agree

Which of the following qualities describe your experience with the prototype?

	A lot	Some	Neutral	not much	None at all
Engaging	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Motivating	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Fun	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Enjoyable	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Helpful	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Cognitively stimulating	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Challenging	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Frustrating	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
Boring	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
Demotivating	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
Rewarding	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Any other experiences with the prototype that you would like to share?

interesting to play with the site and the prototype despite little to no knowledge of the course

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## Usability testing of developed hi-fidelity prototype.

Participation is voluntary and anonymous.

After using the prototype I felt motivated to learn.

	1	2	3	4	5	
Strongly disagree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	Strongly agree

Which of the following qualities describe your experience with the prototype?

	A lot	Some	Neutral	not much	None at all
Engaging	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Motivating	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Fun	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Enjoyable	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Helpful	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Cognitively stimulating	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Challenging	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Frustrating	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Boring	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
Demotivating	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
Rewarding	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>

Any other experiences with the prototype that you would like to share?

Spelling-errors. Assumptions about the premise of certain questions. Ambiguous questions. Unnecessarily long question texts. Some correct answers could be inferred by context.

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After using the prototype I felt motivated to learn.

	1	2	3	4	5	
Strongly disagree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	Strongly agree

Which of the following qualities describe your experience with the prototype?

	A lot	Some	Neutral	not much	None at all
Engaging	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Motivating	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Fun	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Enjoyable	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Helpful	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Cognitively stimulating	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Challenging	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Frustrating	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>
Boring	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>
Demotivating	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>
Rewarding	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Any other experiences with the prototype that you would like to share?

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Participation is voluntary and anonymous.

After using the prototype I felt motivated to learn.

	1	2	3	4	5	
Strongly disagree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	Strongly agree

Which of the following qualities describe your experience with the prototype?

	A lot	Some	Neutral	not much	None at all
Engaging	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Motivating	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Fun	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Enjoyable	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Helpful	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Cognitively stimulating	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Challenging	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Frustrating	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
Boring	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
Demotivating	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>
Rewarding	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Any other experiences with the prototype that you would like to share?

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## D. Supplemental tables and figures.

### a. Quiz Questions.

#### i. www Content Tools

Question	Type	Answers
Development from scratch is slowest and hardest type of development.	true-false	true
Web Content Management System is an advanced Integrated Development Environment.	true-false	false
Match descriptions with development types	matching	<ul style="list-style-type: none"> <li>• WEP</li> <li>• WCMS</li> <li>• XSL transformation</li> <li>• HTML editor</li> <li>• Template based</li> </ul>
There is no clear definition of what constitutes a Content Management System or a Web Content Management System.	true/false	
Which of the following are basic application components?	Multiple choice	<ul style="list-style-type: none"> <li>• user authentication</li> <li>• xsl transformations</li> <li>• single page websites</li> <li>• Searching</li> <li>• Content entry forms</li> </ul>
Web publishing is the process of publishing _____ on the web. Type the missing word to answer.	Short answer	content
How a set of interlinked webpages is called?	Short answer	website
Match descriptions with terms.	matching	<ul style="list-style-type: none"> <li>• Front end</li> <li>• Back end</li> </ul>
Small, personal websites can be created by using a plain text editor.	true/false	true

#### ii. Information Architecture

Question	Type	Answers
Which words describe Information Architecture?	Multiple choice	<ul style="list-style-type: none"> <li>• Findability,</li> <li>• usability,</li> <li>• intuitive access,</li> <li>• navigable,</li> <li>• all of the above,</li> </ul>
Finish a sentence. Information Architecture is...	Multiple choice	<ul style="list-style-type: none"> <li>• A scientific discipline</li> <li>• a practice community</li> </ul>

		<ul style="list-style-type: none"> <li>• The knowledge of how to facilitate websites and intranets</li> <li>• Structural design of an information to support a good user experience accessing the content</li> </ul>
Content Management and Information Architecture are really two sides of the same coin	True/false question	true
Software Development and Information Architecture are two separate independent fields.	True/false question	false
What are the deliverables in Information Architecture?	Multiple choice question	<ul style="list-style-type: none"> <li>• Controlled vocabularies</li> <li>• User stories</li> <li>• Use cases</li> <li>• Prototypes</li> <li>• Metadata schema</li> <li>• Wireframes</li> <li>• Blueprints</li> </ul>
Name 3 infamous circles of IA?	Drag and drop	<ul style="list-style-type: none"> <li>• Users,</li> <li>• Content,</li> <li>• context</li> </ul>
What Is an Online Community?	Multiple choice question	<ul style="list-style-type: none"> <li>• All of the above.</li> <li>• Computer systems, to support and mediate social interaction and facilitate a sense of togetherness.</li> <li>• A shared purpose, such as an interest, need, information exchange, or service that provides a reason for the community a group of people who may or may not meet one another face to face, and who exchange words and ideas through the mediation of computer bulletin boards and networks</li> <li>• Policies, in the form of tacit assumptions, rituals, protocols, rules, and laws that guide people's interactions</li> <li>• People, who interact socially as they strive to satisfy their own needs or perform special roles, such as leading or moderating</li> </ul>
The relationships between usability and sociality. Match descriptions with these concepts.	Matching	<ul style="list-style-type: none"> <li>• Sociality</li> <li>• usability</li> </ul>
Users experience the usability of a site before they are committed to using it and before they have spent any money on potential purchases.	True/false question	true
Which techniques can be used to evaluate usability?	Multiple choice question	<ul style="list-style-type: none"> <li>• Thinking aloud</li> <li>• Focus group</li> <li>• Use of the software</li> <li>• Heuristic evaluation</li> <li>• Contextual design</li> <li>• Usability lab studies</li> </ul>

		<ul style="list-style-type: none"> <li>Qualitative documentation analysis.</li> </ul>
Heuristic evaluation is carried out by users.	True/false question	false
Heuristic evaluation is performed by several evaluators discussing it with each other.	True/false question	false
Match design guidelines with authors.	Matching	<ul style="list-style-type: none"> <li>Ben Schneiderman</li> <li>Keith instone</li> <li>Jenny preece</li> <li>Amy ko kim</li> </ul>

### iii. WCMS Drupal -13 questions

Question	Type	Answers
What type of Content tools is Drupal?	Multiple choice	<ul style="list-style-type: none"> <li>Single page website</li> <li>Web Content Management System</li> <li>Template based approach</li> <li>HTML editors</li> <li>Web Enterprise Portal</li> </ul>
Match Drupal roles, with descriptions. Drag and Drop to answer.	Drag and drop	<ul style="list-style-type: none"> <li>Anonymous</li> <li>Authenticated user</li> <li>administrator</li> </ul>
Match descriptions with Drupal terms.	matching	<ul style="list-style-type: none"> <li>A package</li> <li>A module</li> <li>A project</li> </ul>
One package can contain only one module.	true/false	false
Uninstall deactivates a module and leaves all data and variables intact.	true/false	false
What does a Drupal theme define?	Multiple choice	<ul style="list-style-type: none"> <li>all of the above except Taxonomy Access Control</li> <li>The graphics used for the site's logo and favicon.</li> <li>The site's colour palette.</li> <li>The typography used for the text that appear on the site.</li> <li>The overall layout of a web page.</li> <li>JavaScript.</li> <li>Taxonomy Access Control</li> </ul>
How does a theme framework that you change directly called?	Short answer	starter
How is a theme framework that you build upon by means a sub-theme called?	Short answer	base
How is a theme that reuses the main features of an already existing theme called?	Short answer	sub-theme

Visibility and access control management are the same thing.	true/false	false
By default, Drupal labels nodes with a number.	true/false	true
New entity types will not work within the same framework as Drupal's predefined entity types.	true/false	false
Existing entity can be extended by adding new _____ to it. Answer to fill in blank.	Short answer	fields

#### iv. Legal Aspects 12 questions

Question	Type	Answers
Match Licenses with types	Drag and drop	Attribution, no derivative work, share alike, non-commercial
Owning a cd copy of a music album gives a copyright to the owner.	true/false	false
When new and independent works occurs it's copyright is dependent on copyright of the work that has been used to inspire it.	true/false	false
The person who translates or processes an intellectual work or transfers it to another literary or artistic form requires clearance and has to pay compensation.	true/false	true
How long does the copyright last after the end of author's death year?	Multiple choice	From 40 to 100, answer 70
What type of mental works A Creative Commons (CC) license is recommended to be used for?	Multiple choice	<ul style="list-style-type: none"> <li>• Photographs</li> <li>• Blogs</li> <li>• photograph of public artwork</li> <li>• Database</li> <li>• Articles</li> <li>• Software</li> <li>• children's artwork</li> <li>• websites</li> </ul>
Creative Commons licenses are nonexclusive and non-revocable.	true/false	true
To use a CC licensed work you must state the following:	Multiple choice	<ul style="list-style-type: none"> <li>• state your name</li> <li>• A copyright notice that names the original creator (if available)</li> <li>• state in detail how you got the image</li> <li>• Disclose the license with a link to Commons Deed under which the work is made available.</li> <li>• Indicate if any changes have been made</li> <li>• state the date and time</li> <li>• Link back to the original work</li> </ul>
Which of the following a form of data copying from websites?	Multiple choice	<ul style="list-style-type: none"> <li>• all of the above</li> <li>• Downloading</li> <li>• Web scraping</li> </ul>

		<ul style="list-style-type: none"> <li>• file sharing</li> <li>• Copy-paste</li> <li>• embedding</li> </ul>
The intellectual property rights cease when you delete your intellectual property or your user account, except where you have shared the content with other users and they have not deleted it.	true/false	
Match terms with definitions	Drag and drop	<ul style="list-style-type: none"> <li>• Consent</li> <li>• Data processor</li> <li>• Personal registers</li> <li>• Personal information</li> <li>• Treatment responsible</li> <li>• Processing of personal data</li> </ul>
Match descriptions with terms.	matching	<ul style="list-style-type: none"> <li>• Cookie control</li> <li>• Terms of use</li> <li>• Ekomloven</li> <li>• personoplysningsloven</li> </ul>

#### v. Content Analysis - 10 questions

Question	Type	Answers
What kind of understanding is gained by doing a Content Analysis in Information Architecture?	Multiple choice	<ul style="list-style-type: none"> <li>• extent, relationships and typology.</li> <li>• authorship, authenticity and meaning</li> </ul>
Content Analysis is synonymous with "discourse analysis".	true/false	true
Which practical way of Applying Content Analysis is used in Information Architecture?	Multiple choice	<ul style="list-style-type: none"> <li>• Detailed content counting in connection with migration to (or off) a WCMS.</li> <li>• Coding the content of existing text documents.</li> <li>• Overall survey to understand the scope and content types of the webpage.</li> </ul>
What shapes can content analysis take form of?	Multiple choice	<ul style="list-style-type: none"> <li>• Observation</li> <li>• Interview</li> <li>• detailed content audit</li> <li>• informal survey</li> </ul>
What is a "Noah's Ark" approach?	Multiple choice	<ul style="list-style-type: none"> <li>• focusing on different subjects</li> <li>• collecting a bit of everything</li> <li>• collecting diverse documents on diverse topics</li> <li>• collecting diverse documents</li> <li>• collecting broad mix of formats from diverse sources</li> <li>• collecting from diverse sources</li> <li>• collection a broad mix of formats</li> </ul>
Match questions with answers.	matching	<ul style="list-style-type: none"> <li>• a top-down</li> <li>• a bottom-up</li> </ul>

		<ul style="list-style-type: none"> <li>• a site's organization and navigation structures</li> <li>• site's content objects</li> </ul>
What does benchmarking involve?	Multiple choice	<ul style="list-style-type: none"> <li>• comparison of information</li> <li>• architecture features</li> <li>• visual representation of the existing information environment</li> <li>• Borrowing good ideas, whether they come from competitors or strangers</li> <li>• systematic identification</li> <li>• evaluation</li> </ul>
Which benefit does benchmarking and competitive benchmarking offer? Match benefits descriptions with benchmarking type.	matching	<ul style="list-style-type: none"> <li>• Benchmarking</li> <li>• Competitive benchmarking</li> <li>• both</li> </ul>
Which content types are part of core Drupal 7?	Multiple choice	<ul style="list-style-type: none"> <li>• forum topic</li> <li>• basic page</li> <li>• Panels</li> <li>• Views</li> <li>• Poll</li> <li>• Bok</li> <li>• blog entry</li> <li>• article</li> </ul>
A person should get all the the possible content in one single content survey.	true/false	false

### vi. Types of Systems - 13 questions

Question	Type	Answers
Iconic labels are context- and culture dependent.	true/false	true
Normally a website utilises several types of navigation.	true/false	true
Which words are the examples of labeling?	Multiple choice	<ul style="list-style-type: none"> <li>• News</li> <li>• site map</li> <li>• privacy policy</li> <li>• tags cloud</li> <li>• Indexes</li> <li>• synonym rings</li> </ul>
Finish the sentence. Labeling is essentially a design of _____.	Short answer	navigation
Choose good examples of trigger words.	multiple choice	<ul style="list-style-type: none"> <li>• salaried employee</li> <li>• Virus</li> <li>• Clothes</li> <li>• Studying</li> <li>• When the food is the problem.</li> <li>• to find new trigger words that are not already in common use</li> <li>• glasses</li> </ul>

Often, all types of navigation will be used on a single site. Match the types with the descriptions. Drag and drop to answer.	Drag and drop	<ul style="list-style-type: none"> <li>• Search</li> <li>• Integrated navigation</li> <li>• Additional navigation</li> <li>• Global navigation</li> <li>• Local navigation</li> <li>• The colophon</li> <li>• Contextual navigation</li> </ul>
Match five blocks in a "typical" tree split page outlay with navigation types.	Drag and drop	<ul style="list-style-type: none"> <li>• Global navigation</li> <li>• Contextual navigation</li> <li>• Integrated navigation</li> <li>• The colophon</li> <li>• Local navigation</li> </ul>
Which navigational types are embedded navigation?	Multiple choice	<ul style="list-style-type: none"> <li>• Terms of Use</li> <li>• Contextual</li> <li>• Local</li> <li>• Map</li> <li>• Contact form</li> <li>• Guide</li> <li>• Global</li> <li>• Privacy</li> <li>• Index</li> <li>• Integrated</li> </ul>
A page that a user "lands" after clicking on an External link is called Portal page.	true/false	false
Very many users respond negatively to a navigation through tight control.	true/false	true
What data does Metadata provide?	Multiple choice	<ul style="list-style-type: none"> <li>• Ownership</li> <li>• data attributes</li> <li>• all of the above</li> <li>• Quality</li> <li>• data elements</li> <li>• Structure</li> <li>• Location</li> <li>• characteristics</li> </ul>
A synonym ring connects a set of words that are true synonyms.	true/false	false
Match WGAG 2.0 - principles with the descriptions.	matching	<ul style="list-style-type: none"> <li>• Perceivable</li> <li>• Operable</li> <li>• Understandable</li> <li>• robust</li> </ul>

**b. List of all used Drupal core extensions.**

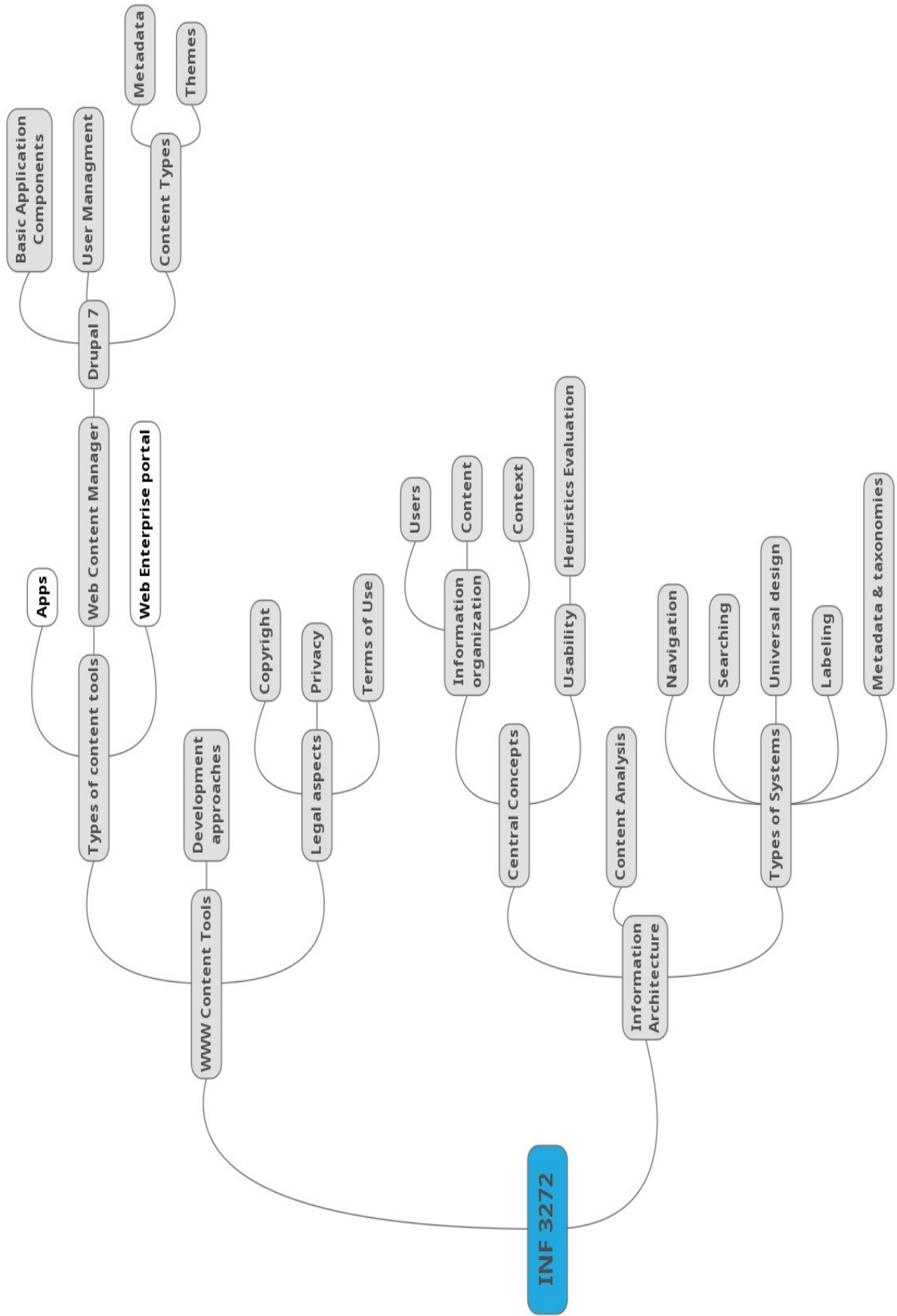
Type	Module name	What it does
module	<a href="#">Quiz</a>	Quiz module for Drupal.

theme	<a href="#">Scholarly Lite</a>	Free bootstrap based theme.
module	<a href="#">Content Access</a>	A module to manage content permissions by role.
module	<a href="#">Acquia Connector</a>	Enables secure communication between Drupal site and Acquia
module	<a href="#">Chaos tool suite (ctools)</a>	It is a set of APIs and tools designed to improve the Drupal developer experience.
module	<a href="#">Advanced Forum</a>	Module that enhances functionality of Drupal core forum.
module	<a href="#">Custom Error</a>	This module allows the site admin to create custom error pages for HTTP status codes 403 (access denied) and 404 (not found)
module	<a href="#">Guidance</a>	Module to create link lists for users.
Module API	<a href="#">Libraries</a>	Allows integration of external libraries.
module	<a href="#">Node Convert</a>	Gives ability to convert types of nodes.
module	<a href="#">Panels</a>	Adds customized layouts to Drupal.
module	<a href="#">Drag and drop with lines for Quiz</a>	Quiz module extension addon
module	<a href="#">Rules</a>	Allows components to reuse functionality
Drupal	<a href="#">CAPTCHA</a>	Spam control
Module API	<a href="#">Universally Unique ID</a>	Ability to add universally unique identifiers (UUID) to Drupal objects.
module	<a href="#">Views</a>	Allows to create and display list of content
module	<a href="#">Footer Message</a>	Configurable footer message
module	<a href="#">Views Bulk operations VBO</a>	Generation of permissions based on actions
module	<a href="#">charts</a>	A charting API for Drupal that provides chart elements and integration with Views.
module	<a href="#">Token</a>	Provides a user interface for the Token API and some missing core tokens.
module	<a href="#">Signup</a>	Allow users to sign up for nodes



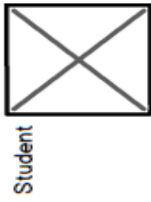
### **C. Supplemental Images.**

- Main theoretical concepts from the course INF3272.
- Wireframe A
- Wireframe B
- Wireframe C
- Wireframe D
- Update wireframe A
- Updated Wireframe B
- Anonymous user viewing the front page with custom user login block
- Quiz module start page with the curriculum Guidance
- Second Version of the Course Overview
- Course overview page with implemented achievements
- Introduction page
- Final matching question in introductory quiz



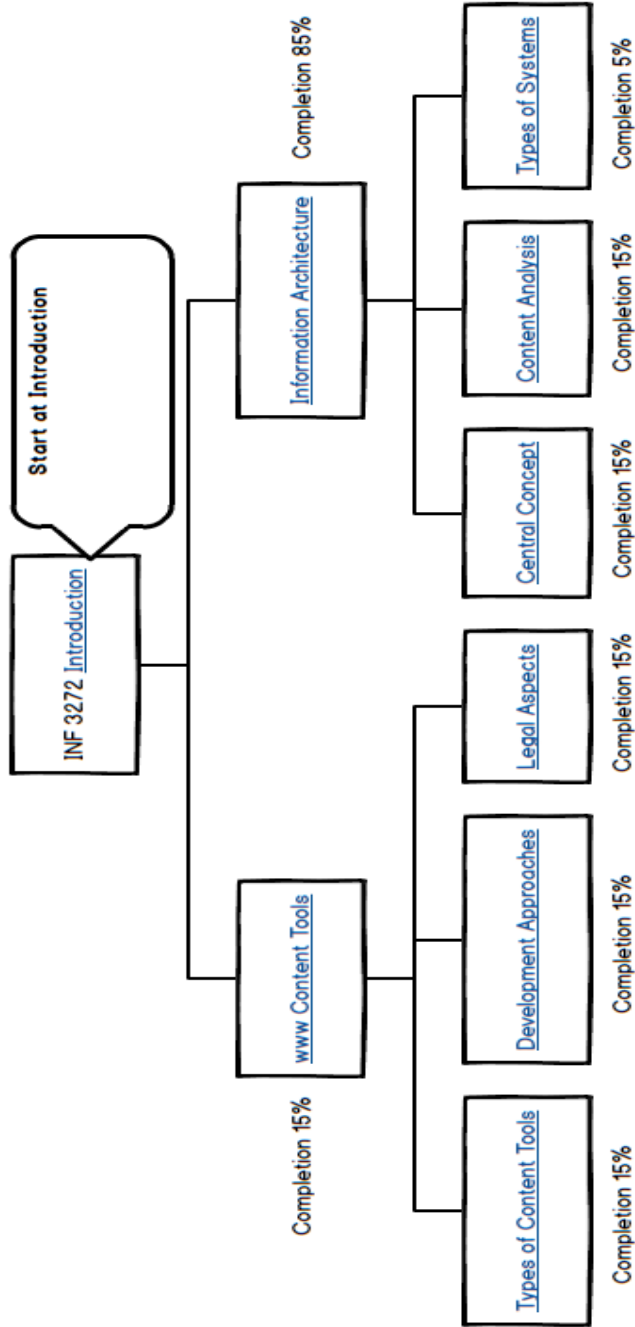


<http://http://diw13.uio.no/CourseOverview>



Student

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It looks like you are struggling. Please read the related article [link](#) or request help from the teacher, send message to Gisle.



http://http://dlw13.uio.no/Gomified Quiz



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Student

Grade progress



Fail Pass

Help Desk

	Why am I learning this? Drupal blah
Name	Aenean at suscipit urna. Vestibulum a porta libero, in vulputate justo. Integer quis nisi a dolor varius dapibus. Nunc sed odio nullo. Curabitur
Gisle	

# Legal Aspects

## Summary

- Question 1 (correct)
- Question 2
- Question 3 (incorrect)
- Question 4
- Question 5
- Question 6
- Question 7
- Question 8
- Question 9
- Question 10

## Tips

You have answered question 3 fail, you can read more about topic at [ link]. Additional information about this topic at(<http://dlw13.uio.no/node/354>)

**Help!**  Answer 1  Answer 2  Answer 3  Answer 4  Answer 5

**Help!**  Answer 1  Answer 2  Answer 3  Answer 4  Answer 5

**Help!**  Answer 1  Answer 2  Answer 3  Answer 4  Answer 5

Aenean at suscipit urna. Vestibulum a porta libero, in vulputate

[Report an error](#)

**Submit**



http://http://diw13.uio.no/StudentProfile



Home | Overview | Profile | Help Desk

Topics	Topic Completion	Estimated Grade
Types of Content Tools	<div style="width: 50%;"><div></div></div>	C
Development Approaches	<div style="width: 50%;"><div></div></div>	C
Legal Aspects	<div style="width: 50%;"><div></div></div>	C
Central Concepts	<div style="width: 50%;"><div></div></div>	C
Content Analysis	<div style="width: 50%;"><div></div></div>	C
Types of Systems	<div style="width: 50%;"><div></div></div>	C

Summary

Overall Training Progress

Correct: 20%    Fail 10%

most problematic: Legal Aspects

Train some more!



Name Surname

Achievements 2 out of 13

Bang! Bang!

Answered 10 out of 10 correct. date

Some text

Some text

Help Desk

Name

Gisle

student x

Why am I learning this? Drupal blah

Aenean at suscipit urna. Vestibulum a porta libero, in vulputate justo. Integer quis nisi a dolor varius dapibus. Nunc sed odio nulla. Curabitur

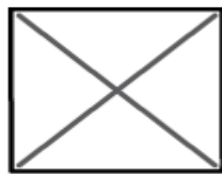
because blah blah blah



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Gisle Hannemyr

### Summary

#### Overall Student Training Progress



Fail 10%

Correct: 20%

Correct: 20%

Fail 10%

Go to Questions

Go to Questions

Central Concepts

Drupal 7

#### Most Problematic Topics

### Help Desk



Student



Gisle

Why am I learning this? Drupal blah

Aenean at suscipit urna. Vestibulum a porta libero, in vulputate justo. Integer quis nisi a dolor varius dapibus. Nunc sed odio nulla. Curabitur



Student



Gisle

Drupal blah blah?

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Student

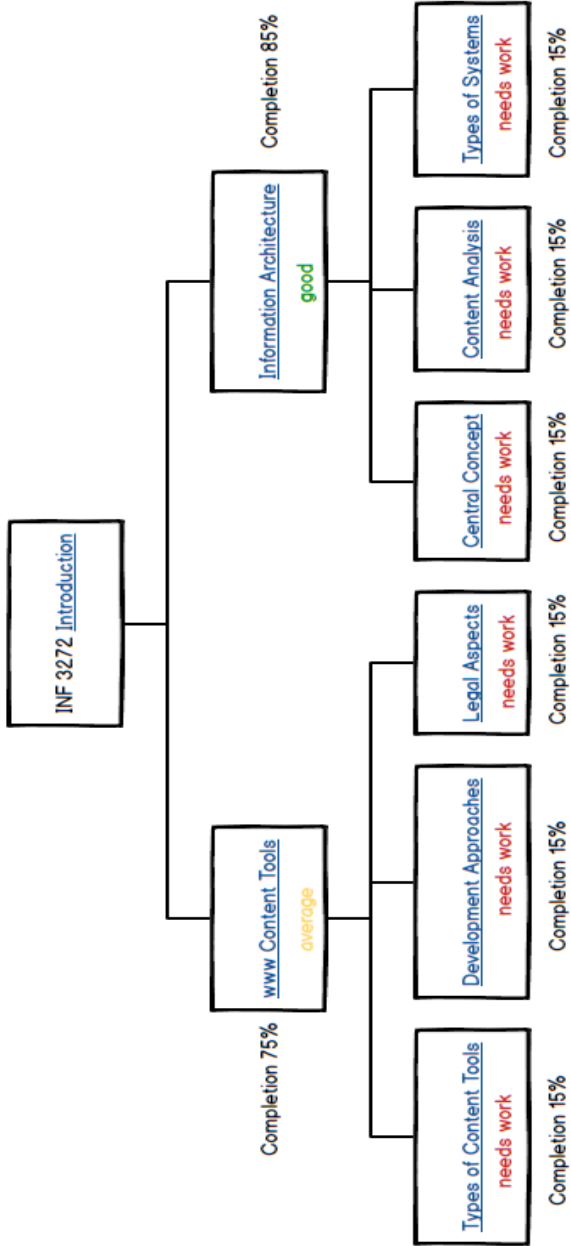
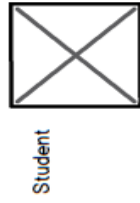


Gisle

Drupal blah blah?



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Exam Prediction



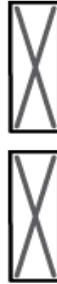
Fail Pass

Compared to average student



Worse Better

Achievements 2 out of 13



# Legal Aspects



Student

Grade progress



Tips

You can read more about this topic at <http://diw13.uio.no/node/354>

Help Desk - Ask teacher for help



Name



Gisle

Why am I learning this? Drupal blah

Aenean at suscipit urna. Vestibulum a porta libero, in vulputate justo. Integer quis nisi a dolor varius dapibus. Nunc sed odio nulla. Curabitur

**1** Multiple choice Question? [Report an error](#) [Help!](#)

Answer 1  Answer 2  Answer 3  Answer 4  Answer 5

**2** Some Question? [Report an error](#) [Help!](#)

Type inn answer

**3** Some Question? [Report an error](#) [Help!](#)

Type inn answer

**4** Multiple choice Question? [Report an error](#) [Help!](#)

Submit



## USER LOGIN

Username:

admin

Password:

.....

[Create new account](#)

[Request new password](#)

LOGIN

# WELCOME TO GAMIFIED INF3272

Gamified INF3272 is designed to help students taking INF3272 course to self-asses own knowledge.

You can read more about the course [here](#).

To use all of the features of this website please create an account.

If you have any questions about our site, please feel free to contact us.

--Webmistress



## CURRICULUM GUIDE FOR WCMS DRUPAL 7

Start this guide to read the available literature for this topic.

- Lecture: Introduction to the Drupal WCMS
- Article: Introduction to the Drupal WCMS
- Article: Drupal Fields
- Lecture: Drupal Modules
- Article: Drupal Administrasjon
- Article: Drupal Access Control
- Article: Drupal Projects
- Lecture: Theming
- Article: Drupal Themes
- Article: Drupal Sub-theme
- Article: Drupal Bootstrap theme

## WCMS DRUPAL 7

View Edit My results Quiz Take Revisions Convert

By admin

NOV 09 2017

QUESTIONS	13
AVAILABLE	Always
PASS RATE	75 %
BACKWARDS NAVIGATION	Allowed

Start Quiz

CLOSE GUIDE



## COURSE OVERVIEW

View Edit Access control Convert

### WELCOME TO THE INF3272 COURSE OVERVIEW.

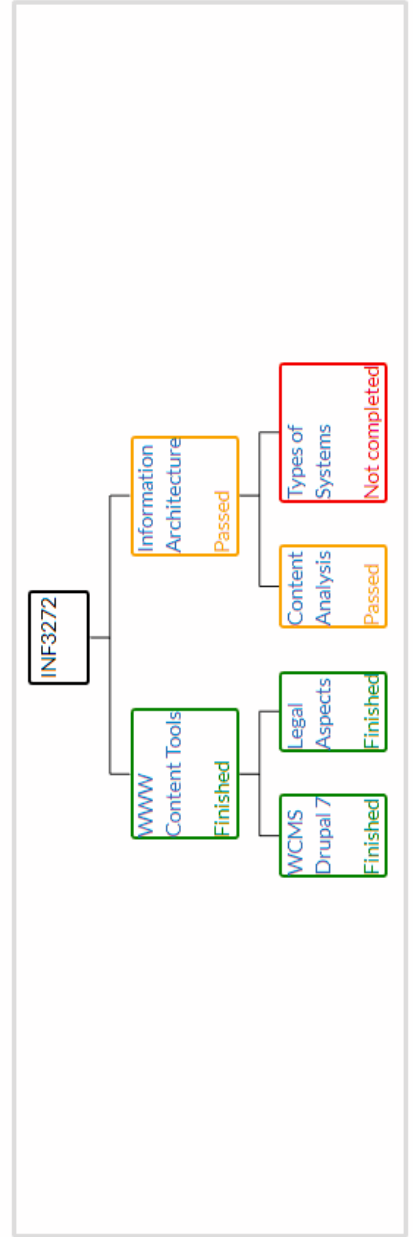
The course consists of two main topics "Information Architecture" and "WWW Content Tools". Choose the main topic or subtopic to access your knowledge.

Green represents a passed quizz with all answers correct (100%)

Yellow represents a passed quizz with some answers correct (75%)

Red represents that you havent passed the quizz yet (below 75%)

Be aware that INF3272 course has a hidden complexity, please read the pensum before attempting the quizz.





## INTRODUCTION TO GAMIFIED INF3272 QUIZ

This is an introductory guide to the external literature guides.

- o Please click on start to view the example links.
- o Then click on links, notice that links are marked as viewed after you click on them
- o **The guide will stay open until you close it.**

- Start at: Course Overview
- Go back to: Introduction to gamified INF3272 quiz

CLOSE GUIDE

# INTRODUCTION TO GAMIFIED INF3272 QUIZ

View Edit My results Quiz Take Revisions Convert

By admin

NOV 13 2017

QUESTIONS	5
ATTEMPTS ALLOWED	Unlimited
AVAILABLE	Always
PASS RATE	75 %
BACKWARDS NAVIGATION	Allowed

Start Quiz

# INTRODUCTION TO GAMIFIED INF3272 QUIZ

[View](#) [Edit](#) [My results](#) [Quiz](#) [Take](#) [Revisions](#) [Convert](#)

Page 5 of 5

## QUESTION 5

This question type is called Matching, because you are matching between questions and predefined set of answers. Sometimes there is a penalty for guessing, which happens when you match incorrectly at first and then change your mind.

**In this type of question you choose an answer between predefined choices.**

multiple choice question

**In this type of question you drag labels to hotspot circles to answer**

drag and drop questions.

**In this type of question you type short answer.**

short answer question

**In this type of question you match questions with answers.**

matching

**In this type of question you can choose between true or false as an answer.**

true/false question

*You lose points by selecting incorrect options. You may leave an option blank to avoid losing points.*

*This is the last question. Press Finish to deliver your answers*

BACK

LEAVE BLANK AND FINISH

FINISH

## **E. Development.**

### **a. Terms of Use**

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When you create an account with us, you are responsible for safeguarding the password that you use to access the Service and for any activities or actions under your password, whether your password is with our Service or a third-party service.

You agree not to disclose your password to any third party. You must notify us immediately upon becoming aware of any breach of security or unauthorized use of your account.

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This website is designed for educational purposes which makes an appropriate and respectful behavior very important.

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Upon termination, your right to use the Service will immediately cease. If you wish to terminate your account, you may simply discontinue using the Service.

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These Terms shall be governed and construed in accordance with the laws of Norway.

#### Changes

We reserve the right, at our sole discretion, to modify or replace these Terms at any time. If a revision is material we will try to provide at least 15 days' notice prior to any new terms taking effect. What constitutes a material change will be determined at our sole discretion.

By continuing to access or use our Service after those revisions become effective, you agree to be bound by the revised terms. If you do not agree to the new terms, please stop using the Service.

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Gamified INF3272 ("us", "we", or "our") operates the [link](#) website (the "Service").

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We use your Personal Information for providing and improving the Service. By using the Service, you agree to the collection and use of information in accordance with this policy. Unless otherwise defined in this Privacy Policy, terms used in this Privacy Policy have the same meanings as in our Terms and Conditions, accessible at <http://drupal-7-56.dd:8083/>

#### Information Collection And Use

While using our Service, we may ask you to provide us with certain personally identifiable information that can be used to contact or identify you. Personally identifiable information may include, but is not limited to, your name and email address.

#### Log Data

We collect information that your browser sends whenever you visit our Service ("Log Data"). This Log Data may include information such as your computer's Internet Protocol ("IP") address, browser type, browser

version, the pages of our Service that you visit, the time and date of your visit, the time spent on those pages and other statistics.

#### Cookies

Cookies are files with small amount of data, which may include an anonymous unique identifier. Cookies are sent to your browser from a web site and stored on your computer's hard drive.

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We may update our Privacy Policy from time to time. We will notify you of any changes by posting the new Privacy Policy on this page.

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#### Contact Us

If you have any questions about this Privacy Policy, please [Contact Us](#).

## C. Code for the Course Overview and achievement modules.

The code is available at <https://github.com/LadyAlisa/GamifiedInf3272>. Further only the code that I have fully written is presented.

### i. Courseoverview html and CSS

```
<!DOCTYPE html>
<html>
<head>
<style>
.center {
  margin: auto;
  width: 60%;
  padding: 10px;
}
a.one:link {
  background-color:white;
  color: white;
  border: 2px solid green;
  padding: 14px 25px;
  text-align: center;
  text-decoration: none;
  display: inline-block;
}
/* visited link */
a.one:visited {
  color: black;
}
}
```

```

/* mouse over link */
a.one:hover, a:active {
  background:#66ff66;
  color: blue;
}
</style>
</head>
<body>
<div class="center">
<a class="one" href="http://drupal-7-56.dd:8083/node/19#overlay-context=node/11" target="_self">Introduction to gamified
INF3272 quiz</a>
<br> <br>
<a class="one" href="http://drupal-7-56.dd:8083/node/9#overlay-context=node/19" target="_self">www Content Tools</a>
<a class="one" href="http://drupal-7-56.dd:8083/node/15#overlay-context=node/9" target="_self">Information Architecture</a>
<br> <br>
<a class="one" href="http://drupal-7-56.dd:8083/node/21#overlay-context=node/15" target="_self">Types of Content Tools</a>
<a class="one" href="http://drupal-7-56.dd:8083/node/22#overlay-context=node/11" target="_self">Development Approaches</a>
<a class="one" href="http://drupal-7-56.dd:8083/node/23#overlay-context=node/22" target="_self">Legal Aspects</a>
<a class="one" href="http://drupal-7-56.dd:8083/node/24#overlay-context=node/11" target="_self">Central Concepts</a>
<a class="one" href="http://drupal-7-56.dd:8083/node/25#overlay-context=node/11" target="_self">Content Analysis</a>
<a class="one" href="http://drupal-7-56.dd:8083/node/26#overlay-context=node/15" target="_self">Types of Systems</a>
</div>
</body>
</html>

```

## ii. Courseoverview.module

```
<?php
```

```

function courseoverview_help($path, $arg){
  switch($path) {
    case "admin/help_courseoverview":
      return t("Course overview module");
      break;
  }
}

```

```

function courseoverview_block_info(){
  $blocks['courseoverview'] = array(
    'info' => t('Course overview'),
    'cache' => DRUPAL_NO_CACHE
  );

  return $blocks;
}

```

```
// return information of a users progress throughtout the course. This information is used to show the users status in
course training.
```

```
function getUserResults($userId){
```

```

  // get ids from drupal node ids
  $quiz_ids = Array('dev' => 22,
    'drupal7' => 100,
    'types' => 26,
    'content' => 9,
    'legal' => 23,
    'analysis' => 25,
    'architecture' => 15);

```

```
$quizResultsForUser = Array();
```

```

foreach($quiz_ids as $key => $quiz_id)
{
  // quiz has multiple attempts, take the attempt with highest score.
  $query = db_query('SELECT * FROM {quiz_node_results} r WHERE r.uid = :uid AND r.nid = :nid ORDER BY
r.score DESC', array(':uid' => $userId, ':nid' => $quiz_id));

```



```

$result = $query->fetchAssoc()['score'];
if($query->rowCount() == 0)
{
    $quizResultsForUser[$key] = 0;
}
else
{
    $quizResultsForUser[$key] = $result;
}
}

return $quizResultsForUser;
}

function courseoverview_contents(){
    return "courseoverview contents";
}

// Provides the view for this module
// The view is composed of a html piece, a javascript piece and a css piece.
// It also includes the javascript library dependencies.
// First data is fetched from database, this data is then used to generate javascript code with values from database, this
code is then used by the
// attached javascripts to style elements and display course progress.
function courseoverview_block_view($delta = ''){
    switch($delta){
        case 'courseoverview':
            $block['subject'] = t('Course overview');
            if(user_access('access content')){
                global $user;
                $userId = $user->uid;
                $userResults = getUserResults($userId);
                $result = courseoverview_contents();
                $block['content'] = array(
                    '#markup' => '
                    <div class="chart" id="overview">
                    </div>
                    <script>

var dev = '. $userResults['dev'] .';
var drupal7 = '. $userResults['drupal7'] .';
var types = '. $userResults['types'] .';
var content = '. $userResults['content'] .';
var legal = '. $userResults['legal'] .';
var analysis = '. $userResults['analysis'] .';
var architecture = '. $userResults['architecture'] .';
var overview_config = configureTree();
                new Treant( overview_config);
                    </script>',
                    '#attached' => array(
                        'css' => array(
                            drupal_get_path('module', 'courseoverview') . '/css/treant.css',
                            drupal_get_path('module', 'courseoverview') . '/css/overview.css'
                        ),
                        'js' => array(
                            drupal_get_path('module', 'courseoverview') . '/js/raphael.js',
                            drupal_get_path('module', 'courseoverview') . '/js/Treant.js',
                            drupal_get_path('module', 'courseoverview') . '/js/overview.js'
                        )
                    )
                );
            return $block;
        }
    }
}

```

```
}
```

### iii. Courseoverview.info

```
name="Course overview module"  
core="7.x"  
version="7.x-1.0"  
description="Course overview module"
```

### iv. Overview.css

```
/* overview STYLES */  
  
.chart { height: 400px; width: 600px; margin: 5px; margin: 5px auto; border: 3px solid #DDD; border-radius: 3px; }  
  
.nodeRoot { color: #000; border: 2px solid #000; border-radius: 3px; padding: 3px }  
  
.nodeCompleted { color: #000; border: 2px solid green; border-radius: 3px; }  
  
.nodeNotCompleted { color: #000; border: 2px solid red; border-radius: 3px; }  
  
.nodePassed { color: #000; border: 2px solid orange; border-radius: 3px; }  
  
.nodex p { font-family: Arial, Helvetica, sans-serif; font-size: 14px; line-height: 20px; height: 20px; font-weight: bold;  
padding: 3px; margin: 0; }  
  
.notCompleted { color: red}  
  
.completed { color: green}  
  
.passed { color: orange}
```

### v. Overview.js

```
// return html style for completed element  
function getCompletedClass(score){  
  
    if(score >= 100){  
        return 'nodeCompleted';  
    }  
    else if(score >= 75){  
        return 'nodePassed';  
    }  
    return 'nodeNotCompleted';  
}  
  
// return html styled text for completed element  
function getCompletedText(score)  
{  
    if(score >= 100){  
        return '<span class=\"completed\">Finished</span>';  
    }  
    else if(score >= 75){  
        return "<span class=\"passed\">Passed</span>"  
    }  
    return "<span class=\"notCompleted\">Not completed</span>"  
}  
  
// builds up the course treeview layout  
function configureTree(){  
    var config = {  
        container: "#overview",  
        connectors: {  
            type: 'step'  
        },  
    },
```

```

};

var parent_node = {
    text: { name: "INF3272" },
    HTMLclass : "nodeRoot",
    innerHTML : ""INF3272<p><a href=\"/node/116#overlay-context=node/11\" target=\"_self\">
Introduction </a></p>\"target=\"_self\"> Introduction </a></p>\"
};

var first_child = {
    parent: parent_node,
    text: { name: "www Content Tools" },
    HTMLclass : getCompletedClass(content),
    innerHTML : "<p><a href=\"/node/9#overlay-context=node/19\" target=\"_self\">WWW <br>
Content Tools</a></p><div>\" + getCompletedText(content) + \"</div>\"

};

var second_child = {
    parent: parent_node,
    text: { name: "Information Architecture" },
    HTMLclass : getCompletedClass(architecture),
    innerHTML : "<p><a href=\"/node/15#overlay-context=node/9\" target=\"_self\">Information
<br>Architecture</a></p><div>\" + getCompletedText(architecture) + \"</div>\"
};

var grandChild1 = {
    parent: first_child,
    text: { name: "WCMS Drupal 7" },
    HTMLclass : getCompletedClass(drupal7),
    innerHTML : "<p><a href=\"/node/100#overlay-context=node/100\" target=\"_self\">WCMS
<br>Drupal 7</a></p><div>\" + getCompletedText(drupal7) + \"</div>\"
};

var grandChild3 = {
    parent: first_child,
    text: { name: "Legal Aspects" },
    HTMLclass : getCompletedClass(legal),
    innerHTML : "<p><a href=\"/node/23#overlay-context=node/22\" target=\"_self\">Legal
<br>Aspects</a></p><div>\" + getCompletedText(legal) + \"</div>\"
};

var grandChild5 = {
    parent: second_child,
    text: { name: "Content Analysis" },
    HTMLclass : getCompletedClass(analysis),
    innerHTML : "<p><a href=\"/node/25#overlay-context=node/11\" target=\"_self\">Content
<br>Analysis</a></p><div>\" + getCompletedText(analysis) + \"</div>\"
};

var grandChild6 = {
    parent: second_child,
    text: { name: "Types of Systems" },
    HTMLclass : getCompletedClass(types),
    innerHTML : "<p><a href=\"/node/26#overlay-context=node/15\" target=\"_self\">Types of
<br>Systems</a></p><div>\" + getCompletedText(types) + \"</div>\"
};

var overview_config = [
    config,
    parent_node,
    first_child,
    second_child,

```

```

        grandChild1,
        /*grandChild2,*/
        grandChild3,
        /*grandChild4,*/
        grandChild5,
        grandChild6
    ];

    return overview_config;
}

```

## vi. Aoachievements.info

```

name="AO Achievements Module"
core="7.x"
version="7.x-1.0"
description="Achievements from quiz"

```

## vii. Aoachievements.module

```

<?php
function aoachievements_help($path, $arg){
    switch($path) {
        case "admin/help_aoachievements":
            return t("Achievements from Quiz");
            break;
    }
}

function aoachievements_block_info(){
    $blocks['overview'] = array(
        'info' => t('Achievements from Quiz'),
        'cache' => DRUPAL_NO_CACHE
    );
    return $blocks;
}

// Queries the Quiz tables in the database and returns achievements as a HTML list string.
function getUserAchievements($userId){
    // get ids from drupal node ids
    $quiz_ids = Array(
        'introduction' => 116,
        'drupal7' => 100,
        'types' => 26,

```

```

'content' => 9,
'legal' => 23,
'analysis' => 25,
'architecture' => 15);
$quizResultsForUser = Array();
$achievementA = false;
$achievementC = false;
$achievementE = false;
$achievementG = false;
$achievementI = false;
$achievementK = false;
$achievementM = false;
$achievementN = false;
$achievementO = false;
$achievementP = false;
$achievementQ = false;
$quizCount = 0;
$allCorrect = 0;
$passCount = 0;
$supermanCount = 0;
foreach($quiz_ids as $key => $quiz_id)
{
    // quiz has multiple attempts, take the attempt with highest score.
    $query = db_query('SELECT * FROM {quiz_node_results} r WHERE r.uid = :uid AND r.nid = :nid ORDER BY
r.score DESC', array(':uid' => $userId, ':nid' => $quiz_id));
    if($query->rowCount() == 0)
    {
        $quizResultsForUser[$key] = 0;
    }
    else
    {
        $row = $query->fetchAssoc();
        $result = $row['score'];
        if($result >= 100)

```



