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Visual Style for Security Development Lifecycle Course Materials

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Degree Programme in Media and Arts
Interactive Media

ABSTRACT

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SALO, HEIKKI:
Visual Style for Security Development Lifecycle Course Materials

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The objective of this thesis was to research and develop a new visual style of cybersecurity online courses for software professionals. These courses are taken by employees when the company wants to start using Security Development Lifecycle processes and get certified. These courses should be as efficient as possible to keep the employees on productive tasks.

The research started with an overview of the state of online learning and Security Development Lifecycle. The author created a survey to gather information on how the target group behaved with online learning material and what their past experiences were. Research continued with an examination of ways to use design as a motivator and to improve readability. The thesis project focused on creating an illustration style for the online courses and improvements in readability and general perception by the learners.

The thesis project produced a visual style to illustrate the abstract subject of cybersecurity with fictional characters. The author used this illustration style to create uniform but diverse cover images for the courses. The author then redesigned the content pages' color schemes and layouts for easier readability.

Redesigned courses were then tested with a group of software professionals. The testing found that the enjoyment had increased, and the learners had fewer struggles reading the course content.

Key words: e-learning, visual design, illustration, cyber security

CONTENTS

ABBREVIATIONS AND TERMS

LMS	Learning management system
SCORM	Sharable Content Object Reference Model, model to move data between course material and LMS
SDL	Security Development Lifecycle

1 INTRODUCTION

Insta Digital provides SDL (Security Development Lifecycle) training for its enterprise customers in the technology and industrial sector. That includes training with a teacher and online courses for self-study. This thesis aims to dig into the online course content and visual style – its desirability, readability and effectiveness. Learners in those courses are software professionals, but not everyone is a software engineer. There can also be, for example, designers and managers who are not often handling security-related tasks.

The courses' raw material is written by security specialists and thus does not always follow all graphic design rules, like readable column lengths and uniform visual style. This thesis aims to determine what should be taken into account when creating online courses for software professionals from the visual design perspective to make a coherent set of course modules. What are familiar learning environments for the learners, and how do they look? Is there a way to motivate the learner or create engagement through visual design? How could the content be easier to understand?

Founder of Authorware, Inc. and Chairman and CEO of Allen Interactions Inc., Michael Allen points out that a designer could enhance learning motivation through novelty and fascinating graphics in his book Michael Allen's Guide to e-Learning: Building Interactive, Fun, and Effective Learning Programs for Any Company (2016, 132). This thesis tries to benefit from this motivational enhancement by creating a visual theme for training materials' illustrations. How can a designer transform something as abstract as security development into an illustration style?

When the author has made the new design suggestions, a few target group members attended user testing. User testing examined if the new visual styling made the courses more efficient and joyful to read. In the end, the author discusses if it is worth the effort to illustrate the rest of the courses in this way.

2 ONLINE LEARNING

This section looks at online learning, its different implementations and how the year 2020 has changed teaching in general. What different technologies a designer needs to understand when creating online learning content?

2.1 Online learning

In the past couple of decades, online courses have grown to be a common way to learn new skills and concepts for many people and can be regarded as mainstream, as the target group survey tells in 4.3 (Downes 2005). No need to sign up and wait for a college course to start, wait for the class every week and hope not to miss any lectures. Anyone can now sign up for a free trial of SkillShare and start learning, for example, web development basics. Alternatively, they can sign up to Coursera and take part in university courses worldwide – without leaving their own homes.

Downes (2005) writes that educators found that through wikis, blogs and podcasts, new learning methods started to reshape the education industry (Downes 2005). He anticipated that online learning moves from being content created by publishers to being created by students as well (Downes 2005). Today we see a lot of learning material produced by professionals who do not have an educational background or publishing company behind them. For example, YouTube is full of videos done by these professionals who just wanted to help others. Stack Overflow is full of questions about common programming problems and answers to them. Software engineers can easily find these resources through search engines and quickly learn ways to tackle their problems.

2.2 Teaching in 2020

During the year 2020, Coronavirus (COVID-19) pandemic has forced higher education and software industry to study and work remotely much more than before,

if not totally. Due to this phenomenon, the usage of classrooms has shifted to online communication tools like Zoom and Microsoft Teams. These communication tools, and human behavior in them, work differently than in-classroom training. Therefore, educators globally have been searching for things to consider when planning and executing courses.

Wei Bao, Associate professor at Peking University, mentions that content should be divided into smaller units of clear topics, each lasting 20–25 minutes. As body language and facial expressions cannot be fully seen in online communication, teachers should slow down their speech appropriately. Slowing down speech in key points helps the learner to grasp key points when they cannot see non-verbal communication. (Bao 2020.)

As participation in an online class is more difficult, like in-depth discussions involving everyone, it is recommended to organize some pre-class study actions, like an offline self-learning phase. When a teacher gets an understanding of pupils' cognitive level before a class, they can adjust the content before class. (Bao 2020.)

Getting students to interact during an online class can be a challenge. Some participants often stay quiet when the questions are asked from a group. During online workshops and meetings, the author has noticed that just assigning questions directly to silent participants can get them into the discussions. Sometimes the participants can warm up even for the general discussion after they have started with this assigned question.

The teacher can get students more engaged during an online class with group tasks and smaller discussion groups. In some online collaboration tools, like Zoom, it is possible to divide a class into smaller breakout rooms. Students can more easily engage in a discussion and group work in these smaller breakout rooms. To get good results, the teacher needs to also give clear instructions before breaking the class into different rooms. (Stanford n.d.)

2.3 Different types of online learning

Teaching methods in online learning can vary a lot. Some platforms offer courses with video content with quizzes in between (Kroonenburg 2020). As an example, APN (AWS Partner Network) Partner Training has gone with a slide-based course style with quizzes in between (AWS Training and Certification 2019).

APN Partner Training content includes many diagrams and illustrations of technical topics, which might change over the years, so, understandably, video-based material could be a burden to create. APN Partner Training uses a Learning Management System (LMS) to keep up a database of their partners' employees' qualifications. Database of qualifications helps them to understand if their partner is educated correctly. (AWS Training and Certification 2019.)

Codecademy takes a more hands-on approach by focusing on the learner's actions. Codecademy shows short articles about a subject and the learner then applies the knowledge by a predefined task (Figure 1). The system then analyses if the task is done correctly. These tasks can later be applied together with each other to gain a holistic understanding of a subject. (Codecademy n.d.)

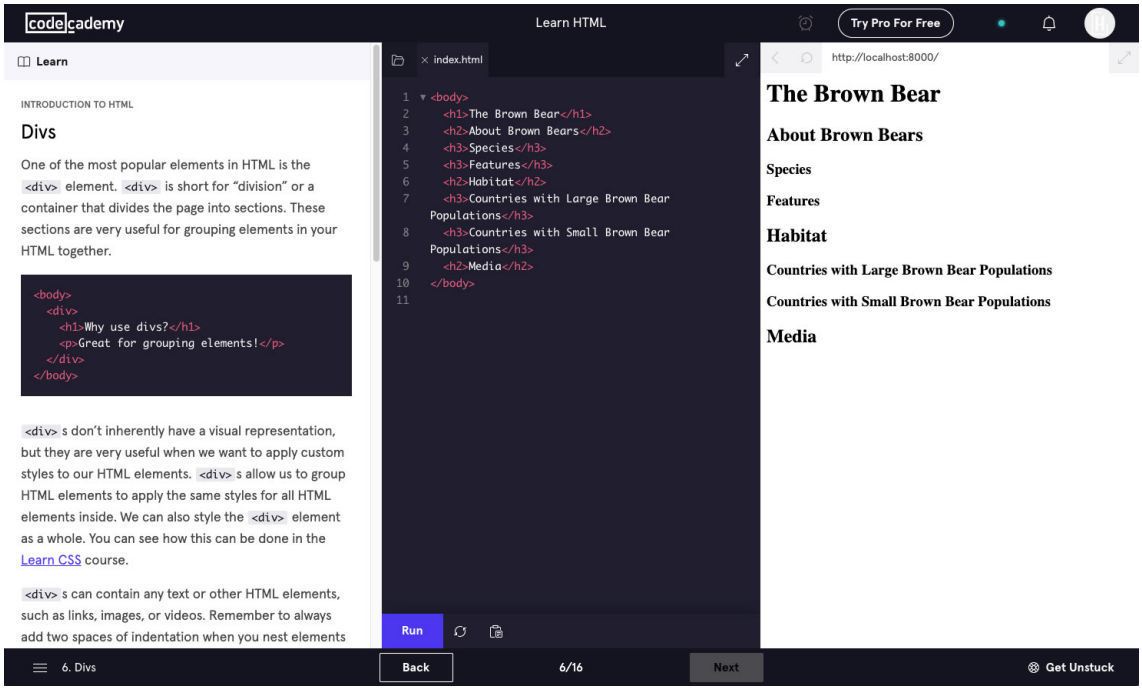

FIGURE 1. Hands-on approach in Codecademy course (Codecademy n.d.)

2.4 Learning Management System vs. authoring tool

I will divide e-learning into two sides: LMS (Learning Management System) and e-learning authoring tools. Simply put, LMS is a repository of online courses and users, where an organization can track learners' progress (Pappas 2017). For example, Moodle is a very common LMS. There are also other LMS options, like Docebo, Adobe Captivate Prime, TalentLMS and SAP Litmos LMS (Pappas 2020).

A designer can use e-learning authoring tools to create interactive courses, which they can then share with learners through LMS (iSpring, 2019). E-learning authoring tools have made it possible for ordinary computer users to create e-learning content without writing code (iSpring, 2019). Like Articulate Storyline 360, some of them are slide-based tools (Articulate 360 2019). By slide-based, I mean that they work similarly to Microsoft PowerPoint, displaying content slide after slide. Some create courses in responsive web page format, like Articulate Rise 360 (Articulate 360 2020). H5P is another option for content authoring, with tools to create, for example, course presentations, memory games, quizzes or interactive video content (H5P n.d.).

Courses can be created directly inside Moodle with Moodle's own tools, but if the content needs to be distributed to other LMSs, a course created in Moodle might not be directly suitable for transfer. A course package created in an authoring tool like Articulate Storyline 360 is possible to distribute in different LMS tools without modification if they support common features like SCORM (Sharable Content Object Reference Model) (Pappas 2020).

E-learning authoring tools often comply with standards like SCORM. When the used LMS, for example, Moodle, is also SCORM-compliant, it can track learners' progress automatically (SCORM n.d.). Then, for example, an employer can track how many courses their employees have completed.

As designers use e-learning authoring tools to create the course content, this thesis will concentrate on them and leave LMSs with less focus. As a reference

tool, the author uses Articulate Storyline 360, which provides a slide-based content structure, much like Microsoft PowerPoint. Master slide templates and generic tools work as in PowerPoint, but on top of that, Storyline makes it possible to add interactive elements and quizzes to help learning and test the learner's knowledge. With the Articulate 360 subscription, users could also use stock images from Articulate's content library.

3 SECURITY DEVELOPMENT LIFECYCLE

Security Development Lifecycle (SDL) standardizes the company's software development processes to systematically think about security requirements, threats, models and responses before writing any code (Romeo 2018). In this process, thinking of security gets distributed throughout the company, not only security specialists (Romeo 2018). In this chapter, the author describes the background of the thesis project.

3.1 Steps towards certification

To get the certification done, the company must prove that all of its employees know the SDL process. Needed courses depend on the employee's role – for example, a user experience designer does not need to know the same things as a system architect.

Training with a teacher

When a company offers training with a security specialist, in-class or online, the specialist can make sure everyone is following, and learners can ask all the questions right away. In training with a teacher, learners can use online course material to find more information about specific topics if needed. Learners answer quizzes after every course module in the online platform to prove that they have correctly understood the course content. This way, the company has a record of every passed course in LMS.

Online self-study training

If the learners cannot participate in training with a teacher or otherwise want to do it individually, they can open e-learning material in the company's LMS and start learning. In online training, the learners cannot ask questions from the security specialist, making it essential to create explicit content. In this thesis, I will concentrate on the user experience of this individually executed online training.

After the employees have completed the training modules and exams, the company can print a list of all qualified people to get certified. The company can get the list from their LMS, which keeps a database of completed modules through SCORM API, as in 2.4.

3.2 Learning SDL practices

When looking at learner-centered and teacher-centered learning models, professional software developers are adults and usually follow a learner-centered model. In the learner-centered model, the learner's path follows their motivations by what they want or need to know (Curry 2008, 19). This can be, for example, a new move in their career or life experience (Curry 2008, 19). The teacher-centered model focuses on subject content, as the learner-centered model focuses on learning to solve problems (Curry 2008, 19).

In SDL training, the driving motivator is the company's motivation to standardize their software development processes. The company needs to teach employees both the subject content, to understand what they are doing and why, and problem-solving skills to use the knowledge. The learning model shifts to teacher-focused, as it is not based on the learner's inner motivations. Because of this business-focused motivation, learning material needs to be easy to approach, compelling and comfortable for the learner.

As cybersecurity attacks and threats can happen through an employee's unintentional behavior (TÜViT n.d., 5), the company's whole development and managing personnel need to learn the processes to get certified. Suppose a company is getting SDL certified and has 200 software developers, 20 managers and five directors. If we calculate that an employee's average cost 60 €/h and the training demands 6 hours per person to complete, the total personnel costs for training come to 81 000 €. If the learners have problems with the material and the training needs 4 hours more per employee, it means 27 000 € more in the total personnel costs. In enterprises, these numbers can easily be multiplied, as personnel numbers can quickly grow to thousands.

3.3 SDL training content format

Contents of the training are digital and read on screen. They are made with Articulate Storyline 360. The end result of a Storyline export is an interactive slide-based course material (Figure 2). Exported course material can include, for example, text, images, videos, audio tracks, hyperlinks, interactive elements and quizzes. However, audio tracks and videos are not used in the content at the moment.

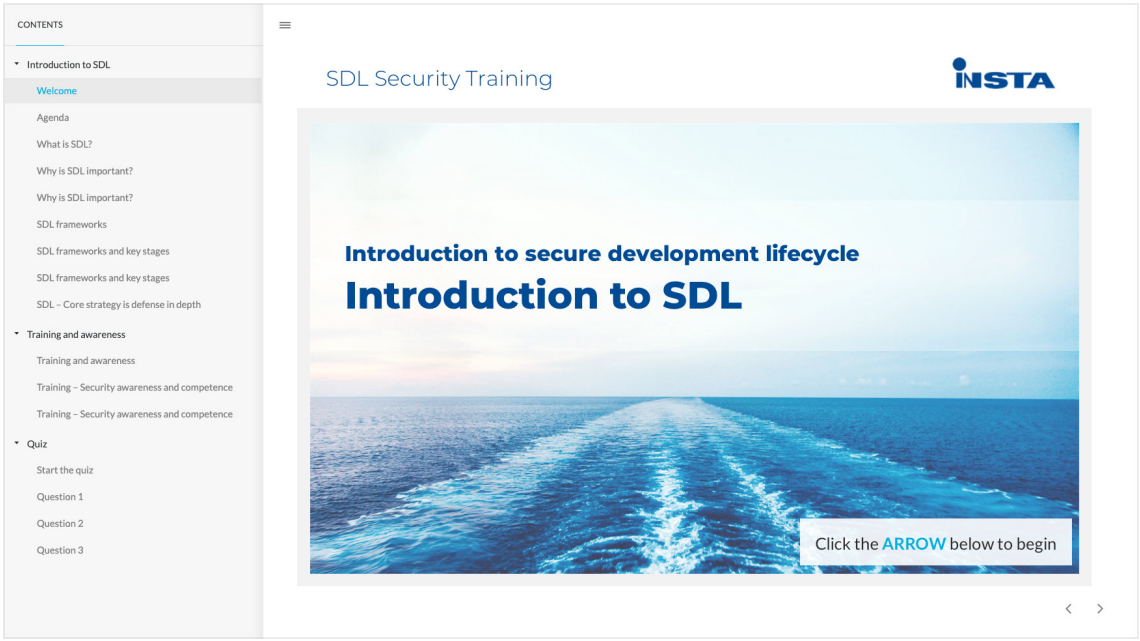

FIGURE 2. Screenshot of Articulate Storyline 360 package (Insta SDL Security Training 2019)

Topics in these courses include, for example, leading the SDL, business context analysis, security requirements management, security threat modeling and security in product maintenance. These topics are covered by telling what the topic means, how it works in the learner's company and how to work with the context.

Main sections, like the introduction, are divided into smaller course modules. Each course module has its own material package, like in Figure 2011. When a learner starts a course module, it tells the learner how much time it is estimated to take. This estimated time is usually between 15 and 30 minutes.

Content is usually text, diagrams, graphs and images. Contents are sometimes interactive to make them clearer and to engage the user. After each course module, the user needs to answer a quiz to pass the course.

4 TARGET GROUP

Who are the learners in SDL training? As in 3.1, for the company's certification, all personnel involved in product development need to be trained for the SDL processes and concepts. All personnel covers, for example, software engineers, designers, managers and directors. This chapter processes this target group, how they think of online learning, and what are their preferences when designing the visual style.

4.1 General information about the target group

The software field is male dominated. Gender segregation displays in ICT field graduates in Finland: in 1987, 37% of graduates were women (Keski-Petäjä & Witting 2018). After that, the number of graduates has doubled, and in 2017 only 16% were women (Keski-Petäjä & Witting 2018). This does not include all of the design professionals, but designers are generally a minor group in the technology sector. PwC Women in Work Index 2020 tells that women share 30% of jobs in the technology sector across G7 countries (PwC 2020, 28).

When a field is male dominated, also color vision loss is more common than in general. This should be taken into account when designing the course content; diagrams and illustrations need to be readable in grayscale.

In the survey results (in 4.2), it seems that there is a large experience difference inside the user group. The largest group was 3–5 years of experience, quickly seconding by a group with over 20 years of experience. A common thing for everyone seems to be continuous learning through their careers. At Insta Digital, the youngest software professionals are in their early 20s and the oldest in their 50s. Therefore, it is not possible to define a more targeted age group.

4.2 Questionnaire

The author sent a questionnaire to Insta Digital Oy software to ask opinions and open questions about their learning habits. Of around 100 employees, 13 responded to this questionnaire. The questionnaire aimed to uncover what platforms or services the target group commonly uses to learn new skills and practices for software development, examples of good and bad experiences with e-learning material, and do they think that visual design affects their motivation to start and finish a course (Appendix 1).

Years of professional experience in the software field

The author asked in the questionnaire the respondents' professional experience in the software field (Appendix 1). The aim was to understand if the seniority level impacts on ways how the professional consume learning material. The author divided experience years into five-year blocks, except 0–3 and 3-–5. The results did not reveal significant differences between seniority levels — the respondents in every seniority level answered with the same scale of courses, project work and self-study.

How to learn new skills or practices

I wanted to get insight into how the target group usually consumes new information. Respondents had a text field to write their answers freely, so it would be possible to gather as much data as possible.

Good and bad experiences with software related courses

Freely written good and bad experiences with courses could provide excellent first-hand knowledge on what the target group appreciates and expects in software-related courses' tasks, implementation or visual design. Results are opened in 4.4. A designer can then avoid these pitfalls in future course designs and to learn from others' mistakes.

True or not claims

In the end, there were five claims where the respondents answered on a 1–5 scale if they agreed with the claim or not. These questions aimed to get some

insight into where the thesis project should focus on. These claims are shown in Appendix 1.

4.3 Learning methods typically used by learners

Based on the questionnaire learners typically learn new skills and practices through:

- Problem-based self-studying with a sample project, supported by peers
- Blogs
- Publications
- Documentation
- Books
- YouTube
- edX
- Online course platforms, like Pluralsight, Udemy, Egghead, LinkedIn Learning and Coursera
- Employer's materials
- Manufacturer's courses
- University courses
- Daily project work

Learning by doing, blogs, YouTube, Udemy and Coursera were mentioned the most. In general, it was seen that the respondents use a lot of material that can be accessed whenever they want to. From this, I can conclude that learners like the ability to learn at their own pace and adjust course schedules to their personal schedules.

It is quite typical for software professionals to be active learners throughout their careers, as the industry is always evolving. As in 4.2, the answers did not reveal apparent differences between junior and senior employees' learning habits.

4.4 Survey findings

When asking about good and bad experiences with courses, the quality of technical content naturally arose from the results. Curry states that adult learners tend to like to use their prior knowledge as their learning base (2008, 19–20). The survey revealed that it is essential for motivation that the content is useful for the learner. The survey results revealed that if the content is too simple or boring (common sense or widely understood), it frustrates the learner and feels like a waste of time. Contrarily, the technical challenge should not exceed the learner's skill level excessively, as then the learner's focus is misplaced. Positive experiences arose when skill level matches and progressing feels good.

Another positively received concept was good hands-on exercises. Video courses or classroom training without any exercises might give the learner the theory but leave them without knowing how to apply that theory in practice. Hands-on exercises can also be counterproductive if they are much different from the examples in the course.

Respondents mentioned clear lectures, structuring content well and a pleasant way of speech and progression as good experiences. Bad experiences included mentions about dullness, content being boring and bad production quality, such as an inadequate microphone and poorly edited videos.

In free-form text answers, visual styling was not picked up as a good or bad experience. From this, I can conclude that it is not the most important factor in a successful course. The questionnaire had true or not claims directly about the visual style's effect on the user's learning. Even when these true or not claims were a bit loaded, the results showed that most respondents agreed that the visual style might affect their motivation to start and finish a course.

5 DESIGN PRINCIPLES

This thesis project aims to make the course modules more attractive and more comfortable to read. The author has approached this through motivational design, playfulness and general graphic design theories. These aesthetical choices often go unnoticed by the user unless they are implemented differently than is expected (Anderson 2011).

5.1 Design as a motivator

Motivation to learn arises from different sources, ranging from internal to external. Internal sources for motivation can be as simple as the pleasure of learning or a sense of achievement. External factors can be, for example, the approval of the educator and peers they are working with, rewards like qualification, or fear of preventing progress. (Holmes & Gardner 2006, 99.)

Can a designer motivate learners through visual attractiveness? “Regardless of the nature of the primary motivation under which a learner operates, it is widely accepted that interesting, attractive and challenging (within ‘reach’) environments will motivate their engagement” (Holmes & Gardner 2006, 99). Visual aesthetics, animation and sound, can create superficial attractiveness and interest in the learning material (Holmes & Gardner, 2006, 99). Bisset & Lockton approves that visual aesthetics can give the learner a motivational boost, although this aesthetic motivation boost will only work in the short term (2010, 15). Allen (2016, 132) defines Seven Magic Keys to enhance learning motivation, and the fourth one also agrees that graphics can indeed draw people in when done well (Table 1).

TABLE 1. Ways to Enhance Learning Motivation – the Seven Magic Keys (Allen 2016, 132).

Key		**Comments**
1.	Build on *anticipated outcomes*.	Help learners see how their involvement in the e-learning will produce outcomes they care about.
2.	Put the learner at *risk*.	If learners have something to lose, they pay attention.
3.	Select the right *content* for each learner.	If it's meaningless or learners already know it, it's not going to be an enjoyable learning experience.
4.	Use an appealing *context*.	Novelty, suspense, fascinating graphics, humor, sound, music, animation – all draw learners in when done well.
5.	Have the learner perform *multistep tasks*.	Having people attempt real (or "authentic") tasks is much more engaging than having them repeat or mimic one step at a time.
6.	Provide *intrinsic feedback*.	Seeing the positive consequences of good performance is better feedback than being told, "Yes, that was good."
7.	Delay *judgement*.	If learners have to wait for confirmation, they will typically reevaluate for themselves while the tension mounts – essentially reviewing and rehearsing!

Allen states that even if the delivery method, like graphics, are very visible part of the appealing context, it is more important to engage the learner through strong situational context and dramatic presentation of the context (2016, 171). Novelty can give a boost only for a short time, but it is possible to draw attention, energize curiosity and create more memorable experiences through it (Allen 2016, 181). Memorable experiences create attention, and if it can be paired with meaningfulness, it will create a perceived value, and that can be turned into learning (Allen 2016, 182).

5.2 Layout design and text readability

Giving a particular element more space on a canvas makes it possible to emphasize it and create drama. Vice versa, not giving an element enough space will diminish its importance. We live in a digital age, and the extra pages do not cost any extra money to print. Therefore, it can be understood that important topics should be divided clearly into their own spaces – make enough room to tell their

importance and let the learner absorb the information piece by piece. While keeping the page not filling up with text, the designer can make the page look more interesting by guiding the reader with conscious white space usage. It is not necessary to fill the page with colors and illustrations. (Tondreau 2009, 18.)

Tondreau claims that lowering the text columns towards the bottom of the page (not starting from the top) will keep readers more engaged as it creates a feeling of movement. That leaves the top of the page for white space or miscellaneous information, creating a more luxurious feeling (Figure 3). Our reading direction usually goes from left to right, but always from top to bottom, which clearly indicates that there is no more information to read, and it is time to move to the next page. (Tondreau 2009, 48.)

FIGURE 3. Illustrating bottom aligned text (Salo 2020)

As important as it is to create easily understandable layouts, it is also important to keep learners interested. Without any variation, clean layouts with the same elements make the reader feel like they are reading the same page repeatedly, and the learner will lose focus (Tondreau 2009, 52).

Concise, scannable and objective bulleted lists score 124% better user experience than promotional writing with inline lists (Nielsen 1997). This scannable simplicity should be a core principle when creating learning content. It should be easy for the learner to read through the material. Too complicated explanations can create problems for the learner, and as in 3.2, they can become expensive.

5.3 Pictures alongside the text

In the middle of long text sections, a designer can enhance the reading experience by giving the reader a break and guiding their attention with rules, drop caps, bold headlines, colors or images. Even if the page looks full with a large picture, it can seem spacious as it is not full of text (Tondreau 2009, 132, 148.)

If there is a face on the page, it is generally very possible that the reader looks at it (Johnson 2010). Many types of images or other breaks in the layout will draw attention, but somehow the presence of faces attracts the most attention (Johnson 2010).

Even when bottom-aligned text can create a feeling of movement (as in 5.2), an image can change that direction. A designer can guide the reader to look somewhere by placing an image of someone else looking there, like in Figure 4 (Anderson 2011).

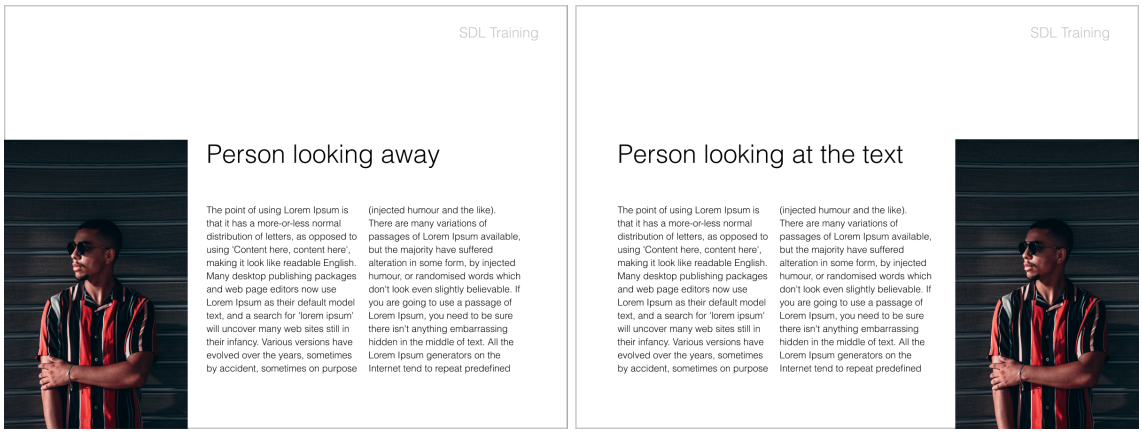

FIGURE 4. A person looking away from the page (left) and the person looking at the text (right) (picture: Nouasria 2020)

As we generally read from left to right, a face or eyes looking to the left breaks this reading flow (Figure 4). If the designer uses a picture with eyesight to the right, it can create more movement forward (Figure 5).

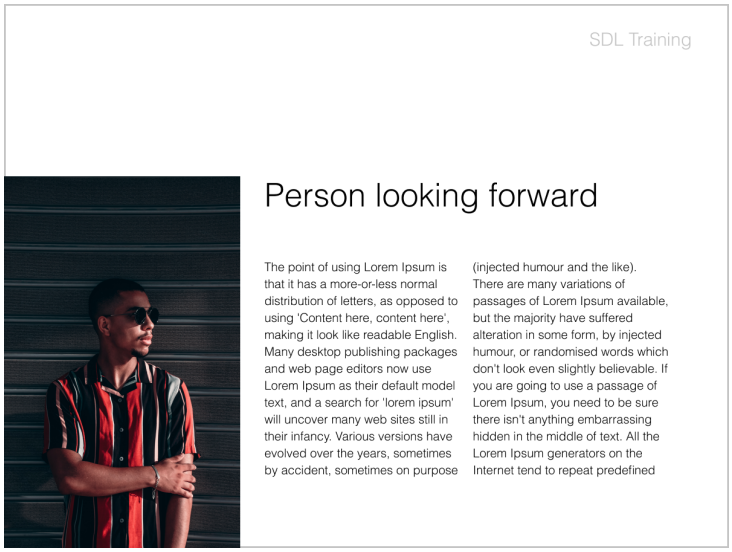

FIGURE 5. A person looking at the text to the right guides the reader to look at the text and move forward (picture: Nouasria 2020)

6 DESIGNING COURSE MATERIALS

In this section, I will go through the process of redesigning course materials. First, I will describe the process of creating a bespoke illustration style to create cover images and give the course a personal touch. After the illustration style, I look at how to create easily readable course contents.

6.1 Goals

The first phase (6.2) aims to make the course content more appealing for the learner by creating a custom illustration style for cover images. Kuniavsky states that if the course material is visually attractive, the barrier of starting the course will be lowered, and the learner will spend an extra effort to understand it (2003, 43). The result will suggest how to illustrate this quite abstract SDL course content humanely. After creating the design comes testing – does the result endorse illustrating all of the courses in this style, or is it not worth the time?

The second phase (6.3) aims to develop the course content's general readability by basic graphic design techniques. After the initial motivation boost, how can the course material keep the learner engaged? The course should have uniform components, so learners do not need to figure out every element, and they can focus on the content (Nielsen 2020). If all of the diagrams look different, learners need to understand all of the quirks and details every time they see a new diagram style (Nielsen 2020). This understanding takes time and effort and thus is not very effective.

6.2 Illustration style

How can a designer create attractive and uniform cover images for a whole online course set? One possibility would be to fill all of the covers with stock photos. Stock photos would seem like an easy solution, but testing showed that this approach had problems. After a while, the designer cannot find any relevant photos

for every course module; the images start to be just generic stock photos without any meaning. The color palette and uniform style are also hard to keep throughout an extensive course catalog when topics vary a lot.

To create a unified look for all of the covers, I decided to try a custom illustration style. This way, the designer can keep the colors and visual cues uniform throughout the course catalog. During this illustration planning, one thing to keep in mind was that it should be reasonably easy to create new compositions, so the style should not be too complicated or detailed.

6.2.1 Color palette

I started the general color theme creation from the company's brand guidelines. The leading brand colors are two different blues and a few contrasting colors (Insta Brand Book 2019). Color theory also claims that blue appeals to men and creates calmness in mind (Cherry 2020). From these starting points, I decided to keep blue as the primary theme color.

While creating the illustrations, I found out that it would be good to have some flexibility in the color palette. Something else than blues were also needed to point out different meanings inside the illustrations. I discovered fitting colors through the illustration work, and they ended up being orange, fuchsia and a darker purple color (Figure 6). Choosing a color across the color wheel, or inverting a pure color, creates a complementary color (Decker 2017). Orange is blue's complementary color, and thus it really stands out from the blue. I included fuchsia and purple to give some extra flexibility. Sometimes the designer might not want to stand the element out as much as it would with orange.

FIGURE 6. The color palette for illustration style (Salo 2020)

6.2.2 Illustrating the product

A software product can be a pretty abstract concept to illustrate; how to illustrate something that does not have a physical form? Could the product be, for example, the princess of the story, the one that needs saving?

I approached this by researching how software has been illustrated through references and sketching on paper (Figure 7). Companies often illustrate software through devices, for example, computers and mobile devices. I did not feel like this would be the most exciting way to do it. An ex-colleague of mine explained that developing software is like building a house. From this house building idea, I tried to illustrate the product as a building or a glass house. When I tried to make the glass house look more organic, I found a playful form like a cell or an alien blob.

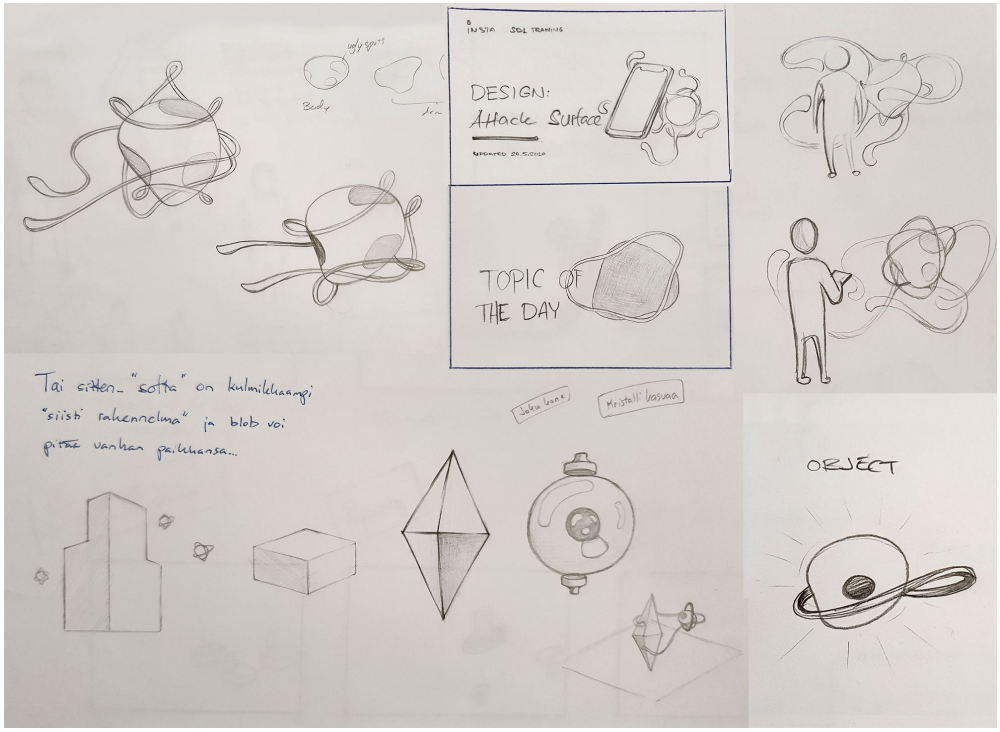

FIGURE 7. Sketching the form of the product (Salo 2020)

I took the direction to illustrate the product as a hovering cell or an alien blob, with alien-like rings as arms (Figure 8). I planned that this alien-like form would fit into many different situations, as the products can be diverse. This approach also created an excellent characterization of the antagonist, as in 6.2.3.

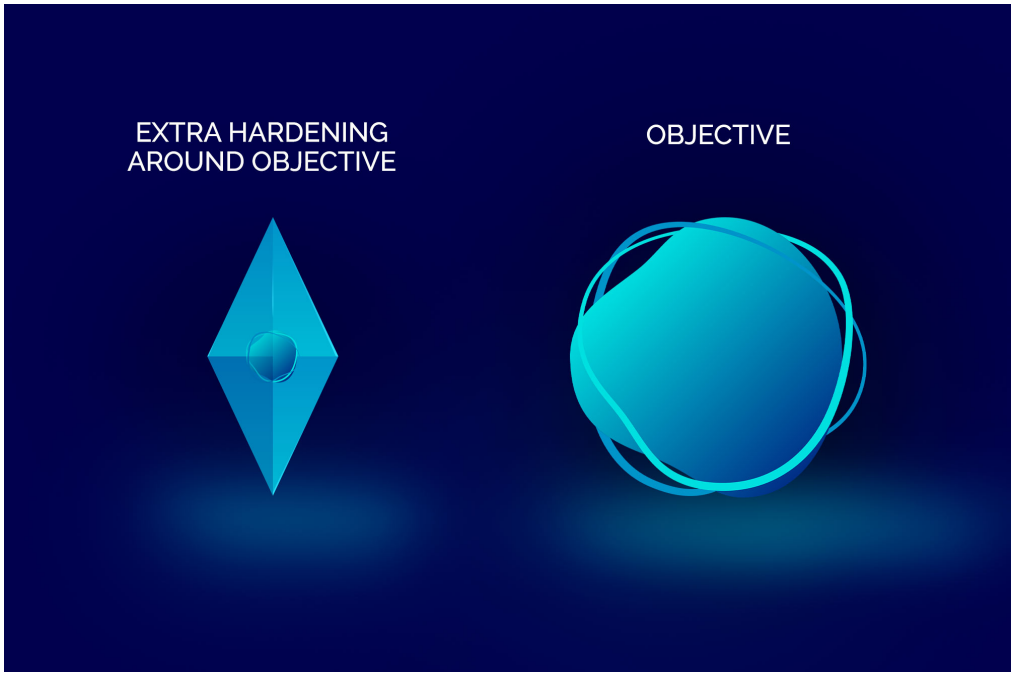

FIGURE 8. The final form of the illustrated product (Salo 2020)

6.2.3 Illustrating the antagonist

I approached the illustration process through a protagonist and an antagonist. ”Next to your protagonist, your antagonist is the single most important character in your story.” (Weiland 2016). In the field of cybersecurity, there are quite clear opponents to choose from. I could have illustrated the antagonist as a hacker, but the hackers are not the only obstacles on the way. Creating illustrations for every possible obstacle and foe would make the illustration style more complicated and time-consuming. If I illustrated the threats only as hackers, it could create false expectations for the learner.

To illustrate the antagonist as a broader threat, I tried to implement a scapegoating ideology for singling out a group without singling out a specific type of threat. Burton describes scapegoats being outsiders, whom the scapegoaters can then persecute (2013). In this case, the outsiders’ group can be hackers or other entities who might harm the system. Illustrating this group as one character could create an easy component for illustrations, so the learner would as quickly as possible recognize that it is an opponent.

While sketching the product, it occurred to me that I could utilize the alien-like blob to represent the antagonist. Alternatively, in the biological cell metaphor, the antagonist can be a bacteria or a virus. It is already dehumanized, as scapegoats often are (Burton 2013). It would easily fit the illustration style, as the form is already in use. I also tried other forms of the opponent in sketching phase but selected the alien-like blob form to represent the antagonist (Figure 9).

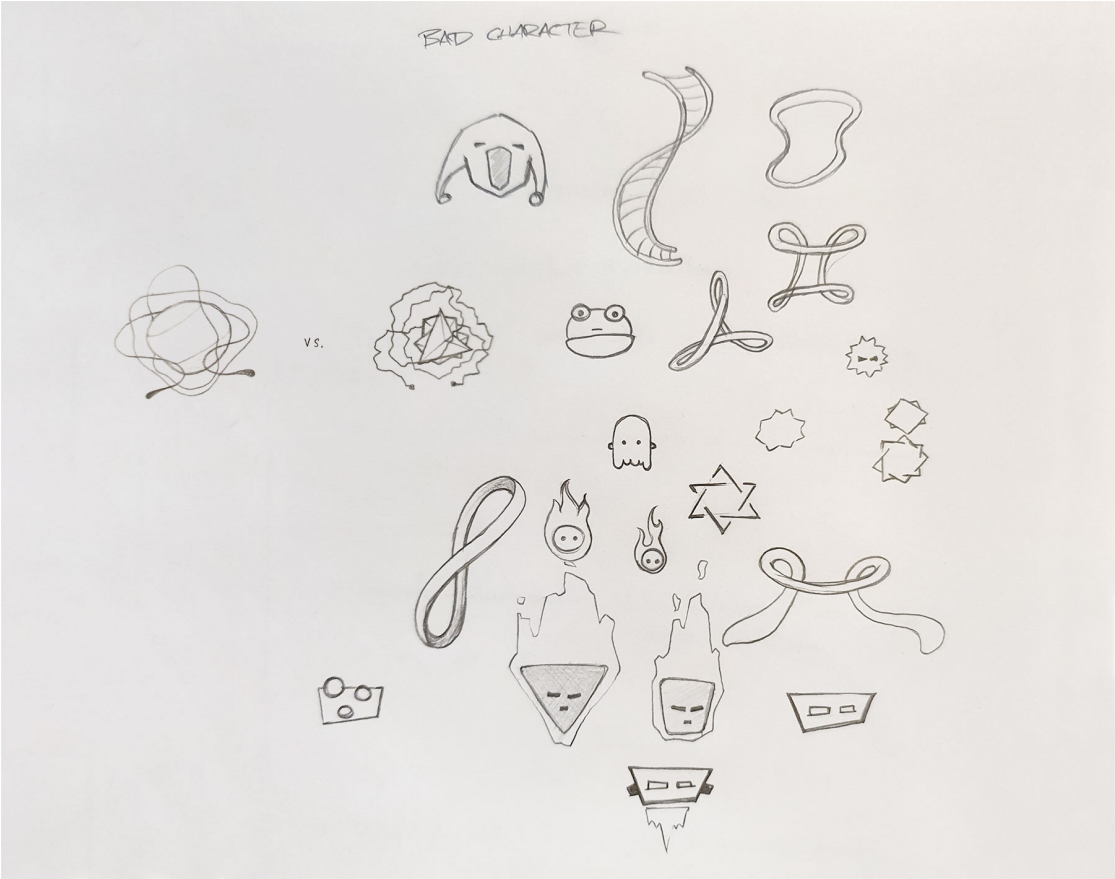

FIGURE 9. Sketching the antagonist on paper (Salo 2020)

I refined the product's form for smaller proportions. As antagonists are typically represented as darker characters, I kept the body of the antagonist dark. Only bright colors did not emphasize the badness of the character correctly. I found that purplish colors represented the ominous opponent characters better in the illustrations (Figure 10). In nature, some organisms are brightly colored to warn predators of their poisonousness. With this warning ideology, I colored the rings around the body brightly with the contrasting colors from the color palette.

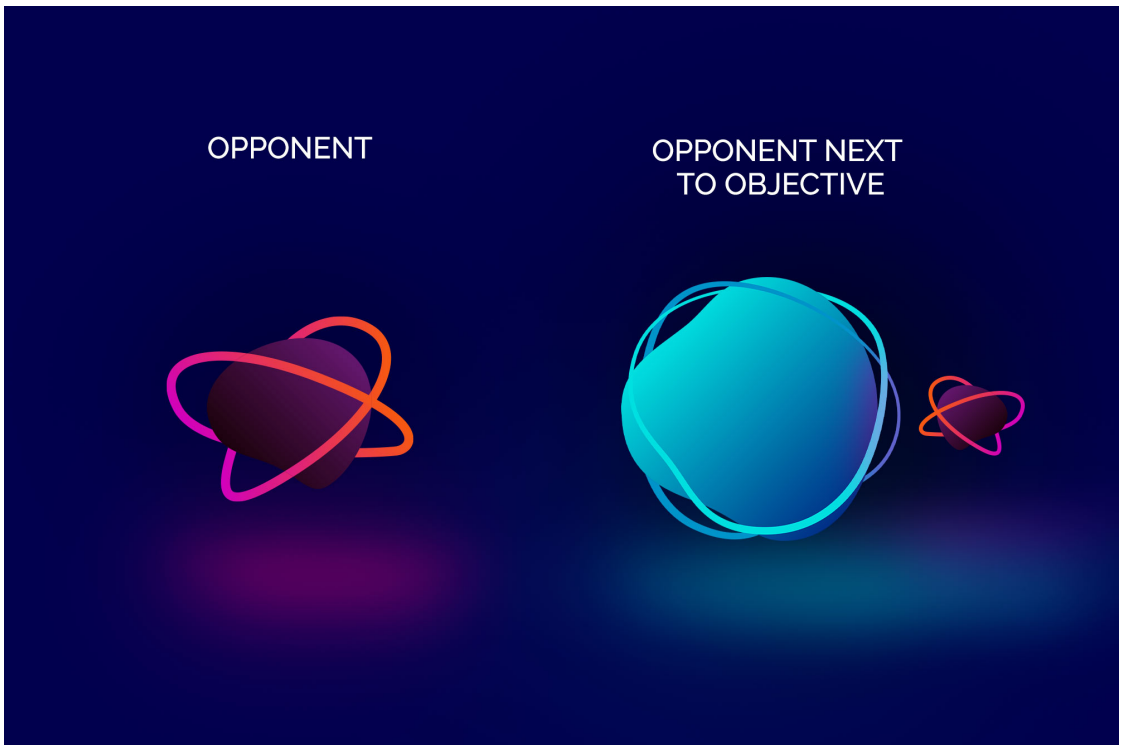

FIGURE 10. The final style of the antagonist (Salo 2020)

6.2.4 Illustrating the protagonist

If the antagonist is dehumanized, as Burton says they often are (2013), the protagonist should be seen as human as possible. As the learner will be protecting the product from the antagonist, a straightforward way to illustrate the protagonist is to use the learner as the hero. I illustrated the protagonist as an engineer or a scientist, as the target group consists mainly of male engineers (Figure 11).

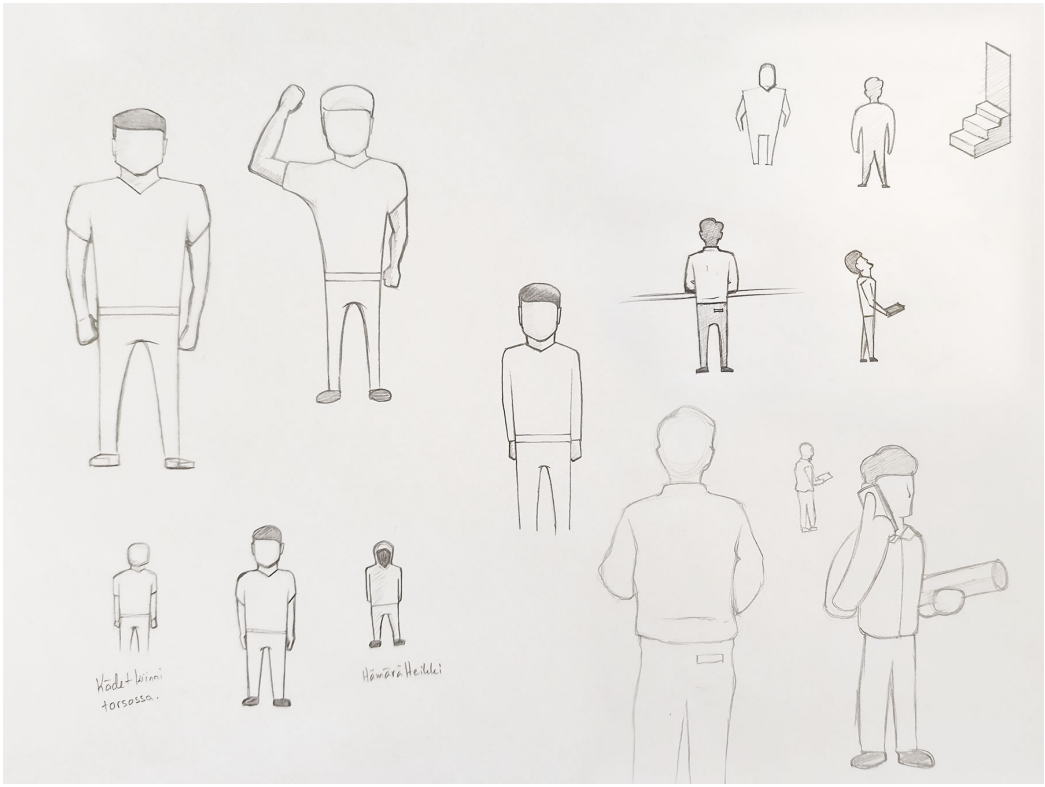

FIGURE 11. Sketchings of the protagonist character (Salo 2020)

This human form creates more complexity and details, so a uniform character might be hard to create everywhere. In some places, the character needs to be tiny, and in some other places, it needs to be much bigger (Figure 12). The product's and antagonist's alien-like blob can be scaled up or down when needed, and they do not necessarily need many poses. The human form is more complicated and needs delicate adjustments for different situations.

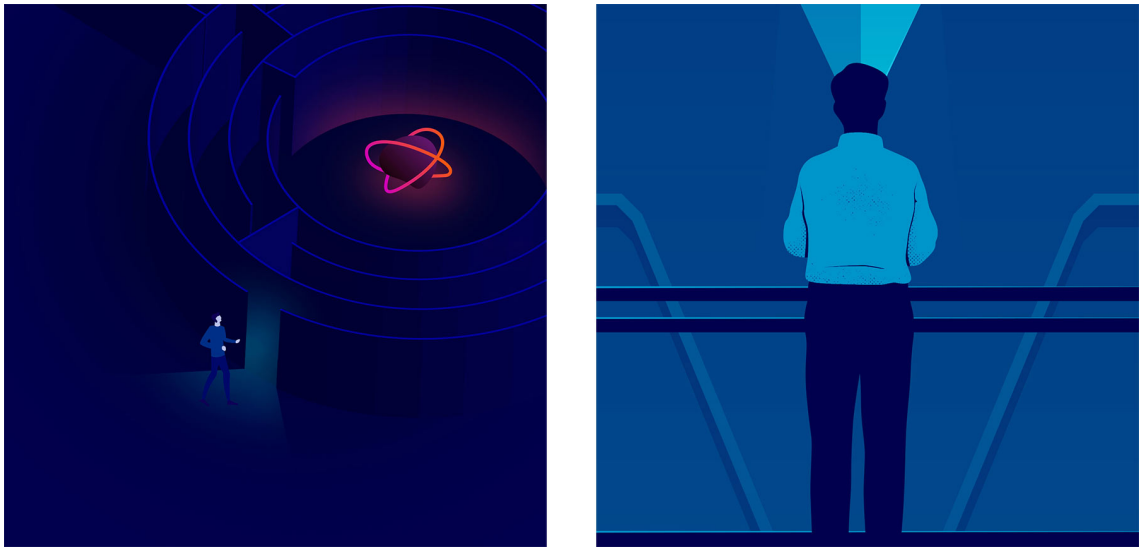

FIGURE 12. Examples of the final protagonist (Salo 2020)

6.2.5 Creating cover illustrations

I selected the darkest blue for the background of all of the illustrations. It gives excellent contrast for white text and is a good canvas to build the illustration on top of it (Figure 13). All of the illustrations need space for the course titles, which I placed on the left side. When the background colors and texts are alike in all course covers, it creates a uniform look, even if the illustrations vary a lot. For example, in all of the shown examples (Figure 13), the illustrations vary drastically, but they still look like they belong together.

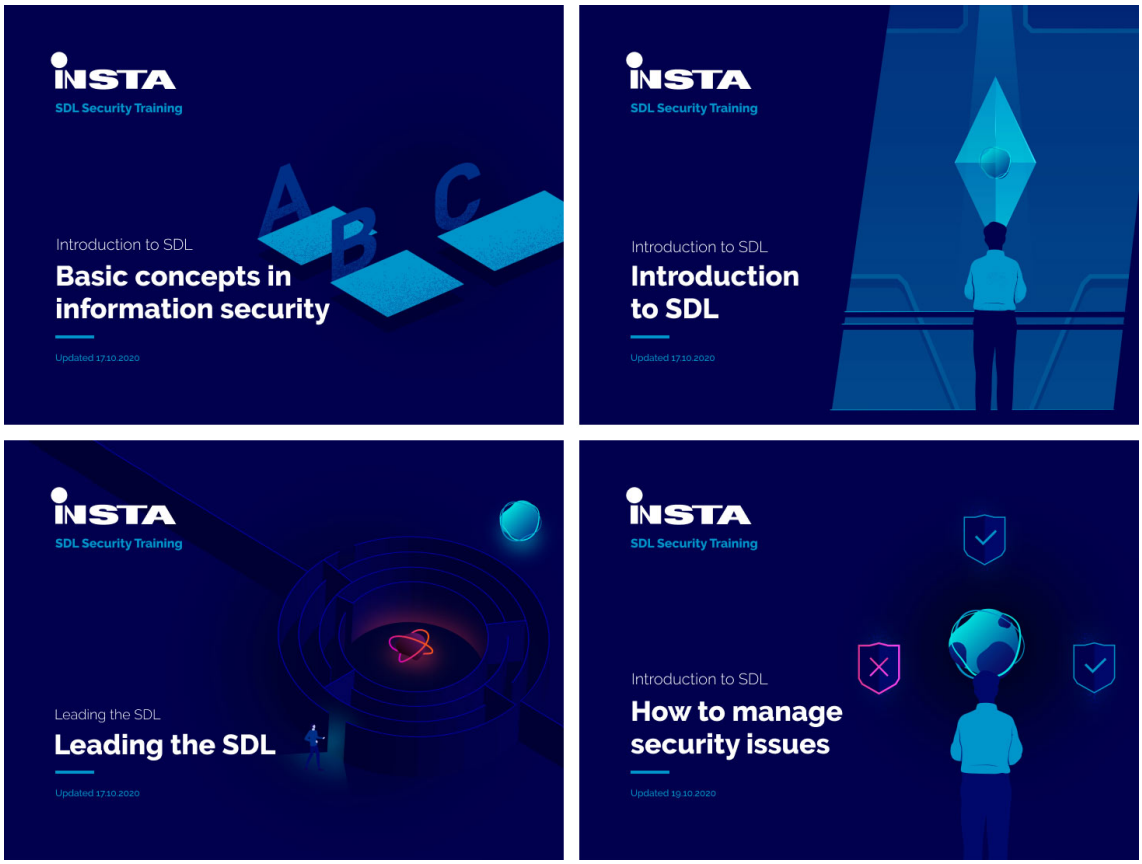

FIGURE 13. Cover examples (Salo 2020)

6.3 Course content styling

Cover images and illustrations enhance the mental image of the course. To make the course more effective, content is in a critical position. The course's learning outcomes must be clearly addressed, and the content needs to supports this (Holmes & Gardner 2006, 100–101). I tried to implement this by emphasizing the contents that the learner needs to notice.

6.3.1 Typography and color palette

Fonts for the typography were defined by Insta's graphical guidelines (Insta Brand Book 2019), Raleway for titles and Lato for body text. I defined the generic color palette already in 6.2.1. However, as the learner consumes content pages differently than the cover images, they might need slight adjustments. Content pages have much text that the learner needs to read on a screen. There have been discussions if it is better to have light text on a dark background or the opposite. Even when some people like to read light text on a dark background, light text on a dark background might cause reading difficulties for people with astigmatism (Cole 2019). Therefore I decided to go with dark text on a light background.

When creating the layout for course content, I noticed a need for different tints and shades of the defined colors. Old course materials sometimes had colors from all over the color wheel, but I wanted to use the two primary blues to keep the color theme uniform. These hues could then be divided into more colors with different tints (adding white to the color) to create more variability if needed (Figure 14).

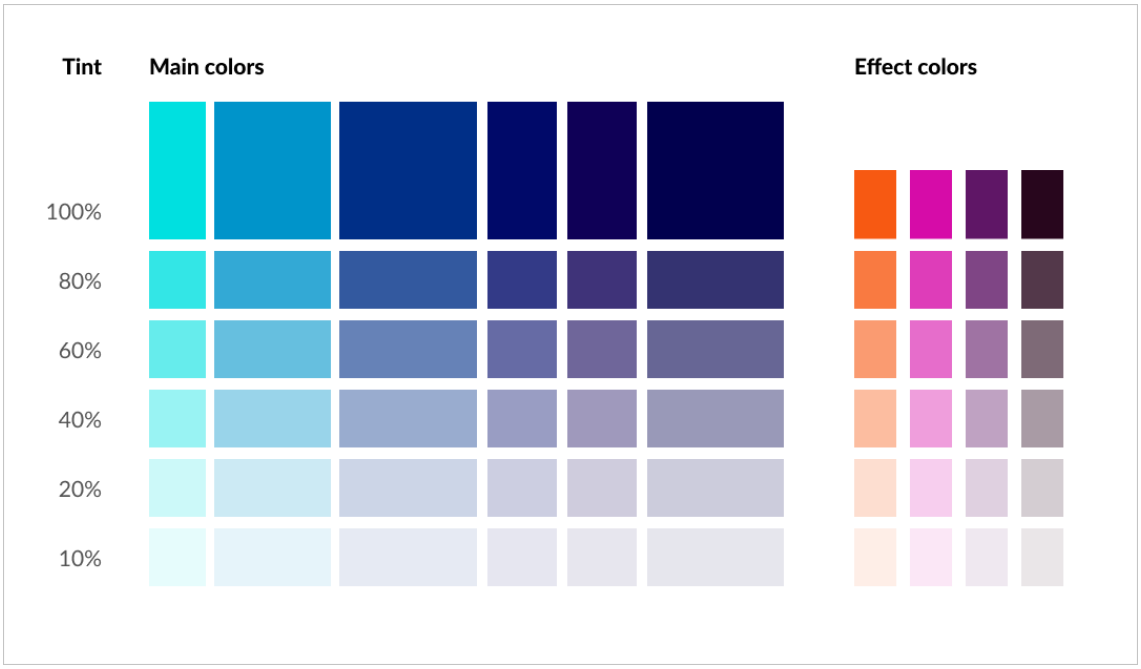

FIGURE 14. Adding tints to scale up the color palette (Salo 2020)

6.3.2 Keeping text easy to read

In the course materials collected from the specialists, texts are often pretty monotonically styled and just in one full-width column. I felt that these wide columns were hard to read, as there were 120 characters in one row in one example (Figure 15).

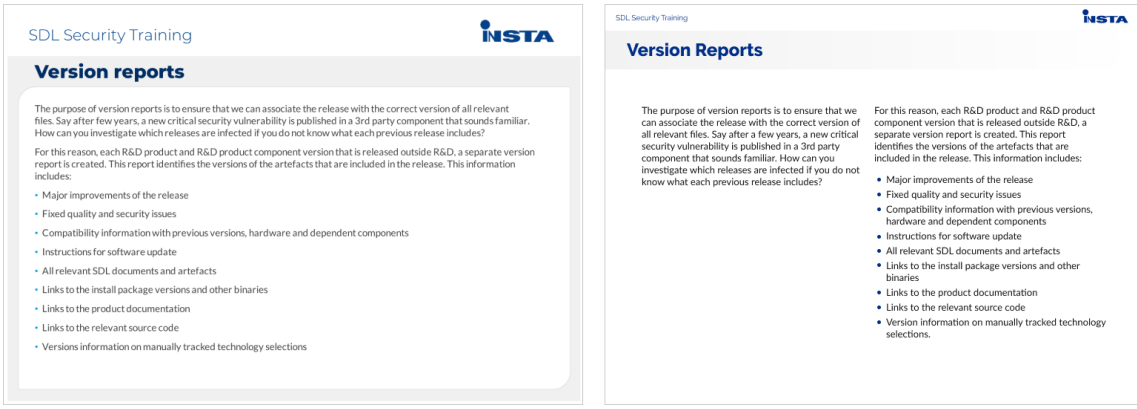

FIGURE 15. Example of a wide text column (left) and redesigned layout for readability (Insta SDL Security Training 2019; Salo 2020)

In the redesigned layout, the column width is approximately 50 characters per row (Figure 15). This row length fits in the optimal line length of 40–50 characters

in multi-column text (Choose a comfortable measure n.d.). Optimal line length should improve the readability, as the learner does not need to search for the correct place after each row (Holst 2010).

I wanted to give the content area as much space as possible. To do this, I made the header area slightly smaller. I also removed the gray frame from the original material to remove visual clutter (Figure 15).

How about text alignment? Which is easier to read, left aligned or totally justified paragraphs? According to Harrison (2020), Colin Wheildon, editor of the largest Australian motoring publication, found in his testing that totally justified text had a much better comprehension level than left-aligned text. This would give a guide to use a totally justified text in this project. However, as Butterick (n.d.) writes, “Keep in mind that the justification engine of a word processor or web browser is rudimentary compared to that of a professional page-layout program”. A totally justified column would need to be configured precisely to avoid large gaps between words (Smith 2014). The best option for many digital applications is to use a straight left edge with a ragged right edge (Smith 2014). Just do not let the right edge deviate too much, “The rag should be between one-fifth and one-seventh the width of the paragraph” (Smith 2014).

6.3.3 Repeating pages

There are specific pages that occur in every course module. For example, the agenda page is seen in every module (Figure 16). That is a page with varying lists placed in various places.

FIGURE 16. Old agenda page (Insta SDL Security Training 2019)

This page's content is always pretty similar, so I could divide it into specific sections. To make the sections clearer, I created some iconography to make it feel a bit more unique and present the specific areas more clearly (Figure 17).

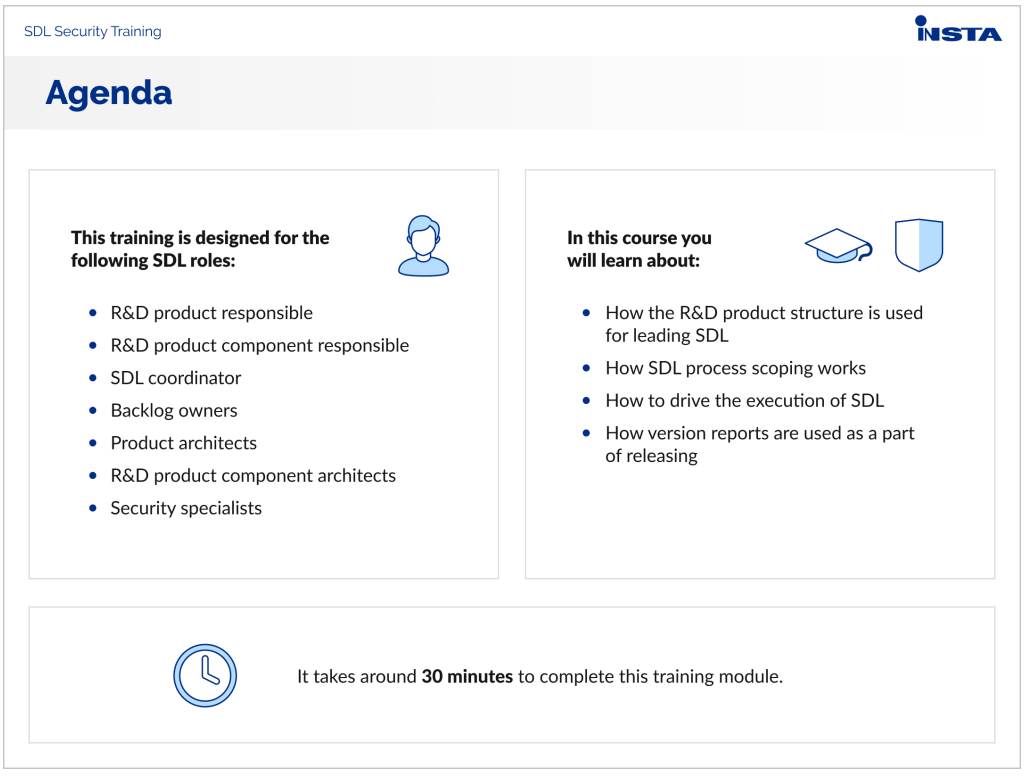

FIGURE 17. The redesigned agenda page (Salo 2020)

6.3.4 Diagrams

As mentioned in 6.3, emphasizing the right information at the right time can make following the course much more comfortable and rewarding than letting the learner always figure out the needed information. Technical content often has many flow diagrams to present how the system works. In the original format, some of the diagrams had every block with a different color for no apparent reason (Figure 18).

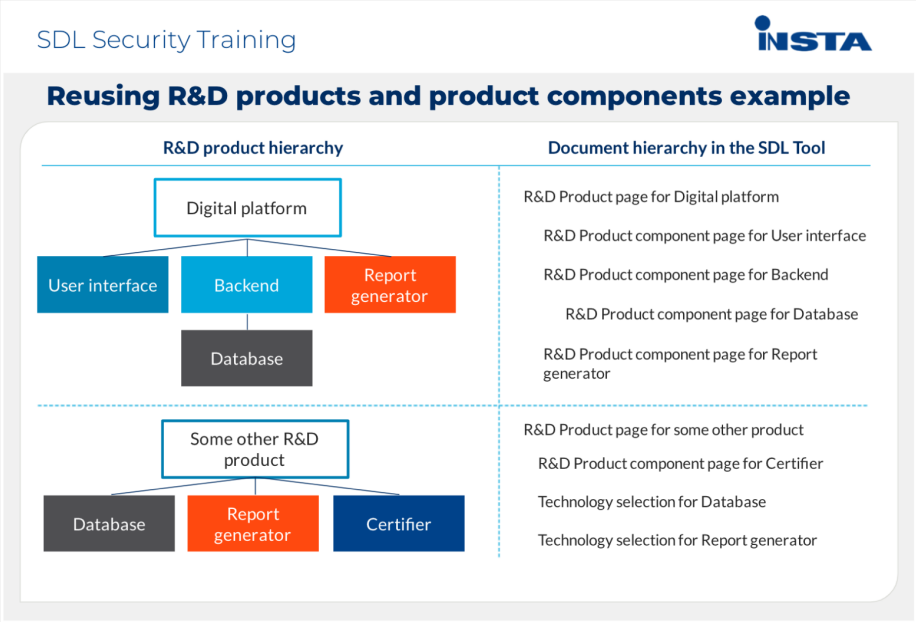

FIGURE 18. Every block uses different colors (Insta SDL Security Training 2019)

I wanted to emphasize the needed information by keeping regular blocks uniform and the specifically needed blocks clearly different, so the learner could understand by a glance what they should be focusing on. I implemented this by coloring regular blocks with different tints of light grey or light blue and specifically needed blocks with clearly different colors (Figure 19). This coloring created contrast, which guides the learner's eye quickly in the right direction.

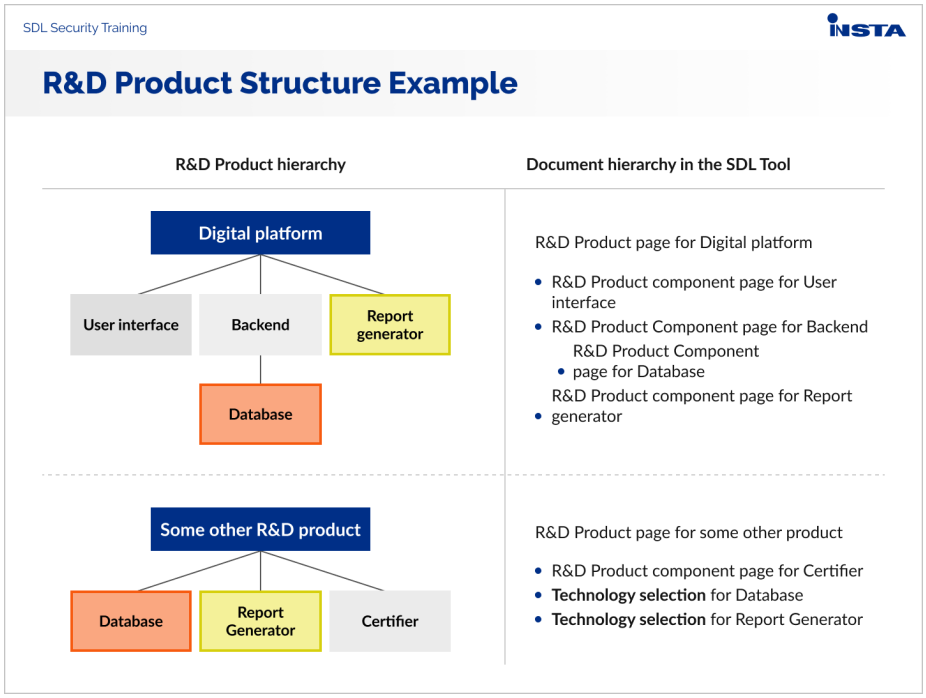

FIGURE 19. Different colors are pointing to only needed objects (Salo 2020)

Especially in a male-dominated field, some learners will have a color vision impairment or total color blindness. For that purpose, I differentiated the special attention needing elements also with a stroke around the block. This stroke should give some indication also for the learners with no color vision (Figure 20).

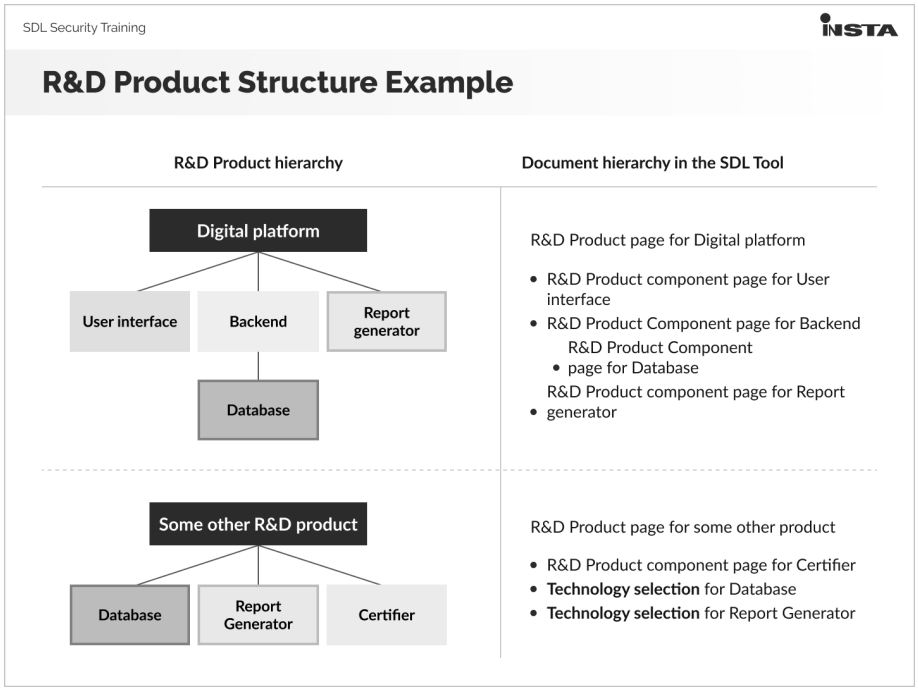

FIGURE 20. Demonstrating diagram with no color vision (Salo 2020)

6.3.5 Visually divide good and bad

There will come situations when it is needed to display options or lists that are separated by good and bad. Often learning materials have examples of “do this” and “never do this”. In these separations, it is possible to display a separation in color, but is it enough?

If the elements are lists, the first step is to separate each other as separate elements (Figure 21). Keeping them still attached by some familiarity, the learner can observe them as a pair with just a glance. The designer can create this familiarity through element shapes and placement.

FIGURE 21. Example of separation of what to do and what not (Salo 2020)

It might be needed to portray a bad actor in these course contents. In the cover illustrations, I am illustrating bad actors with a specific character. To keep the visual cues uniform, the designer can use them to portray bad actors inside the content.

6.4 Testing metrics

Due to the outbreak of Coronavirus disease (COVID-19), the year 2020 has been tough for many and created some time constraints for the users I had available for testing. As meetings in person were not possible, and many were still struggling with working from home only, on top of regular pressure at work, I needed to lower the scope of this testing.

I redesigned two online courses for testing purposes. I wanted to see if the new design suggestions were more effective and joyful for the learner than the earlier ones. To point the learners' attention to these two aspects, I created questions and tasks for the learner. The learners first completed two of the current courses and then answered a set of questions about them. Then the redesigned courses were introduced to the same learners, and after completing them, the learners answered the same set of questions based on the redesigned courses.

The first indicator was if the product solved the learner's problem by making the material more comfortable to read (Norman & Nielsen n.d.). Nielsen very much encourages tracking performance metrics (2012). To track these performance metrics, I created a task for the learner to track how many times they struggled to find the correct line to read or understand the text (Appendix 2). With the lowered testing scope, I did not have enough testers to conclude performance metrics safely, but this task pointed their attention to keep the easiness of reading in mind for feedback.

The second indicator was "joy to use", testing if the learner wanted to consume the course material (Norman & Nielsen n.d.). At the start, I told the learners to think about how they like the courses' visual design. The learners then gave this a score through a question "How likely is it that you would recommend this course to a friend or colleague?" on a scale from 1 to 10 (Appendix 2). Again, with the lowered testing scope, there were not enough testers to conclude safe metrics, but this pointed the testers' attention to the general feeling of the course.

After these direct tasks and questions, I also gave the learners a feedback form to give their thoughts in free text form. With some of the testers, I also messaged afterward to talk about their feelings.

6.5 Testing results

Four learners from the target group performed testing tasks and gave feedback. Results were positive; with the redesigned course, some learners struggled less, and the likelihood of recommending for friends and colleagues increased for everyone. A mention needs to be given for the fact that the questions pointed the testers' attention towards the visual styling.

Current courses

Tester number one mentioned the big and wide blocks of text in the current course materials as a negative thing. Tester number two said: "It was not a joyful experience, but it worked". Tester number four commented: "Several times I had to read sentences again because they are long and monotonous, making them hard to follow through. In my opinion, some pages have simply too much content/text in them, and the wording is confusing at times as well".

Redesigned courses

Tester number one mentioned that the slides still contain some bigger blocks of text, but they are still slightly easier to read. Tester number one also mentioned that the slides look more uniform, modern and professional than before. Tester number two said: "The new CIA vs AIC graph is much easier to read!" Tester number three said: "Overall I like the new layout; looks more professional, that's why I would recommend this with likelihood "9" instead of "8" for the previous". Tester number four commented: "I liked how the use of bolding and bullet points made long sentences more readable. In general, the content felt clearer and less cluttered. The design was clean, simple, and enjoyable. I felt this version was more readable and easier to follow, even though the text was exactly the same."

7 DISCUSSION

Designing online courses is fascinating. There are many ways to improve the learner's engagement, and the work can always be improved. Even while this thesis aimed to look at it only from the visual design point of view, there are many aspects to consider.

Small improvements in the layout design made the reading easier for the learner. Taking these improvements to project templates will help to create new courses. The designer can work faster with a set of predefined components, and at the same time, create a more uniform set of courses. All of the improvements can help the learner consume the information faster, which is beneficial for the company.

Cybersecurity is an area with abstract concepts, but I found a way to create an illustration style that is easy to extend. Based on the feedback, this illustration style and visual improvements in the content increased the learner's motivation to recommend the course to friends and colleagues, even though this was not quantitatively proven.

As the test group was limited to four people, the test results need additional evaluation to decide on continuation. However, nothing indicated any negative signals of this approach. From the lack of negative signals, I can say that the work was successful, and at least parts of it should be taken into use when these courses are updated more. In the target group survey, I found that visual design was not the target group's major pain point in online learning; therefore, this redesign does not need to be prioritized too much.

Some additional topics for future research were found. As many of the target group's typical learning platforms use audio as one of their methods to deliver their content, would it be beneficial to add audio to SDL training courses? Another research topic could be if it would be beneficial to make the courses easier to use on mobile devices.

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APPENDICES

Appendix 1. Target Group Questionnaire About E-Learning Preferences

1. How many years do you have professional experience in the software field? (Multiple choice)
    a. 0–3
    b. 3–5
    c. 5–10
    d. 10–15
    e. 15–20
    f. >20
2. Where do you normally learn new skills or practices related to software development?
3. Related to course's tasks, implementation or visual design: Have you had a really good experience with a software related course? What was so great about it?
4. Related to course's tasks, implementation or visual design: Have you had a really bad experience with a software related course? What was so bad about it?
5. How true are these claims? (Scale 1–5)
    a. Course's visual style has an impact on my motivation to start it
    b. Course's visual style has an impact on my motivation to finish it
    c. I feel that I learn better and/or faster when the course is nicely visualized
    d. I feel that I learn better and/or faster when the course has text based quizzes testing my understanding
    e. I feel that I learn better and/or faster when the course has game-like interactive elements testing my understanding

Appendix 2. Redesign evaluation

1. Moodle course
    a. How many times did you struggle with understanding something in the courses?
    b. Giving a score for the "Joy to use" – How likely is it that you could recommend this course to a friend or colleague? (1–10)
    c. Free form feedback for Moodle course

2. Redesigned course evaluation
    a. How many times did you struggle with understanding something in the courses?
    b. Giving a score for the "Joy to use" – How likely is it that you could recommend this course to a friend or colleague? (1–10)
    c. Free form feedback for redesigned course