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Digital Learning Designed for Entrepreneurial First-Time Smartphone Users

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Todo list

Digital Learning Designed for Entrepreneurial First-Time Smartphone Users

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Titel
Title

Design och utveckling av mobilinlärning för entreprenörskapscoacher i Uganda och Zambia

Digital Learning Designed for Entrepreneurial First-Time Smartphone Users

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Sammanfattning
Abstract

If your thesis is written in English, the primary abstract would go here while the Swedish abstract would be optional.

Nyckelord
Keywords   problem, lösning

Sammanfattning

Svensk sammanfattning här.

Abstract

If your thesis is written in English, the primary abstract would go here while the Swedish abstract would be optional.

Acknowledgments

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Notation

The following definitions of words will be used while reading:

DESIGN SITUATION

Word	Definition
entrepreneurship	the act of creating new businesses
entrepreneur education	when an entrepreneur goes trough training
training	can be both physical and digital training, but always has the purpose to improve the skills or knowledge of the trained
effectiveness	is about keeping the same quality with less means (economical, physical, time resources, etc)
coaching	is the activity in which a person is helped by being asked questions and support, often by a person

DIGITAL DEVELOPMENT

Word	Definition
digital tool	electronic help for a person, designed to solve or assist a person in solving a task that otherwise would have been more cumbersome
digital education	an education which takes place on an electronic device, either partly or fully
app / application	a kind of digital tool, and can often be downloaded from an app store, either on mobile or web

DESIGN PROCESS

Word	Definition
interaction design	describes the creation of digital artefacts
client	the organization in need of the (master thesis) project

LEARNING

Word	Definition
formative assessment	given to you, for your own sake
summative assessment	given to the employee, for the employee's sake

1

Introduction

This chapter is the introduction to the master thesis report.

1.1 Purpose

In order for young ambitious entrepreneurs to build sustainable enterprises they need to have basic entrepreneurial skills. This is where a mobile learning platform comes into the picture.

1.1.1 Task

The entrepreneurship education YoungDrive is an initiative of Illiana Björling from YoungDrive, now collaboration with Plan International. Within the project A working future, they have educated, supported and inspired 12 000 Ugandan youth in the process of starting their own businesses. [Nissar, 2016]

YoungDrive now requests two digital modules, to reach even better results and to be able to scale up the operations to more locations with confidence.

The overall aim of the master thesis is to do a Minimum Viable Product (MVP) of module 1, the Coach module.

The master thesis is about how to design an app for entrepreneurship education, including evaluating it's effectiveness towards the coaches.

The result is an app which the coaches use during and after the coach training.

1.1.2 Goal

By training coaches that can carry out the education in larger groups of entrepreneurs, the education reach many young people at the same time. A mobile learning plat-

form is predicted to improve the effect of the training even more, by fulfilling the following purposes:

- Validate the coaches' level of knowledge during their education

- Train the coaches on distance

- Certify all staff

Young Drive's experience goal for the app is "It should be easy to understand, pedagogical and enjoyable to use, and the coaches should think it is fun and meaningful to learn via the app". [Björling and Lönn, 2016]

1.2   Theoretical Background

To understand how to reach the objectives of the project, this chapter presents background and relevant theories.

Part 1-2 deals with the design situation, part 3-4 gives introductions to relevant topics, and part 5 presents related work.

Part 1-2: Design situation

For design situation, the client context is described. This also includes a motivation for digital learning, and related work to the thesis.

The first section describes the opportunities for entrepreneurship in Uganda, followed by how Plan International and YoungDrive uses this to tackle child poverty by fostering and educating youth in starting their own businesses. This section concludes by how digital learning and digital tools becomes increasingly demanded, which is why this master thesis has emerged.

Part 3-4: Relevant topics

In this section, an introduction is given into entrepreneurship education, digital education, and hybrid app development.

Part 5: Related work

In this section, first examples within digital tools are named that have either considered a developing country context.

Secondly, two studies within digital learning are named, which have combined learning theory and a mobile or computer platform.

1.2.1   Social Innovation and Social Entrepreneurship in Uganda

This section will present background on working with mobile learning platforms, and understanding the society of entrepreneurs in Uganda.

Why Uganda is the world's most entrepreneurial country

According to Nissar [Nissar, 2016], some facts related to entrepreneurship in Uganda are:

- Uganda is the world's most entrepreneurial country. (28% av of the population are entrepreneurs)

- Uganda has the second youngest population in the world (77% of all Ugandans are below 30)

- Uganda has a very high unemployment rate (64 % of people between 18–30 are unemployed)

With a high unemployment rate and little or none social security, starting a business is for many young entrepreneurs simply a tool for survival. But tough conditions can also lead to creativity, and there are as well many innovative entrepreneurs with great ideas and the aim to create positive social impact.

No matter the reason of starting a business, Uganda's many entrepreneurs are contributing to the national society by boosting the economy and creating new jobs.

Why mobile services is growing fast in Uganda

One of the reasons is that the country has invested heavily in communication networks, even connecting remote rural villages with fibre optic cables and thereby connecting them to a world of information.

As much as 65% of the adults in Uganda owns a cell phone, which has allowed many areas in the country to skip the landline stage of development and jump right to the digital age.

For those who hasn't electricity at home, there are plentiful of charging booths for mobiles all over the country.

Mobile services and social innovations

The wide use of mobile phones has lead the way for the development of several innovative mobile services and in many cases the mobile service are way ahead of us [Nissar, 2016]. In Sweden mobile banking services that allows us to transfer money through our mobile phones were made popular with Swish, introduced in 2012. In Kenya people have had similar services for the last 10 years.

1.2.2   The Client: YoungDrive

In this section, the project that the *client* YoungDrive is in is first described, and then how YoungDrive fit into the structure of the thesis with its entrepreneurship education program. In the last part, future plans of YoungDrive and A working future is presented, giving relevancy to the field of digital education.

The Project: A Working Future

Plan International works towards eliminating child poverty, and their project A working future, supported by SIDA since the year 2012 until 2016, tackles unemployment among youth in rural areas. The project runs for 12 000 youth in Kamuli and Tororo.

The Structure: Youth Savings Groups with Trainings

Because of high tuition fees, saving (financial literacy) and earning (practicing vocational skills) are central.

VSLA (Village Savings and Loan Associations) groups have existed for many years, where a group starts a village savings and loans group together. A democratic process makes the group independent of banks, which rates are in general high and which may not even borrow money, either because of long distances to the bank or of no previous financial history.

For Plan International, VSLA groups have been successful in several countries for a long time. However, while the groups were skilled with saving, they did not always spend the money in the most strategic way.

Plan's pilot with A working future, was to introduce trainings on top of the VSLA structure.

Where CBTs (Community Based Trainers) were previously only responsible for hosting the groups, not they were trained and tasked with carrying out different programs: like agriculture, financial literacy, and the most successful program to date, focusing on running own businesses, YoungDrive.

The Entrepreneurship Program: YoungDrive

YoungDrive is based on a Swedish concept, and had previously had a pilot in Botswana, when tasked with running the entrepreneurship module of A working future. The organization fosters and educates young entrepreneurs in developing countries. They train the CBT's, provide training material, and support the CBT's via direction and direct support through co-project leaders and Youth Mentors (YMs).

YoungDrive moves an entrepreneur to location, becoming country manager. Then, she educates project leaders during four days, followed by educating CBT's, which then roll out the training to the youth groups during 10 sessions, 1 session per week in average. The CBT's also rolls out other trainings, often simultaneously.

Future Plans

For the future of YoungDrive, they want to make the CBT's even better, and collect and take use of data (monitoring and evaluation). Another motivation is scaling and monetization, as Plan International wants to increase the project to more countries, with an increased digital focus, and YoungDrive wants to be independent of project funding (i.e. a social enterprise). This was a great time to

introduce digital enablers, where there previously had been no technology-focus, especially towards CBT's and YM's. The master thesis is the first project which focuses on digital enablers for YoungDrive.

1.2.3 Entrepreneurship education

Entrepreneurship education has been a growing field of investigation over the last three decades. While Dickson [Dickson and Weaver, 2008] says there are few empirical studies available, examples include among others Kuratko [Kuratko, 2005], Pittaway [Pittaway and Cope, 2007] and Bae [Bae and Fiet, 2014].

Especially relevant for this work is the recent interest in interventions for teaching and learning entrepreneurship in the developing world: [Oviawe, 2010] [Iakovleva and Stehphan, 2011]

First, Oviawe [Oviawe, 2010] conclude by how teaching of creativity and problem-solving skills seems to be especially beneficial for entrepreneurship in developed countries. In YoungDrive, the youth are tasked with starting their own business from no capital, which fosters creativity and problem-solving skills.

Further, Iakovleva [Iakovleva and Stehphan, 2011] indicated that respondents from developing countries do have stronger entrepreneurial intentions than those from developed countries. This stems from attitudes, subjective norms, and perceived behavioural control. Their encouragement, is that developing countries need to focus on the development of institutions that can support entrepreneurial efforts. YoungDrive is one such example.

Ruskovaara & Pihkala [Ruskovaara and Pihkala, 2015] concludes, that the teacher seems to be the main factor for entrepreneurship education, and that research agrees with them.

There seems to be no indication of difference between men and women, nor previous professional teaching experience.

Entrepreneurial activity seems to lead to better entrepreneurship education.

Recommendations for enhancing entrepreneurship education practices are mainly two things.

First, the playful side of teaching and learning is mentioned [**?**].

Secondly, they encourage teacher training that develops the competences as a mentor, enabler or coach.

1.2.4 Digital Education

In recent times, e-learning has had a tremendous impact both outside and inside the classroom. With a growing teacher interest, research so far shows that digital education is hard, risky and possibly rewarding. [Luckin and Noss, 2012] Thus, digital education shows both great potential and great considerations.

Brining research into reality

Clark [Clark, 2014] has done a comprehensive study, which motivates why a digital tool or game is a good thing by showing a .33 standard deviations in intrap-

ersonal learning outcomes, relative to non-game instructional conditions. They also conclude, that design rather than medium alone predicts learning outcomes.

Much of the research to date on digital games has focused on proof-of-concept studies and media comparisons. The study's encouragement, is to focus on how theoretically-driven decisions influence learning outcomes: for the broad diversity of learners, within and beyond the classroom. Literature that have looked at mobile apps for learning specifically, are Godwin-Jones [Godwin-Jones, 2011] and Page [Page, 2013].

Caring for the context

Luckin [Luckin and Noss, 2012] emphasises the need to care for the context. Stickdorn [Stickdorn and Schneider, 2010] exemplifies how the design process should be altered when the context is social innovation.

Service design in a social innovation context is called "social design", and is a new field. [Stickdorn and Schneider, 2010]. No longer is service design solely focused on creating and promoting consumer goods, but to offer services to society. The design process should be designed to tackle a social issue, or with the intent to improve human lives. The focus is on delivering positive impact.

E-assessment

There are numerous examples of developments in e-assessment using mobile environments, as well as immersive environments and social and collaborative environments.

Interest in formative e-assessment is increasing. A large amount of development has taken place on diagnostic testing environments, that allow teachers and learners to assess present performance against prior performance. [Luckin and Noss, 2012] For example, it has been shown that multiple-choice tests in e-assessment can be used to good effect [Nicol, 2007].

Luckin says that further consideration should be given to how technology can be used to enable the assessment of knowledge and skills not usually distinguished within current curricula. [Luckin and Noss, 2012] One such example would be entrepreneurship.

1.2.5   Hybrid App Development

The history of app and web development is rich and increasingly intertwined. First, websites were developed for desktop only, and when smartphones became popular, they were made responsive.

With today's possibilities of native mobile development or developing a native app using web technologies, there are numerous viable alternatives available if an app should function on several devices, depending on budget and preferences.

One of the main argument for developing an app in web technologies, is that the whole application, including the server, can be written in one programming language, JavaScript (full-stack).

Tools such as Apache Cordova can compile JavaScript applications into native apps. Thus, they can appear on Apple iOS and Android Play Store, as well as on the web, or installable offline on a smartphone from the computer.

JavaScript is developing rapidly as a language, as well as its ecosystem of frameworks and tools. Frameworks have emerged and matured, like Meteor.js, which makes building full-stack applications in JavaScript reliable and fast.

Previously, web hosting has been troublesome for JavaScript server applications. Today, tools such as Meteor.js and Heroku have introduced free and paid hosting for such applications, with smart bindings to code platforms such as GitHub, which makes collaboration and version handling easy.

1.2.6   Related work

Caring for the context

One great example of a mobile banking service that is a true social innovation is Ledger Link, developed by Grameen Foundation in collaboration with Barclays Bank. This mobile banking service empowers saving groups in rural areas to save money. It is developed with human centered design methods, and has won several awards. [Nissar, 2016]

The educational app platform iSchool, developed by iSchool Zambia, has been praised and made popular as it was designed to fit the Zambia school curriculum to the point, accessible as a home edition, pupil edition and teacher edition.

Digital assessment and mobile learning

Two studies within electronic assessment (e-assessment) or mobile learning (m-learning) have been done that this master thesis is inspired by. One uses deliberate practices on a mobile learning environemone [Yengin and Uzanboylu, 2012]. The other focused on and further validated the research of various experimental studies, that multiple-choice can be a viable auto-assessment method to improving student learning, especially for m-learning [de Marcos and Otón, 2010].

1.3   Research Questions

The overall aim of the study is to create and apply a design process of an application for entrepreneurial learning, to be implemented in a developing country context.

In response, the following specific research questions were raised:

1. How is the development affected by the technical possibilities?

   - Limitation _____ insert limitation here

2. How is the design affected by the contextual constraints, e.g. young entrepreneurs, entrepreneurship education, and culture?

- The app will be a compliment to the physical YoungDrive training, not a replacement. This would be interesting continued work.

3. How can test questions be developed to support entrepreneurship learning?

    - Solely existing YoungDrive teaching material will tested using the app, not new material, or other entrepreneurship programs.

4. How does design affect usability and learning done via the app?

    - Ideally, the master thesis would include measuring how app usage affected their youth session quality, measured by the coach, the youth, and co-project leaders.
      If this would have been the case, there could have been three different control groups: A, using the app and the YoungDrive training, B, using only the YoungDrive training, and C, using only the app.

5. How can users' feedback be used to inform modifications of the app?

    - Limitation

insert limitation here

2

Methods and Implementation

This chapter presents the methodological framework, via presenting methods to design for learning and motivation.

Then, the setting and research context is described, together with a description of the participants.

Then, application implementation is described, followed by presenting the study design and data collection.

The final topic is data analysis theory.

2.1 Methodological Framework

2.1.1 Methods to Design for Learning

The following sections, are about how to design for effective learning [Dirksen, 2012], by designing for the mind, cognitive psychology.

Cognitive psychology deals with how our brain works in regards to our memory.

The section presents strategies and techniques to design learning for the mind, and what needs to be considered.

Two aspects are especially relevant when it comes to education: how humans can be supported to retaining (the first second) and retrieving (the second section) communicated information.

In how humans learn, the purpose is to find the most powerful strategies and techniques to design effective learning (mapping educational objectives, how to build skills, pattern-matching techniques, and the power of reflection and assessing).

In how people forget, UCLA Bjork's Learning and Forgetting Lab [Bjork, 2016] researches how people forget, and how to design so that people do not forget (

retrieval practice and spaced practice).

Learning Entrepreneurship: Mapping Educational Objectives with Bloom's Revised Taxonomy

What to teach should be determined by the learning objectives of the activity.

Learning activities often involve both lower order and higher order thinking skills as well as a mix of concrete and abstract knowledge. This needs to be designed for. Here, Bloom's revised taxonomy can provide usable insight into how to design, by the combination between lower or higher cognitive complexity, and concrete (factual or conceptual) or abstract knowledge (procedural or metacognitive). [Cheong and Cheong, 2012] The taxonomy thus provides a framework for determining and clarifying learning objectives. See figure 2.1 from [Heer, 2012]. Each colored block is an example of a learning objective matching with the two dimensions. The figure also explains the different concepts. Depending on the objective, it fits differently into the Knowledge dimension and Cognitive Process dimension of Bloom's Revised Taxonomy. [Krathwohl, 2002]
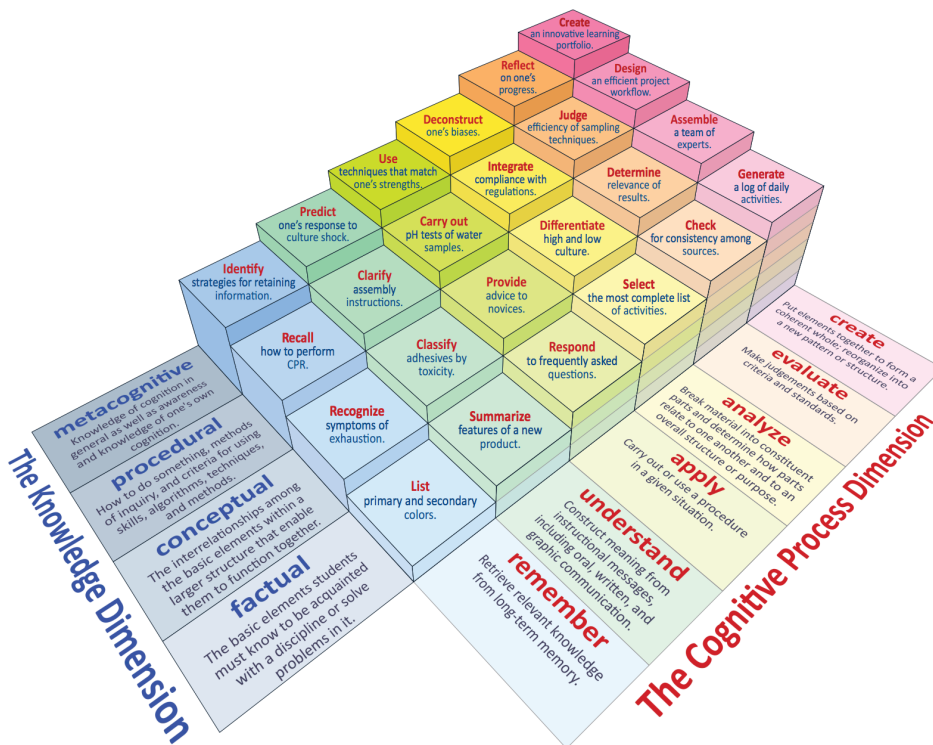
Figure 2.1: *Bloom's revised taxonomy visualised with examples of different learning objectives.*

Bloom's revised taxonomy can be useful both to map learning objectives for en-

trepreneurship and as an entrepreneurship coach. To craft good multiple-choice questions could be an art, but to map the question to the learning objective makes it into more of a science:

Entrepreneurship topic question: "What is financial literacy?" (= *conceptual* and *remember*)

To simulate a procedural environment, the question can be presented as a scenario:

Entrepreneurship coach question: "It turns out that 10 youth have not carried out the business action, what should you do?" (= metacognitive and evaluating)

There are several traps that the person formulating the question and answer alternatives can fall into, in the case of multiple-choice, where a good question might be de-amplified because of the answer alternatives.

Consider the coach being asked to give business advice to a fictional youth named Adam: "Adam wants to start a business that is based on a product. which business should he start?". Before, the coach has been given questions on what a service and product is (factual remember), what the difference is (factual understand), and been given examples (conceptual analyze). Now, the skills are being put to a procedural test.

If the answer alternatives are obvious (or memorized), the learning will be lower than scoring high on Bloom's revised taxonomy.

If the answers are high-quality alternatives, all of the answers must be evaluated and considered. In such cases, multiple-choice learning can actually amplify learning, via *learning by repetition* or *learning by thinking*.

In this case 3-4 valid alternatives might be: "Start a salon", "Start selling soap", "Start a bricklaying business".

It is still hard to score high on the knowledge and cognitive dimension using techniques such as multiple-choice with entrepreneurship and coaching. This is however necessary, if the app should reach the learning objectives of YoungDrive.

There may need to be additions to the multiple-choice design, and not only content. Such design ideas may be utilizing flip card techniques (don't see answer alternatives until you've thought of your answer), or asking "How sure are you?", both encouraging metacognitive thinking.

More ambitious ideas, would be to simulate the entrepreneur coach environment more accurately than via text (using more channels, like audio, video, voice), or to do simulations instead of using multiple-choice. The advantage of multiple-choice, is that data can be collected easily, and that it serves the target group of first-time smartphone users, and because of ease of implementation.

Building skills: by Spaced practice, Deliberate practice and Perceptual exposure

Spaced practice deals with spreading out learning, with the purpose of not forgetting. E.g. Clark [Clark, 2014] concludes that spaced learning versus massed learning (no rest between sessions) did have a memory benefit in their study.

Taking spaced learning into consideration, could mean making the user apparent on the person's meta-cognitive ability (your personal insight of what you'll

remember and when you are likely to forget), and meta-memory (when you need to repeat information in order not to forget).

Clark [Clark, 2014] found no evidence of consistent correlation between total duration and effects on learning outcomes in their study. So how do you design for optimal learning outcomes of skills, particularly if those are entrepreneurial or coaching skills?

When building skills, Sierra suggests deliberate practice [Yengin and Uzanboylu, 2012] [Sierra, 2015]. The goal is to help users practice right, by designing practice exercises that will take a fine-grained task from unreliable to 95% reliability, within one to three 45-90-minute sessions.

Deliberate practice has been proven to be an effective way to build skills. It has also been tested before for mobile learning environments. [Yengin and Uzanboylu, 2012]

Sierra [Sierra, 2015] suggests skills to be divided into three buckets: can't do (but need to do), can do with effort, and mastered (reliable/automatic). The goal then is to move skills from can't do into mastered, in the best way possible. See figure **??** from Sierra [Sierra, 2015]. Sierra says, if you can't get the user to 95% reliability within this time, stop trying; you need to redesign the sub-skill. [Sierra, 2015]
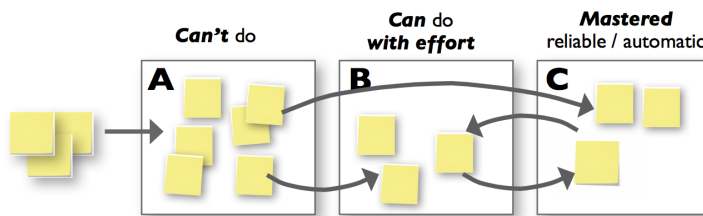
Figure 2.2: *Moving skills from A (Can't do) to B (Can do with effort) into C (Mastered) can move different ways, depending on how effective the learning is. Deliberate practices focuses on A-B-C, while perceptual expose enables A to C. Reflection allows knowledge to go backwards, to get better at the skill than previously possible. An example might be to teach "Financial literacy". Concepts and factual knowledge (like what income and profit is) might need to move A-B-C, whereas entrepreneurship skills (like taking financial decisions) can move A-C if it becomes intuitive for the user, e.g. via having been exposed to a lot of trial-and-error examples in the app.*

Desirable difficulties applies here, meaning that during deliberate practice, it may feel as if learning gets harder and harder, but in the long term the user is actually learning more. As a result, less people does true deliberate practice, but they do not get the same reward in return. This needs to be designed for, e.g. using social psychology.

By deliberate practice, you can practice better. The second attribute of those who became experts, were that they were exposed to high quality, high quantity

examples of expertise. [Sierra, 2015]

It shows that whenever a skill relies on intuition, we could try exposing the user a well-designed trail and error test. In the case of multiple-choice questions, this could be done by exposing users to very high-quality samples during a very limited time. Perceptual knowledge includes teaching what we think of as expert intuition (like being a good entrepreneurship coach).

Sierra shows how researchers have repeatedly, by well designed tests, been able to quickly build expertise by trial-and-error feedback. A novice would hazard a guess and an expert would say yes or no. Eventually the novices became, like their mentors, masters of the expertise that could otherwise would have been intangible for long.

Learning from Assessment

Knowing what learners know, and don't know, is crucial to effective learning, Luckin [Luckin and Noss, 2012] says.

Assessment can partly help to design for flow, matching challenge and ability [Brühlmann, 2013], which is effective for intrinsic motivation (see next chapter).

Moreover, it also has cognitive benefits. It can help to offer appropiate feedback, increase learners' awareness of their learning needs, and give accurate assessment and analysis, and allows learning to be tailored.

By recognizing differences of students, in their ability to understand what they know and how they can progress, it is possible to ensure that everyone achieves their full potential.

Effective assessment by a teacher or agent includes individual feedback (task-oriented and informal) and appropiate feed-forward advice.

Learning by Thinking: Reflection & Retrieval Practice

Stefano [Stefano and Staats, 2015] suggests that that reflection has been an overlooked area of research for a long time. During the act of reflection, the student develops necessary skills and self-awareness to refine their own learning activities. His results suggests that reflection as an activity that can be more effective than additional learning. This surely applies to the teacher as well, Luckin says. [Luckin and Noss, 2012]

Stefano found that individuals who are given time to reflect on a task, outperforms students who are given the same amount of time to practice with the same task. But, similar to deliberate practice, it is a desirable difficulty: individuals in the test themselves, had a tendency to believe that allocating time to practice on the task rather than reflecting on it would benefit them.

When it comes to study technique, Bjork [Bjork, 2016] as well shows that retrieval from memory is more effective than people who repeat reading the same thing to remember: the more effective students, retrieves from memory.

One way to use memory retrieval as a study technique, is to ask "What was in that article?", before checking the answer in the article (the flipcard principle). It is an example of memory retrieval that is extremely effective for learning, their

research shows. There is a danger with multiple-choice questions, that the student is given no time to reflect on the question and their prior knowledge, before evaluating the alternatives.

2.1.2   Methods to Design for Motivation

Social psychology can guide the design when there is a wish to make people behave differently. One of the biggest areas of research is motivation psychology.

Motivation is commonly divided into three areas:

- Self-determination - the students inner motivation, genuine wishes

- Achievement - the students motivation to achieve

- Expectation value - the expectations on the student

Koballa [Koballa and Glynn, 2007] and Abell [Abell and Lederman, 2007] gives an overview of theories developed for these three fields. Further, Fulmer [Fulmer and Frijters, 2009] provides a review of methods to collect data which can be used to study motivation.

Deci [Deci and Ryan, 1985] and Ryan [Ryan and Deci, 2000a] studies self-determination theory, Elliot [Elliot and Covington, 2001] studies achievement theory, and Eccles [Eccles and Wigfield, 2002] and Wigfield [Wigfield and Eccles, 2000] studies expectancy-value theory.

If you have designed for the user's compelling context, Sierra says, the users are already motivated. Their motivation is to become better (achieve). [Sierra, 2015].

In terms of effective learning and expectation value, a growing research field is training transfer [Brinkerhoff, 2013]. Before and after is as important as the training itself. To design for this, the leader should be involved with the participants before the training, and communicate expectations. The student should be expected to implement the training in everyday life. [Brinkerhoff, 2013]

Sierra [Sierra, 2015], suggests the focus to be how to help users progress (see "Progress and payoffs", achieve), and what pulls them off (see "Cognitive load theory").

Cognitive load theory

Sierra argues working on what stops people, matters more than working on what entices them. Thus, a focus needs to be identifying and removing blocks.

Sierra [Sierra, 2015] describes how humans have scarce cognitive resources, and how to design for these.

Cognitive load theory (CLT) research is divided into three areas: intrinsic CLT (stumbling blocks), extrinsic CLT, and germane CLT. Below, to design for these are described.

Intrinsic CLT, needs to be dealt with if the effort is too high. Sierra [Sierra, 2015]describes two strategies. She first says that according to deliberate practice, if you can not get to 95% reliability within three 45-90 minute sessions, split

skills that can be done with effort into sub-skills. The purpose is to reduce time spent practising being mediocre.

Extraneous CLT, is about the way information is presented to a learner, and should be handled via designing to support cognitive resources, Sierra says [Sierra, 2015].

Germane CLT, is the work put into creating a permanent store of knowledge. To support cognitive resources, escape the brain's spam filter by making the information essential. Either by designing for the compelling context, or desining for just-in-time learning versus just-in-case, Sierra says. [Sierra, 2015]

Scaffolding is a technique to step by step remove the support wheels for the user, e.g. present information in different ways. Clark's [Clark, 2014] report shows that in their research, each category of scaffolding demonstrated significant effects on learning.

Another way to reduce cognitive leaks is don't make users memorise unnecessary things: make the thing you want the user to do, the most likely thing to do (affordances). Everything that takes willpower, reduces cognitive leaks.

In the case of an quiz app, the visual presentation of the questions can reduce extraneous load by removing unnecessary information. Germane load can be increased by giving scaffolding support at the end of each section, for example helping users to remember, by showing them their answers.

The rule of thumb is that you want to decrease extraneous load (bad load), and increase germane load (good load).

Progress and payoffs

Sierra argues that to pull users forward, to stay motivated, progress and payoffs are essential. Both of these, are investigated in terms of motivational psychology.

The feeling of progress can be emphasised by a path with guidelines to help the user know where they are at each step, e.g. for a training. To create a path, she encourages the designer to make a list of key skills ordered from beginner to expert. Then, these are sliced into groups of ranking or levels.

This way, it is possible to design a "belt" path for your context. The first level, should feel like a superpower for the user. The best payoff, is a intrinsically rewarding experiences, according to Sierra [Sierra, 2015]. For an entrepreneur, gaining the skills of selling (the progress) can be as rewarding as having gained the money for it (the payoff).

For motivation, the earlier, lower levels should be achievable in far less time and effort than the later, advanced levels. One practice is to try to have each new level take roughly double the time and effort of the previous level. This highly relates to flow.

Caring for the compelling context, why the user wants to learn the skill, are helpful strategies. A sometimes critiqued way of progression is to give the user high pay-off tips, but if done in a fair way, it is a good way for both learning and motivation.

This kind of path map is suberb to simple gamification, says Sierra [Sierra, 2015]. In an app for building entrepreneurship coach skills, the act of becoming

certified (getting 100% correct), might not be as rewarding as the progress of getting there. Therefore, gamification of the sort "rewarding effort" might be more beneficial with "rewarding result". Suitable gamification could also mean unlocking new possibilities of adding value to the app (for example adding questions to the quiz), versus getting a badge or a star.

The shown benefits of designing for intrinsic motivation is in-line with self-determination theory [Deci and Ryan, 1985] [Ryan and Deci, 2000a]. Pink [Pink, 2011] says that the surprising truth about what motivates us is that drive is fostered by autonomy, mastery and purpose. Meanwhile, Clark [Clark, 2014] says that simple gamification as well as more sophisticated game mechanics can prove effective. However, he adds that it should be investigated if "simple gamification" (e.g. contingent point and badges connected to learning activities) more frequently focus on lower-order learning outcomes, compared to studies with more sophisticated game mechanics. For the case of entrepreneurship, the goal is on higher-order learning outcomes, meaning simple gamification is not enough to motivate users. Thus, if you do not design for the compelling context, entrepreneurship coaches may well prefer other learning methods instead of using your gamified app.

2.1.3   Design Thinking

Interaction design talks about the creation of digital artefacts specifically. When it comes to the design process, it is influenced by related areas such as human-computer science, and more recently human-centred design.

However, various disciplines suggests different design processes. For example, agile development suggest how do develop software efficiently.

Whenever a project is multi-disciplinary, various design processes may need to be combined. Whenever this happens, design thinking (how to think about design) becomes a skill essential to thoughtfully design the process.

Löwgren [Löwgren and Stolterman, 2007] writes about design thinking and useful techniques in general, from his interaction design perspective.

Service design thinking connects various fields of activity [Stickdorn and Schneider, 2010], and it's methodology relies on being close to the users.

While interaction design talks about the creation of digital artefacts specifically, service design talks about the creation of services.

As some digital artefacts are used within a service, or can be thought of as both a product and service simultaneously, the combination of the two can be very useful. Service design could help the designer be aware of how such a artefact would need to interplay with its physical environment.

Each discipline holds efficient methods and tools, that can be modified to suit the specific situation even better. From the field of graphic design, mental models describes the perceptions of the user. From interaction design, desirability, utility, usability and pleasurability can be useful principles to evaluate a product. While none of these are a mandatory part of service design, these have been useful in service design projects previously. [Stickdorn and Schneider, 2010]

In difficult situations, combining different disciplines places demands on the designer. This is where design thinking becomes relevant.

Below, relevant methods and tools are briefly described, and what it means to be a good designer.

A good designer

The result of a method can not be better than the people engaging in carrying out the process [Löwgren and Stolterman, 2007].

With its user-centered focus [Stickdorn and Schneider, 2010], service design can be said to equip the designer with tools both for reasoning and design ethnography. But it also suits to get to know and design for the learning situation.

In learning, the end goal is that the student raises their level of knowledge and expertise, and the design needs to be adapted for this specifically.

Central to design for learning is to dig deep into the topic being communicated. In this case, understanding entrepreneurship, understanding exactly what is being taught (the training), and adapting the design after this.

A good designer can deal with the complexities of design: a satisfactory (and surprising) solution or design can be achieved while working in a highly restricted situation [Löwgren and Stolterman, 2007]. This can be done e.g. by inventing new design techniques. One such example that would suit designing an app for entrepreneurship training in a development country, would be a *field hackathon*.

A field hackathon would thus allow that during the training, the topic *and* the users are observed and understood. Then, the app can be tested (in this can a quiz assessment of the trained material). Then, users can be invited to give feedback, suggestions of improvements, and ideas. For the next day, an improved version of the app is tested, and then the process is repeated.

More examples of how a service design process can be invented to deal with digital artefacts, can be desribed in the chapter Digital Service Design. However, to do such field tests (like a field hackathon), requires building trust and having an enabling environment, which is where relationships and roles becomes crucial.

How to deal with relationships and roles

According to Löwgren, "real" design is about finding ways to design a project within the existing preconditions and limitations [Löwgren and Stolterman, 2007]. Being innovative, and communicating well with the stakeholders, becomes crucial.

While a researcher is interested in reality, a designer is interested in what reality could become. [Löwgren and Stolterman, 2007] Being thoughtful means conceptual clarity from the designer, caring for the vision, and being equipped with appropriate tools of reasoning. These are all good characteristics for a successful project.

There are three roles as interaction designer in particular can take: the computer expert, the socio-technical expert, and the political agent. The trend is in-

creasingly towards socio-technical experts [Löwgren and Stolterman, 2007], the middle ground, as human understanding and collaboration is so important.

This seems to be a perfect fit with service design, where interaction design is both technical skills and design, and service design can be both design and ethnography. Even more importantly, service design suggests making the whole process co-creative, involving all stakeholders. [Stickdorn and Schneider, 2010]

Thinking of a product as a service

Service design thinking is described as a process of designing, rather than to its outcome.

A service's intent is to meet customer needs. If it does, it will be used frequently, and recommended. [Stickdorn and Schneider, 2010]

As this is often not the case, service design can be applicable to fields including social design, product design, graphic design and interaction design.

The result can be a product service hybrid. When designed and considered well, service design shapes the value proposition and desirability of the product for the better.

Starting the project

Löwgren writes about the beginning of a project: This is where the designer gets involved in design work, establishes a preliminary understanding of the situation, navigates through available information, and initiates all neccessary relationships with clients, users, decision makers, and so forth. Based on all this, she creates a design proposal. [Löwgren and Stolterman, 2007].

2.1.4   Service Design Methodology

Below, brief descriptions of five principles of service design are described according to Stickdorn [Stickdorn and Schneider, 2010], together with how the work is divided into iterations, and examples of tools that can be applied.

Principles

Stickdorn [Stickdorn and Schneider, 2010] describes five principles that constitute service design thinking, and how to follow these.

He describes how to follow these principles, by making the process user-centered (e.g. via *design ethnography*), co-creative (involve all stakeholders) and holistic (keep the big picture). Sequencing (visualize the service, and make iterations) and evidencing (make the service tangible) are the two last important principles.

Sequencing

Sequencing the process means splitting the design process into iterations, which consists of a number of steps, which are repeated for each iteration. This is a com-

mon denominator with the agile methodology SCRUM, which is often applied in software development.

While service design literature and practice refer to various frameworks, regardless of number of steps, every service design project includes: exploration, creation, reflection and implementation [Stickdorn and Schneider, 2010].

Nissar [Widmark and Nissar, 2016] suggests a model where one iteration consists of insights, ideation, trigger material, and interactions. See figure 2.3.

Figure 2.3: In Nissar's model, a iteration consists of Interactions, Insights, Ideation and Trigger material.

1. Interactions, where you are listening, the *Explorative phase*.

2. Insights, which is where you use the Interactions in order to try to understand, the *Understanding phase*.

3. Ideation, where you find possible ideas and when creation of new version of the app is done, the *Design phase*.

4. Trigger material, where material is developed to test the outcome of our evaluation in the next round, the *Trigger development*.

The iterations should come closer and closer to a desired outcome. It is not always obvious what this outcome is. For each iteration, the process takes the project closer, from Why? to What? to How?, often with overlaps [Widmark and Nissar, 2016]. See figure 2.4.
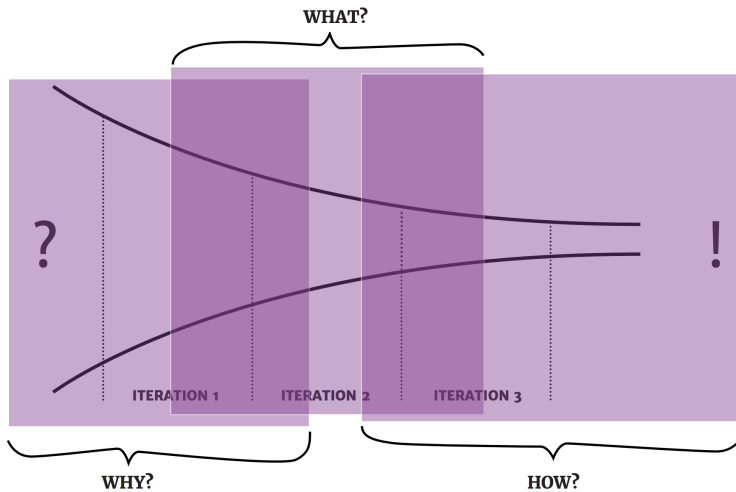
Figure 2.4: *The iteration process consists of a number of iterations with different focus, starting with broad strokes, and narrowing down into a concrete product. Between iterations, the overlap between "Why?" and "How?", "How?" and "What?", signals that there is a learning process which means conclusions may need to be quickly questioned as new insights emerge. This is especially important in projects where you work with an unfamiliar target group and there are several uncertainties and constraints.*

Service design tools

There are a number of popular service design tools that follows the five principles, e.g. how to make it user-centered.

Explorative tools are e.g. Shadowing, Customer Journey Map, Contextual Interviews, The 5 Why's (same as "Why-why-why" within interaction design [Löwgren and Stolterman, 2007]), Cultural Probes, Mobile Ethnography and Personas.

Tools to create and reflect can be done via a certain work methodology, e.g. agile development like *SCRUM*, and structuring and inspiring brainstorms, e.g. via "What if...?" and Co-Creation, inviting stakeholders in the creation process.

Interviews are often done via open questions (encouraging stories) and dialogue can be facilitated with a questionnaire guide.

In workshops, post-its are often used, and followed up with specific questions.

Service design methodology encourages taking pictures, filming and recording audio, benefiting the analysis done afterwards.

2.1.5   Digital Service Design

The method combines the benefits of Service Design, Agile Methodologies (namely SCRUM) and Interaction Design. Its purpose is to contribute a holistic approach to the digital design solution for a specific target group. The methodology was co-created by me and Expedition Mondial for the master thesis. [Nissar, 2016]

A "Service Sprint"

In Digital Service Design, an *iteration* is called a *service sprint*. Each iteration includes four steps: insights, ideation, trigger material and interactions. Each steps borrows a number of best practices from agile development or interaction design. There are also new methods, like how a *field hackathon* includes *mini service sprints* each day.

Below, the four steps are presented.

Insights: Analysis, Retrospective & Stakeholder feedback

Insights consists of *analysis* (service design), but also a *retrospective* (SCRUM) and *stakeholder meeting* (service design).

In the analysis, the app is evaluated (in terms of interaction design - pleasurability, usability, utility and desirability), and quantative data is processed (often by clustering data points) and compared with qualitative data (quiz results and questionnaires). This produces an analysis overview of the result.

In the *retrospective*, the design process is evaluated ("start doing, stop doing, continue doing"), and changes to the design process are suggested for the following iteration.

Both the result analysis and the design process analysis is then presented during two stakeholder meetings (service design), structured as *sprint demo*s" (SCRUM), with the purpose of getting feedback.

The first "Expert meeting" informs the next iteration's design process, while the second "Partner meeting" informs the next iteration's delivery.

From the insights, a *product backlog* (SCRUM) is converted from needs and ideas into *stories* balancing 1) user needs and 2) stakeholder needs.

Ideation: planning interactions and delivery

Ideation consists of doing *sprint planning* (SCRUM) for the trigger material (a *lofi* or/and a *hi-fi prototype*) and the interactions (where tests and workshops and field visits happen).

- Trigger material

    1. Ideas are formulated which would satisfy the user needs. This is often a iterative process, which happens in dialogue with chosen experts and entrepreneurs in technology, design and education.

2. To plan implementation of the ideas, every technical task are laid out, measured in time and prioritized. The least prioritized tasks can thus be cut or moved to the next iteration, in case it is necessary.

- Interactions planning

1. If the technical planning has been realistic, it is time to determine what this iteration's interactions should look like. How will this be tested?

2. The interactions activities are chosen (what, how, when), so that these are communicated to the local partner, who may schedule the days I will visit, and solves the needs to the best of their ability.

Trigger material

Trigger material is about preparing the interactions (field visits, interviews, app tests, workshops) and creating the lo-fi (pen and paper) and hi-fi prototype (developed app) to be tested with the users.

To track the progress and plan effectively, each day starts by a daily standup, where today's targets are set, ending by reflecting if the targets were met. If they were not, either the design process needs to change, or something needs to be cut short.

Interactions: with "Service Mini-Sprints"

Interactions always consists of a sprint demo with the users with the lo-fi or hi-fi prototype. During the development process, these are *formative tests*, while for final app evaluation, this is a *summative test*.

Group tests are facilitated as workshops. Often, a scenario is presented, devices are given, results are submitted, followed by an open discussion.

Individual tests are facilitated in the field (using the before, during, after technique). I observe how the coach does the job today, tests and observes if the app fits into the process, followed by an interview.

These tests always informs what steps to be taken next, both in terms of app development and interactions. Instead of waiting for the next iteration to do these changes, I often do what I call a *Service Mini-Sprint*.

Service Mini-Sprints

The insights gathered during the day allows for last-minute adjustments of coming pre-planned workshops (*co-define*, *co-create* or *co-refine*) or field visits (change of interview questions), that can sometimes happen the same day.

To take advantage of the precious time with the coaches, at the end of the day, app improvements are made and tomorrow's design process revisited.

This means, that already the next day, an improved version of the app can be tested. Similarly, if I was not satisfied with a workshop format, it has been modified.

These mini-sprints allows for very fast iterations, which can sometimes accelerate the outcome of the visit.

2.1.6   Methods for Data Analysis

Visualizing Data

Here, each step of the visualization pipeline is presented, allowing analysis of data.

The Visualization Pipeline describes the process of generating an image from the data: [Ropinski, 2014]

1. Data acquisition ($\rightarrow$ data are given)

2. Data enhancement ($\rightarrow$ data are processed)

3. Visualization mapping ($\rightarrow$ data are mapped to for example a geometry)

4. Rendering ($\rightarrow$ images generated)

Data acquisition presents how data was acquired.
Data enhancement explains how the data was processed.
Visualization mapping is the process of mapping data to e.g. a geometry.
Finally, rendering allows images to be generated, presented in 2D.

Calculating Correlation

Calculate means, follow formula. Cumbersome to do with all of the axises against all the agises.

This can be done in Google Sheets as well as the R programming language.

In Google Sheets:

It is clear that analysis in Google Sheets can only go so far. It can be greatly helpful to sort by multiple columns (e.g. first by Manual?, then by School level, then by Quiz 3). However, it takes a long time to filter the data on multiple parameters, and the work easily becomes tedious. For some applications, it may not be viable to discover the data using this approach.

One approach is to calculate and compare means on a "control" with a response variable.

Psuedo-code in R would be:

```
x1 = c(1,2,3,1,5,6)
x2 = c(2,3,4,NA,6,7)
cor(x = x1, y = x2)
cor.test(x1,x2)
```

Visualizing Correlation

In Google Sheets, color scale can be used to give different column values different colors.

It is still hard to compare all of the axises towards all the axises, and it is not a scientific approach.

Include figure

In R programming language there are more powerful tools for visualizing correlation, e.g. using a "Correlation Heatmap".

Psuedo-code in R would be:

```
random_matrix <- matrix(rnorm(100), nrow = 10, ncol = 10)
random_matrix[1,1] <- NA
colnames(random_matrix) <- paste("V",1:10)
cor_mat <- cor(random_matrix)
heatmap(cor_mat, keep.dendro = FALSE)
```

The result would be:

Include
figure

Calculating Logistic Regression

A limitation with correlation is that only two dimensions can be compared with each other.

With multiple-variable data, Logistic Regression is helpful if our response variable can be a logistical dimension (e.g. women or male, used manual or not), while linear regression needs to be used if it is a linear or nominal scale (e.g. age and city respectively).

In either case, the first step is to determine a response variable: the variable I want to compare against, e.g. is there a difference between men and women? In my case, it needs to be a quantative measure of: "Have you learned anything?".

If I add more variable, e.g. also adding if a manual was used, this is called my "control". It is possible to add as many controls as possible.

If linear regression, then I need to determine a quantative measure of ("How much have you learned?").

In Google Sheets, this is not effective to do. R, however, is a very suitable tool.

First, the data is loaded, e.g. as a CSV file. Then, we tell R which the N/A values are, e.g. "N/A" or "Vet ej". We use this to filter the data.

Then, each column we want to use is converted into a factor.

When factors, a model can be created, e.g. using the General Linear Model. A different family can be selected, e.g. binomial.

Then it is possible for R to show this data, showing the coefficient, the Pr value, and others. See code below.

```
mydata <- read.csv("Development/R/quizResults.csv", na.strings = c("N/

mydata$y = ifelse(test = is.na(mydata$Quiz.9..y.n.1st),  yes = 0, no =

mydata$y <- as.factor(mydata$y)
mydata$Help <- as.factor(mydata$Help)
mydata$Sex <- as.factor(mydata$Sex)

mymodel <- glm(formula = y ~ Pre.test.score + Sex, data = mydata, fami
```

```
summary(mymodel)
```

```
plot()
```

For analysis, looking at the summary, coefficient (e.g. -1.0704) shows either a negative or positive correlation (in this case -7%) for what I compare with as a response variable.

To be significantly significant, a common measure is that the Pr value ("the p-value") needs to be higher than 0.05. If the p-value is higher than 0.05, meaning it is significant with a 95% probability.

Analysing data with a Parallel Coordinates Visualization

To learn how to analyse the data, Une-terre [Lopez, 2016] was consulted. He writes "||-coords are a data visualisation which allow you to "read out" the relationships and trends between your dimensions. Positive relationship (correlation), negative relationship (invert), or no relationship (random)."

2.2   Setting and Research Context

In setting, the people that are involved with the project is presented. In research context, the physical environment is described.

2.2.1   Setting

There are two groups, with me included in both of them, which gather at the end of each sprint for a check-up meeting.

The Expert group consisted of Expedition Mondial and LiU Innovation. Expedition Mondial could help with the design process, and LiU Innovation could offer input on social innovation. The meetings mostly lasted for one hour.

The Partner group consisted Iliana Björling from YoungDrive, and Lena Tibell and Konrad Schönborn from Linköping University. In Partner meetings, The Insighs from each iteration was presented and discussed. Then possible decisions were laid out, followed by discussing the alternatives.

Outside of these groups, these people can also give advice in certain situations. For specific areas, there are also some experts which have been beneficial during the proects. Below, the whole team is explained:

Supervisors

The supervisors are from YoungDrive and Linköping University.

The YoungDrive team consists of Iliana Björling, founder of YoungDrive, and Josefina Lönn, country manager in Zambia. They are both helpful in giving knowledge on the entreprenership education program, and giving support.

The Linköping University team consits of Lena Tibell, Professor, and Konrad Schönborn, Doctor, within the Department of Visual Learning and Communication.

Stakeholders

The stakeholders are YoungDrive, Plan International and Linköping University.

YoungDrive is the client of the work, and their needs should be satisfied. This person is mainly represented by Iliana Björling, who is part of the YoungDrive Strategic Management Team.

Using service design, the project leaders in Uganda and Zambia, are also considered stakeholders: Josefina Lönn in Zambia, and Patrick John Obbo and Christine Achom in Uganda.

Finally, the most important stakeholder of all according to service design, is the actual users: the coaches. They should be the main consideration of the work.

Plan International is the organization allowing for all the interactions with the end users in Uganda. A similar organization is operational in Zambia. They are the ones that are providing facilities, organizes transport, etcetera. They in turn, have the organization Community Vision, which organizes the coaches. If Plan International or Community Vision does not approve of my work, then the interactions with the coaches will not be possible.

Linköping University is a stakeholder, as the supervisor (Lena Tibell) and examinator (Camilla Forsell) determine if the work is a valid master thesis or not. Also, LiU Innovation is interested in supporting continued work with the project, and their representative Peter Gahnström gives advice on social innovation and how this project can continue in the future during expert meetings.

The designer and developer

I take on several roles in my project: most notably that of a designer, developer, but also product owner. It is me that needs to balance all different opinions and requirements, caring for the vision, like mentioned in the chapter "A good designer" . My motivation is three-fold: learn as much as possible, create a successful project, and finish the master thesis.

`Add reference`

Experts

Since the development country context is new to me, there are also experts involved in the project.

For design process, Susanna Nissar and Erik Widmark from Expedition Mondial has supported with all of their knowledge within service design.

For technical development for rural areas, Julien Tantege, Research Specialist at Grameen Foundation, has offered support before and during the work, sharing their insights from related work, and giving feedback during ideation.

For pedagogical development, Henrik Lundmark from edtech startup Knownly in Sweden has given support with regards to building skills within digital learning.

2.2.2 Research context

The biggest challenge with regards to time constraints and cultural differences is that it is difficult to understand the audience.

It led to me choosing to spend 3 months in Uganda, because the client and academy is there, and start the design process when I'm there. It also led me to wanting to apply service design.

By being in Uganda and applying service design, I will come closer to the client and coaches.

The internet is worse, especially outside Kampala (I will not be able to access 4G, and prices are high).

Working mainly from Kampala, because that is where YoungDrive is situated, means that there is still a long distance to the coaches in Tororo, which is located near the Kenyan border.

2.3 Subjects (Participants)

2.3.1 Roles

Country Manager

Project Leaders

The Community Based Trainers

The CBT's are often volunteers, receiving a small scholarship from Plan International. They are often business owners themselves.

Thus, the CBT's can be described as social entrepreneurs. As Mitchel says about entrepreneurship [Mitchell and Smith, 2007], motivation does not need to be wealth accumulation anymore. The activity of entrepreneurship contributes to society, in a way that is not caputed by the commercial entrepreneurship literature.

Many of the YoungDrive participants are driven by that their business can have an impact on their community, as well as take them out of unemployment or increase their current livelihood.

The Youth Mentors

Write about the YMs

The Youth

Write about the youth

2.3.2 Training Material

Each youth is given a participant manual, describing each week of the 10-week YoungDrive program.

CBTs and Youth Mentors are also given a Coach guide, which describes how to carry out and teach each week's topic during the youth training.

2.3.3 Data on Coaches

Tororo, Uganda

In Tororo, there are 2 Project Leaders (PLs), 19 Community Based Trainers (CBTs) and 8 Youth Mentors (YMs).

Both (2) of the PLs, are also YMs.

14 of the CBTs, have a YM.

The subjects, lives in all parts of Tororo: 9 in East, 9 in West and 11 North, with different distances to town.

There were 26 out of 27 possible respondents among CBTs and YMs in Tororo, when in 2015, a statistics summary was carried out.

Phone/power/data among CBTs and YMs

Of these, 26 (100%) had a cell phone, 3 (12%) had internet on the phone, 0 (0%) had power at home, 3 (12%) had solar energy at home, and 4 (15%) knew how to write on a computer.

Of the 3 that have internet on their phone, 2 (67%) are using internet each day, and 1 (33%) is using internet once a week. They mostly use Facebook, followed by email.

Companies among CBTs and YMs

In Tororo, 26 (100%) are running a business, 14 (54%) are running two businesses, and 1 (4%) is running three or more businesses.

In Tororo, the businesses range from: ananas, water melon, onion, chili, bakery, catering, corn, beans, fabric, plastic products, bird farm, milk, fish, ground nuts, cabbage, tomato, hairdresser, sewer, shop and rice.

Kabwe, Zambia

In Kabwe, there is 1 PL, and 10 YMs.

2.3.4 Project Leaders in Uganda

In Tororo and Kamuli, there were 6 out of 6 possible respondents.

6 (100%) have phones, 1 (17%) have internet on phone, 2 (33%) have power at home, 3 (50%) have solar panels at home and 6 (100%) are able to write on a computer.

In Tororo, there are 2 PLs. Christine's business ranges from: bakery, corn, pig farm and plastic products.Patric's business ranges from: silver fish, beans, corn, and bird farm.

In Kamuli, there are 4 PLs. Their businesses ranges from: selling office supply, boda boda, bird farm, pig farm, green pepper, corn, cabbage, tomate, aubergine, chipati ("bread"), chilli, and charging of cellphones.

2.3.5   Youth in Tororo

The youth are the ones receiving the training from the CBTs and the YMs. In the 2015 report, with 225 respondets from Tororo, these were the statistics regarding phones, power, data, language, businesses and the most popular companies:

Phone/power/data

99 (44%) have a cell phone, 9% have internet on their phone, 3 (1%) have power at home, 22 (10%) have solar panels at home, and 20 (9%) are able to write on a computer.

The mostly use Facebook, followed by Google and WhatsApp. A few people are using it for Twitter, email, news and school information.

English skills

In Tororo, 129 (57%) understands when someone speaks English, 116 (52%) can speak english, 133 (59%) can read English, and 132 (59%) can write in English.

Businesses

In Tororo, 165 (73%) of the youth runs a business. 60 (27%) are not running a business.

The top 8 most popular businesses in Tororo, with 134 respondents, are corn, cassava ("potato"), saloon, fish, making of bricks, beans, brooms and rope. These range from 9 for corn (6.7%) to 5 for rope (3.7%).

2.3.6   Coaches in Zambia

In Zambia, the coaches have higher education, and better access to technology.

6/10 has power at home. 3/10 knows how to write on a computer.

2.4   Study Design and Data Collection

Add more info about Zambia coaches here

Using novel methods like *service design* when developing the app according to research question and *data-driven design* and interviews for understanding interaction according to research question.

Creation of Design Process

As there was a unfamiliar target group - mostly young Ugandians with little or no experience of smartphones - service design thinking would benefit true understanding of cultural context and in-depth empathy for the end users.

Tools and methodology in service design were chosen with the help of Expedition Mondial in Stockholm, who provided education and coaching.

At the same time, the end result would be a digital artefact (an app), which is not common in service design.

While this product could be though of as a service, the tools and methodology would benefit to borrow from Agile methodology and Interaction design.

I'm the computer expert kind of designer [Löwgren and Stolterman, 2007], adjusted to agile methodology and interaction design, but aspiring to be a sociotechnical expert. Expedition Mondial are experienced with service design, aspiring to be more of computer experts.

This led to the joined development of a Digital Service Design method, co-created by the both.

The result is that the design and development phase in Uganda is an iterative process with the human in focus. The process is built on top of service design process and methodology, while in-line with digital design practices.
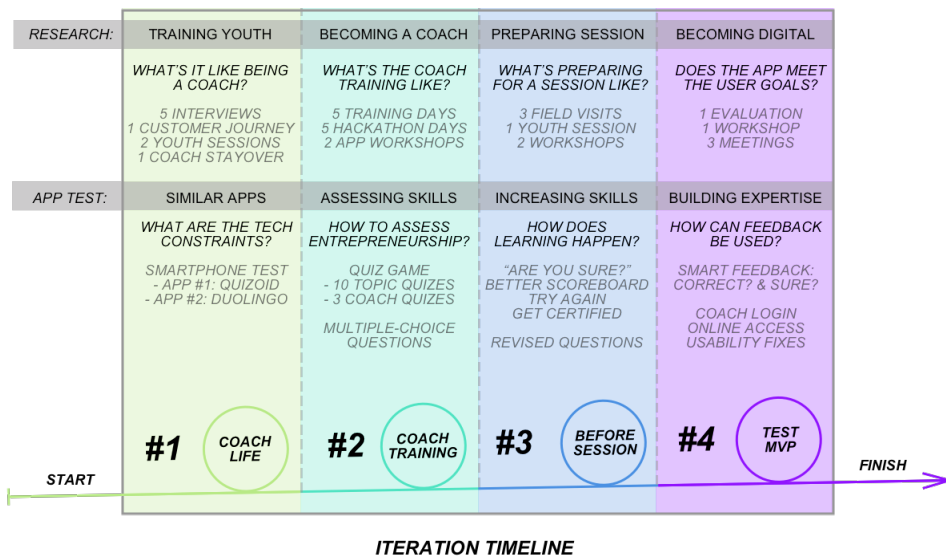

ITERATION TIMELINE

Figure 2.5: *The iteration timeline shows the process from iteration 1-4, by different colors. Each iteration leads to a loop, with the design situation as the focus, in which interactions can happen that is related to either research ("What's ...?") and an app test ("How can we ...?"). This output from the loop, then gives force to the next iteration.*

Implementation of Design Process

See figure 2.5. There were four iterations. The first iteration follows Service Design, not starting the app development, while the other three follows the new methodology, Digital Service Design.

In iteration 1, there is a very broad scope, without digital focus, where iteration 2, 3 and 4 introduces and narrows down the project into a digital solution.

Expedition Mondial gave support in each iteration, helping with refinements of each iteration as learnings happened along the way, and they were able to educate me during the different stages with methodologies whenever necessary.

2.4.1   Iteration 1

Following the service design sequencing, the first iteration had a very broad scope and truly is a service design iteration: "From your perspective, what is it like being a coach?". [1]

Lowgren's though about how to start the project was used, meaning that the purpose was to get a preliminary understanding of all important aspects, and build relationships with all stakeholders.

Insights depended heavily on interviews with all the stakeholders (2 with Plan International, 3 with YoungDrive), and local experts (1 visit each at Grameen Foundation and Designers without Borders, 1 workshop with Mango Tree), since no Interactions with users had been made yet. Also, I immersed myself with the Uganda tech scene as possible, from the new home and office in Kampala, working at the tech hub and co-working space Hive Colab.

Ideation were about creating a questionnaire guide for the interviews, a co-creation workshop using "Customer Journey Map", and identifying how the app test should be designed to test their existing knowledge (and be informed of the design preferences of the YoungDrive app).

Trigger material was the finished questionnaire guide (constructed with Expedition Mondial) a written plan for the co-creation workshop ("A day as a coach"), and a written plan for testing the quiz app Quizoid and the language learning app Duolingo, and a schedule for the interactions.

The interactions were focused on design ethnology, getting to know and learn from people in a different culture, namely the coaches. The focus was on the their needs, motivations, and context.

To accomplish these, four days were spent in Tororo, with one day of travel. There were four face-to-face-interviews, one meeting with Plan, one meeting with the local partners, two workshops, one coach stay-over, and two youth session visits.

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[1]A coach meaning either a Community Based Trainer (carrying out all the trainings), or a YoungDrive coach, depending on who was asked the question.

2.4.2   Iteration 2

The interactions for this iteration were planned to be in Tororo. However, during a meeting during the first week with YoungDrive project leader Josefina, I was invited to participate in the coach training in Zambia. A new work plan was created, so that I could travel to Zambia and develop the app and participate in the YoungDrive coach training together with the coaches.

This time, the iteration has a more detailed scope, with a hypothesis on what needs the app should meet in the end, and create lo-fi and hi-fi trigger material to meet those needs.

A co-creation workshop started the interactions, followed by repeated app tests at minimum one session per day, followed by a feedback round. At the end of the week, there was a co-refinement workshop of the current hi-fi material, and also lo-fi material for the new version of the app.

The co-creation workshop was made to identify important functionality in the minds of the coaches.

Insights

There were two main insights to consider from iteration #1:

- The aim is for the coach to feel self-confidence for its youth session

- The skill to be trained is having a youth session

During the evaluation meeting with Linköping University and YoungDrive, it was the determined that Iteration #1, is answering the research question #1, #2, and #3.

The iteration had provided a good basis for answering research question #5.

It was concluded during the partner meeting, that iteration #2 should:

- Allow to test the validity of the insights from iteration #1.

- Be carried out in a way that allows comparison of usability and learning done via the app, between iteration #2 and #3.

Ideation

This was the start of the quiz app. The focus was on assessment. For example, it was decided with Iliana, that no facts would be presented before the quiz. The app would solely ask questions, not give the information beforehand. For that purpose, previous knowledge or the physical manuals could be consulted, meaning, it was not a top priority.

It was discussed, how the correct information about YoungDrive would be presented:

It was determined that questions would be created by YoungDrive, using the thesis' relevant theory and recommendations on designing for learning.

Thus, the ideation started with me creating a guide how to write questions according to Bloom's revised taxonomy, which was shared to the YoungDrive team.

The initial plan was that the team would only produce questions for two sessions, not all 10.

Iliana Björling from YoungDrive did questions initially for the two sessions, mapping each question to the Bloom taxonomy using the guide. Then, it was decided that the app would be developed and used during an actual coach training in Zambia, for each day.

Trigger material

Project leader Josefina in Zambia refined the first question sets, prepared for my visit in Zambia. Josefina created question sets with Bloom at the back of her head, also taking into account the structure and the order of the coach manuals, what it means being a coach within the topic, and lastly scenarios.

A hi-fi trigger material was done, a very basic quiz app, keeping it as simple as possible (see Application Implementation, Iteration 2). All of the devices (tablets and smartphones) that I had available were brought to Zambia.

I added the questions to the app, and installed the app to all of the devices. This process was repeated for all the days, Sunday-Friday.

Interactions

Design workshop #1

The coach training started with me having a design workshop with the coaches, not showing them the app that I had created.

Since the knowledge about smartphones and apps were low, I started by introducing these topics.

All were familiar with Facebook, so thus I showed the Facebook app. Me wanting to know what the app would look like if the coaches would have designed the app, I first needed to train them how to design an app via drawing wireframes.

Using postits, they started with during limited time drawing the start view from the Facebook app.

Then, they were asked to draw what they thought happened on the friend icon click, drawing the view on another postit.

Then, the mission of the YoungDrive app was described. They were then divided into two teams, having limited time to draw the best imaginable Young-Drive coach quiz app they could. First, they designed the app from the top of their heads. They then pitched their results to each other.

On the next iteration, they were to suggest and design improvements how the app should be designed to improve learning, not only assessment. They then again pitched their results to each other.

The result was fantastic, in the sense that it gave me an unbiased look at what the coaches expected from the app, what functionality wasn't important, and into their technical preferences.

The designs and insights gained were used throughout the week to further improve the app I had actually started creating, and gave great insights to who the coaches were and their thinking.

Assessment via quiz

At the end of each day, the app was used to test the coaches' knowledge. Each coach got either a smartphone, tablet or computer. The coach first took the quiz for the most recent session, and could then choose what to do next.

As there were no back-end developed, Josefina by hand documented the scores of each coach, writing the name of the coach, the session, number of correct answers, and what questions had been answered wrong.

Josefina then, when planning the next day, looked at the statistics, looking for trends that would inform the sessions for the following day.

She also evaluated the quality of the questions, before creating the new question sets for the next day.

Experimenting with quiz before or after the session

Since the coaches appreciated the app so much, we felt tempted to try what would happen with fun and learning if we tried using the app *before* a session instead of only after. During the rest of the week, we continued, finally finding preferences and tendencies from the coaches, via observation, interviews, and survey.

Experimenting with design of questions

During the week, extra tests were done to test the following:

- Number of questions per quiz

- Single-answer questions or multiple-answer questions

- Framing of questions

- Challenge level of questions

- Determining what made a question hard

Interviews with Josefina

At the end of each day, an evaluation interview was held with Josefina. At the end of the week, a final interview was held.

At the end of Day 5, Josefina and I discussed what it would look like to not record the answers manually, but pushing the results online. A co-creation workshop was held, where she drew an Educator Dashboard.

2.4.3   Iteration 3

Iteration 3 had an even more detailed scope. Since the app now succeeds with the first use case, the coach training, not the focus could be on "learning at distance".

A requirement from Josefina was also to test if the app created in Zambia could work also in Uganda. All the quiz questions would need to be converted

from the new manual to the old manual, since both structure and content had changed.

To test on all of the coaches in Uganda, it would be preferable if data collection would happen via the app instead of manually, since there would be more than 10 test subjects, which had been the limit in Zambia.

A future requirement was that quiz responses would need be available to the teacher. This means that there needs to be a database, but also a login, so individuals are traceable.

How can login and the database be implemented in the best possible way?

The insights on learning also needed to be considered:

- Are coaches really learning via the app, especially learning to be better coaches?

    – How can questions be formulated in a way that teaches entrepreneurship, which is so practical?

- How can the current multiple-choice quiz app be improved, to:

    – reduce guessing

    – improve confidence

    – encourage learning

Thus, the study design of Iteration 3 became very important. A lot of development and ideation was done.

Also, instead of only testing the app in Tororo, a test was held in Kampala, to get feedback from an entrepreneurship student.

For the interactions, a big app test was held, and also a co-creation workshop was held.

Before the workshop, the wished functionality and goals were well formulated. It was also discussed beforehand how to best design the workshop, together with Linköping University and Expedition Mondial.

Questionnaire 3 was created, used after the test. After interviewed in a big group, they were divided into co-creation workshop groups, with a presentation in the end.

Aim

To get an app suitable for learning, it was determined that the pedagogical model behind the app needed to change, emphasising feedback.

The aim was to score higher on Bloom's revised taxonomy, while still including multiple-choice questions in the app.

Trigger material

Josefina was given a task to create a quiz "Are you ready for Session 9?". The aim of this quiz, was partly to score higher on *Bloom's revised taxonomy*, partly to

test if Correct Structure and Time Management could be assessed using multiple-choice.

Also, the questions were translated from the new manual into the old manual, which is used in Uganda.

Interactions

There was another partner meeting, with Plan International and Community Vision present. There was an app test with all of the coaches, "Testing the Young-Drive coach app", followed up by splitting into six workshop groups based on solving different problems discovered during the test.

The following day, there were three field visits to CBTs, observing how they prepared themselves for a youth session, and then testing the app for assessing and becoming prepared for a session.

The last day, there was a co-refinement workshop ("Usability Improvements") and one co-creation workshop ("Educator Dashboard") held in parallel, with 3 CBTs and 1 project leader respectively.

2.4.4   Iteration 4

The focus of iteration 4 was a summative test.

First, a pre-test was carried out in paper, including questions about the coach and an entrepreneurship quiz, based on a well-known study [Walstad and Kourilsky, 1998].

During the test, this was the first time that the app could send data to the server. Data was sent whenever a quiz was started, and whenever a quiz was finished.

The group was divided into two, the ones who brought manuals and they who did not.

After the test, every coach was divided into one or three groups, on random. In these groups, they were asked:

1. Why do you think you were correct or incorrect?

2. Do they like the app?

3. Are you stimulated by the app?

4. What did you like?

5. What did you not like?

6. When do you want to use the app?

7. When are you not able to use the app?

To analyse the paper-submitted data, all of this was combined first into a Google Spreadsheet.

The app results were also recorded in paper, but only as a backup.

Data collection was done by the app itself, which pushes data to server whenever online (it saves quiz start, and quiz finish).

The next day, a small app evaluation and co-creation workshop was held for the Educator Dashboard, and the final version of the app.

Also, a test was done with the Plan Tororo staff.

Back in Kampala, a presentation was held with Plan International.

Back in Sweden, a presentation was held with the YoungDrive Strategic Management Team.

2.5   Application Implementation

In this section, the prerequisites for the app is described, from the perspective of the user, stakeholders, and the developer.

2.5.1   User needs

The technical constraints for the project, would need to affect the technologies used, if the project would be user-centered.

On the client side, the app would need to be mobile and web based, consider non-access to internet, and not use a lot of battery, to work for the coaches of YoungDrive.

That the app should be simple to use in this cultural setting leaded to design constraints and needs for evaluation.

2.5.2   Stakeholder needs

As the project was only three months, and the first month would be without digital development, time constraints were massive. However, to be able to answer research question #2, evaluation needed to be done via data collection.

If no evaluation, there would be no need to write code, instead working with a lo-fi prototype using pure design tools. Now, a data-driven approach was needed to measure, and therefore an app needed to be developed.

On the server side, a database and API would be needed, to pull data from the database and push data from the client. Since internet was not always available, the client must be smart in its usage of pushing and pulling data. This would need to be investigated further into the project.

2.5.3   Iteration #1

Here, the work and result from iteration #1 is presented.

Devices are prepared

As most of the coaches did not have smartphones or tablets, enough smartpones and tablets were brought with me from Sweden, either donated, borrowed or bought devices. These were a combination of Android and iOS, smartphones and

tablets, so the app could be tested on as many platforms as possible. During the user tests, also using a laptop would be tested.

App/Web Development

Early in the project, it was thought that existing tools could be used, instead of building the app from scratch. E.g. using existing tools like Knowly or Typeform[2] during the first iterations for understanding users, and during development e.g. the Typeform API (http://typeform.io/). The Typeform API allows developers to create surveys from within their own applications or systems.

Choosing cross-platform framework

In the start, Ionic and Meteor were both tested and compared with each other.

Add from mindmap **React.js**

Add from mindmap **2.5.4 Iteration #2**

Here, the work and result from iteration #2 is presented.

Before Interactions

Since Meteor was chosen, a multiple-choice quiz tutorial in Meteor was used to guide the first version of the app. Modifications were made, e.g. making it responsive and changing it to YoungDrive's graphic profile.

The app was pushed to GitHub, and hosted on Meteor free storage, available via youngdrive.meteorapp.com.

For Android and iOS, it was made possible to install the app from the computer.

During Interactions

For each day of the training, new quizzes were added to the app, which created a path (see Sierra on motivation [Sierra, 2015]).

After Interactions

Staging environment using Heroku

A different hosting platform was needed when the Meteor free tier was removed.

Staging environment using Heroku allowed changes on specific GitHub branches to deploy updates automatically on Heroku servers.

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[2]examples include https://showroom.typeform.com/to/ggBJPd and https://showroom.typeform.com/report/njdbt5/dIzi

The MongoDB database was created using the Heroku plugin MongoLab.
A Meteor build-pack was used to allow Meteor to be used with Heroku.

Android Play Store

It was tested to upload the app to Android Play Store. The neccessary steps from
Cordova needed to be followed, screenshots needed to be uploaded, and some
administrative tasks. After this, it only took a day for the app to appear on the
Play Store, and everything worked satisfactory.

2.5.5   Iteration 3

For me, the user's first feeling of a superpower is a hint of becoming a Certified
coach.

On the client, as components grew, there was a need for a client-side router.
The Meteor plugin Flow Router was used, as it was very popular with good inte-
grations.

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App for Learning

This was not much harder than to add new components and functionality for
learning. The hard part, was the ideation, deciding on what ideas and what de-
sign was the best. For this, see Result .

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Login, Database, and Meteor upgrade

In order to store data per individual, a database and login would be needed. Me-
teor upgrade from 1.2 to 1.3 was made to do this easier, but ended up being the
reason this was not implemented in Iteration 3. Below, the work is presented.

Login To record data per user, would require login. This would be a usability
issue for most problems, being 1st-time smartphone users. They need to find it
intuitive, user-friendly, and be able to remember the password in the future. A
lot of different suggestions were through the ideation phase.

The simplest login possible was chosen: a 3-digit code, which was to be given
to each coach during the test.

Meteor had limitations with their auto-login module, which is very fast to im-
plement. It forces username and password, and instead I wrote the login myself.

The front-end was not problematic, however, implementing server-client com-
munication so that it worked online and offline, was.

Online database If data was to be sent from the client to the server, there
needs to be a database with Meteor Collections.

As in version 1 of the app, no results were saved whatsoever, this was new
functionality.

An example app was made first, only using Meteor Collections. Meteor's
use of Distributed Data Protocol (DDP), made app pushes feel immediate, even
though data was not sent until there was Internet access.

However, it was found out that if it took more than 15 minutes to get online, the push would be aborted. For users that are seldom online, this would not be viable.

Offline database An offline database was needed, and the plugin GroundDB was implemented. As it was cumbersome to get right, pushing the data whenever online, and hard to test (needed to wait 15 minutes each time), this was not ready for the interactions.

Upgrading from Meteor 1.2 to 1.3 Meteor 1.2 had several disadvantages: while it worked for all devices, it did not support React.js

Meteor 1.3 was released, which promised a better developer experience, with JavaScript ES6 support, and access to Node Package Manager (npm), plus official support for React.js.

In 1.2, only some npm packages had been adapted for Meteor, and tools such as Webpack could not be used.

The downsides was discovered after implementation:

- there were missing backward compatibility to the older of the Android devices

- Heroku had no Meteor build-pack for 1.3 - a push led the website to crash

This meant, that the app would not be able to be installed on many Android devices, and for those devices, a web version would not be available either. As this was unacceptable, the project downgraded to Meteor 1.2 again.

Unfortunately, since the online and offline database had now dependencies on version 1.2, the login and database integration could not be part of iteration 3, but this work needed to be saved for Iteration 4.

2.5.6   Iteration #4

For iteration #4, data collection was done by the app itself, which pushes data to server whenever online (it saves quiz start, and quiz finish).

The server receives JSON data, stored in a MongoDB database.

Each data point is saved in a database called Results, with the signed in user (from the Users database).

In the API, I added Users, Quiz Lists, and Quiz Results.

Now there was a build-pack for Meteor 1.3 available, so GroundDB could be implemented again. It made me refactor app into 1.3, and I had to redesign routing.

There were a lot of technical issues. GroundDB was successfully used for offline Meteor collections, and pushing offline data whenever online.

2.6   Data Analysis Theory

2.6.1   General

2.6.2   Iteration #1

2.6.3   Iteration #2

2.6.4   Iteration #3

2.6.5   Iteration #4

Data analysis is done first by a general overview in Google Sheets, by statistical analysis in R, and by a parallel coordinates visualization. The process to do this, is described below.

Data Acquisition from Server

It was desired to store the data in Google Sheets, thus it was necessary to collect the MongoDB database content, and convert JSON format into a Google Sheets-readable format, like CSV.

Multiple approaches were tried, and the Google Chrome extension called Magic Json by agaze_dev_team (last updated October 29, 2015) was the one that worked without problems. [Team, 2016].

Data Acquisition from Pre-Study

The Pre-study data acquisition was done by instead of looking at the paper-submitted pre-study evaluation forms, using the data processed into Google Sheets.

Data Enhancement of Server Results

This section presents how data from the server was processed, to enable visualization mapping.

To make the data easier to work with, the columns were reordered, and made sortable and filterable.

Some columns were given conditional formatting, so it would be easier to spot irregularities.

After this, some observations could be made. For example, there was a surprisingly low number of answers where the user answered the question without confidence. Also, more users had started a quiz without finishing it than anticipated. Finally, a lot of users had done quizes that were not Topic quiz 3 and Coach quiz 9, which might indicate high interest (if they did more than 2 quizes) or confusion (if they did not do 3 or 9, but they did do other quizes) during the app evaluation. This meant that on some aspects, there were less data than anticipated, (which was troublesome, as there were already few data points), and some aspects where there was more data than anticipated (that were overlooked)

Lägg till bild "results-colored.p (finns på skrivbordet)

To be able to compare the test results with the pre-test results, it was clear that it would not be viable to test every dimension against every dimension.

Instead, since goals of the app evaluation had been predefined in the following way, the quiz results were summarized into a new sheet so that the following could be derived:

- % correct 1st try

- number of tries until 100%

- number of tries until 100% in 1 try

These could be calculated by having columns for:

- Quiz 3

    – Start time training
    – % correct 1st try
    – number of tries until 100% in 1 try
    – Time difference start to end time certification

- Quiz 9

    – Start time training
    – % correct 1st try
    – Time difference start to end 1st try
    – Time difference start to passed training
    – Time difference 1st try to certified

Then, to see trends, I again added color scales. With ordinal values, a sequential color scheme is used (e.g. fastest time, from green to red), and with nominal values (like if they are female or male) where there is no right value, a qualitative color scheme is used. Now, it was easier to spot outliers and trends.

Date Enhancement of Pre-study Results

To see differences in answers more clearly, the data from the pre-study was made sortable and filterable. Then, the data was resampeled for each column that hade numerable (sortable) data in text instead of numbers, so e.g. "The day before" was changed to -1 and "The same day" to 0. In a similar way, school level was divided into four different groups, from 0 to 3, where 0 meant secondary, year unknown, 1 meant lower secondary, 2 meant upper secondary, and 3 meant tertiary.

After this, each column was given conditional formats using a color scale, using Google Sheets built-in functionality. This gave a visual way to quickly get a overview of the pre-test data.

Observations from the data was that a surprising number of cells were left blank. One user had not done the pre-test, where some had left questions unanswered (most commonly "Do you own a company?" (should have used the word "business"), plus "Hours of preperation" and "Occations for a youth session" (there is a tendency this might be because they were not proud of their answers, because of correlations with low quiz results).

Missing cells was not as obvious with the app results, were users could not progress in a quiz without answering both the question and the confidence. However, none of the passed quiz 9 certification answers had been submitted. Thus, it was needed to add these from the manual recordings, which had been used as a backup in case anything like this would happen.

Data Enhancement by joining Pre-test and Results Summary

I joined the summary sheet and the pre-quiz sheet, meaning I had created a multiple-variate data set (serveral dimensions that I needed to compare with several dimensions).

I met with my university supervisors, so they could further support me in how to properly analyze the data. Since the two control groups showd similar means on the pre-quiz results, the two control groups were determined comparable.

To meet the challenges of using Google Sheets, a multivariate analyzation software or a visualization was suggested to discover the data in less time.

It was hard to determine a suitable multivariate analysis software suitable when having so few data points. Principle Component Analysis or Cohen's kappa would not be suitable, neither was it believed applicable to do Linear correlation on all dimensions.

After discussion with other Master thesis students working with analysing data (one from KTS and one from MT), parallel coordinates was suggested. It would allow me to very quickly filter the data, find correlations, and distinguish outliers and common characteristics.

To guide the usage of the parallel coordinates (as there is so much to discover in the data set), using R to do Logistic correlation was also done. A disadvantage with this method, is that to be statistically significant, many data points may be needed, and it was now known before-hand if the method would be useful. Probably, parallel coordinates would be the best method with analysing a small multi-variate data set.

2.6.6   Visualization Mapping

The goal with visualization mapping is to generate renderable data, in my case for the parallel coordinates visualization.

Thus, I added a new spreadsheet, specific for visualizing the data.

I deleted columns that would serve no visual purpose (e.g. timestamps), gave all cells data values (even N/A when undefined), deleting users that did not have data, and shortened the column names so they would fit on the screen.

The data was then exported from the Google Sheet into CSV.

2.6.7   Rendering

For rendering, the JavaScript library D3.js was chosen. It supports data-driven documents for visualizing data with HTML, SVG and CSS. It supports both JSON and CSV data.

A visual framework for multidimensional detectives for D3.js was found, called "Parcoords.js", written by Chang Kai (2012).

The example code from "Linking with a Data Table" provided the basis for the rendering. It would be a great benefit to bee able to see both a parallel coordinates visualization, and to see the same values present in the Google Sheet.

I replaced the example CSV file with the exported Google Sheets data in CSV.

Eventually, I also changed the colors, and added to the example the toolkit's functionality to drag the axes titles around to reorder the dimensions, since the goal was to quickly compare and find correlations.

Add par- allell coordi- nates visual- ization exam- ple

3

Results

In this chapter, the results are presented, so that in the next chapter, these results are analysed.

3.1 Developed Application

Here the results from the app for iteration 2, 3 and 4 are shown. Iteration 1 is missing, as the app development had not started.

3.1.1 Iteration #1

There was no developed application at this point.

Instead, two workshops were held, which together would inform the future development of an application.

There were the findings from those two workshops:

Workshop #1: Customer Journey Map: A day as a coach

Workshop #2: Quizical and Duolingo

3.1.2 Iteration #2

Result

Quiz-flödet 1.0: standard multiple-choice, designat för assessment, men ej för learning Besvara multiple-choice-frågor Få resultat-tavla med Question 1: 0, Question 2: 1, samt "Total score: X/X" Gå tillbaka till startskärm

3.1.3   Iteration 3

Result

Quiz flow 2.0 was designed for learning and self-reflection

- vid varje fråga besvarar du det alternativ du tror är rätt samt "Are you sure?" Yes/No

- vid färdigt quiz, få en resultattavla med personliserad feedback

- läsa igenom dina felaktiga svar och hur säker du varit på dem

- observerat de korrekta svaren

- klicka "Improve" för att bara få dina felaktiga svar igen upprepa tills inga felaktiga svar var kvar (det står "quiz try: 3", om det är försök 3)

- vid 100

- innan dess, uppmuntrades du läsa igenom coach/deltagar-manualen

- om du då fick något fel, fick du gå tillbaka till träning igen

- om alla rätt på, blev du Certified coach. Om du klarade det på första försöket, fick du även en guldstjärna (andra försöket = silver, tredje försöket = brons)

- sedan kunde du ta ett annat quiz

Kommentar, fördelar med feedback-läge: Genom att på varje fråga besvara "Are you sure?": Yes/No, så stärker vi inte bara coachens meta-kognitiva förmåga, utan vi kan vi även ge personliserad feedback i resultattavlan, istället för att bara visa Question 1: 1 point. Question 2: 0 points, som i Iteration 2.

Detta gör att coachen kan reflektera över sitt lärande på t.ex. följande sätt: - få en självförtroende-boost (via feedback "You were correct, and you were sure") - gå från gissning till självsäkerhet (via feedback "You guessed, but you were correct") - ändra uppfattning snabbare (via feedback "You were incorrect, but you were sure") - uppmuntra coachen att läsa i manualen (via feedback "You were incorrect, and you were not sure")

Fördelar med tränings-läge, och certifikations-läge: From Josefina: "Jag gillar idén att när coachen har kunnat svara rätt på alla frågor, kunna befästa kunskapen med hjälp av certifikations-läget, då coachen ska kunna få 100% rätt på 1 försök."

3.1.4   Iteration #4

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3.2   Qualitative Data

Here the results from the qualitative data for iteration 1, 2, 3 and 4 are shown.

3.2.1   Iteration #1

Understanding the coach situation

A CBT can be responsible for from 7 up to 12 different youth groups in different programs, and such a high number places huge demands on the CBT.

Even if there are only 7 groups, being behind on schedule or not being confident, can be very demanding.

Different kind of coaches

The interviews with CBTs, PLs and stakeholders led to the realization that different coaches handles this differently well.

Depending on the situation, e.g. you are not confident, or you are falling behind with the schedule, you can be in one of these need groups.

- The ideal coach

- The realistic coach

- The challenged coach

It was discovered, that coach confidence comes largely from being able to have good youth sessions.

A good youth session

For having a good youth session, these are the most important attributes:

- Correct information

- Correct structure

- Time management

- Fun atmosphere

The fact that the coach knows they have these qualities, leads to self confidence from the coach. This in turn, leads to better meetings with the youth.

The room for a digital solution

It is definitely a problem that so extremely few have smartphones.

This needs to be designed for. Either, I build only for the use case of having an app tailored for the coach training, where the donated devices can be used.

Alternatively, I design only for the users that does have a smartphone, and count that more will get smartphones in the future.

Thirdly, I can use a SMS tool, not building an app but an SMS-based service, which also could be an app. Such tools exists, and are compatible with multiple-choice questions, like VOTO Mobile.

3.2.2   Iteration #2

The desire perspective

Insight: "The app could be used on my spare time". This is particularly true, about the bonus quizzes that were produced during the week.

Insight: *Coach:* "I'll buy one" (a smartphone), *Response from other coaches:* "Whoa!"

The utility perspective

Ideation: "The app should have notes, not only quesitions"

The usability perspective

Low resolution screens, made the text be barely visible. This showed, that the app needed to be tested on a lot of different devices. This is particularly true, as on day 1, the coaches did not know how to zoom, which could cause accident refreshs, frustration or confusion.

The app needs to work offline! To be online on the phone is too expensive for the coaches, and too unrealieable to give a satisfactory experience. Also, during testing, relying on internet can cause a lot of problems, especially if the teacher is alone.

The learning perspective

The coaches had surprisingly high results, and at day 3 they wished harder questions when asked.

We responded by having harder questions, e.g. by introducing similar answers, and testing 4 alternatives instead of 3. This was appreciated.

The following analysis could be done:

Doing a pre-quiz: good for learning

When asked about what they thought about doing "Graduation" as a pre-quiz (before the session), 10/10 said they liked doing the quiz before, and that it benefited their learning during the session.

When asked why it helped, these were the results:

- "During session, it is easier to follow" - 10 (100%)

- "Giving the paper manuals before, scanning headings and pictures etc, would not help" - 10 (100%)

It was also tested to work in group or individually. The ones who answered, said that you learned more individually (3/3), and more fun doing it together (3/3). Doing it together, was enjoyable as it was "Very easy because of using different minds" and "We can collaborate to do better".

Doing a post-quiz: Spaced versus massed learning

In "Goal setting", quotes were "I thought it was fun and challenging to do the quiz immediately afterwards", with another coach commenting "The mind was still fresh".

When asked on timing preference, 10/10 said it would be more fun to do the quiz immediately afterwards, not at the end of the day. The motivation, seemed to be that it was easier.

9/10, said they wanted to do the quiz afterwards. The outlier, said it would be better for learning doing it later.

After this comment, this was the distribution:

- 3/10 wants to do the quiz both before and after a session

- 1/10 wants to do the quiz before and at the end of the day

- 7/10 wants to do the quiz only immediately afterwards

- 10/10 wants to do the quiz immediately afterwards, and then again at the end of the day

- 7/10 wants to do the quiz immediately afterwards, and then a joined quiz with other topics at the end of the day

The teacher perspective

Low scores The 9/19 shows the relevancy of the quiz, as Josefina did not think she would have discovered that the coach was lagging behind otherwise.

In the data, it was observable that the coach had done well together with others, but 3/7 when done individually.

Josefina said about the 9/19: "This is where a control group would be beneficial". "He is often passive during open questions, but active during the team exercises."

The question we needed to ask ourselves, was: "Does this imply he is a good or bad coach?".

What would hinder Josefina from using the app

Josefina says: "Not doing data collection digitally works whenever they are 10 - but not with bigger numbers than that."

According to the final interview with Josefina, she does not wish the app to replace her. She enjoys teaching, thinks she has an important role, and suggests the app to be designed to support her and the coaches, not replace her.

Acceptance criteria

If you have a high score, you are ready. If not, you need to redo the quiz.

If you are 8/10 or lower, you are in the red zone. If lower than 10/10, they are not ready, the motivation being that what they don't know, they will teach in an improper way: affecting hundreds of youth. This is why Josefina thinks they should need all of the answers correct.

The developer perspective

- Bugs was a big hindrance to functionality, and a lot (both high-dose, and high-scale) of testing is very important

- Simpler design than I thought (KISS) was sufficient

3.2.3 Iteration #3

Observations from Kampala test

The entrepreneurship student in Kampala, informed the following changes:

Instead of "Become certified", he would be more motivated by unlocking the opportunity to apply the skills.

"Improve" should be renamed "Try again", because it is more intuitive.

His overall opinion on the app was:

"Can you give me the link, because I'd love to do more of this. I think it's amazing."

Field visits

Big app test

Learning: The app test simulated the app being used to assess preparedness for a youth session. They clearly showed evidence between the difference between designing for Assessment and Learning:

Given a coach having prepared for their youth session on week 9, and then only scoring 5/10, what should happen? In a similar way, what should happen if 9/10 correct answers?

For the coach training, the assessment was okay, since Josefina could pick up and give feedback.

Before a youth session, leaving the coach there is not viable. If the coach has 9/10, that coach should not only be let be, and especially if the score has been 5/10.

Feedback was that one user did not want to press "Improve", until having read the manual. The motivation was: "Not because that is what the info says, but

because I can learn more from the manual, about more than what the questions says."

This is indeed the preferred behaviour from Josefina, and the app should continue to encourage only using the app training or certification mode after having prepared via the manual. This way, the app is still assessment, but it is "learning by thinking", with feedback.

3.2.4   Iteration #4

Everyone now thought the app was good and easy to use.

With the Plan Tororo staff, it was shown how important the certification mode was: even though one group had 100% on their first try, and a person had 1 wrong answer, the person with 1 wrong answer got 100% on the certification, while the 100% group had 1 wrong answer.

It is therefore determined, that when all of the answers can be answered correctly, after having gotten all answers correct once, that the knowledge is reliable - this is deliberate practice.

3.3   Quantitative Data

Here the results from the quantitative data for iteration 1, 2, 3 and 4 are shown.

3.3.1   Iteration #1

Understanding the coach situation

A CBT can be responsible for from 7 up to 12 different youth groups in different programs, and such a high number places huge demands on the CBT.

Even if there are only 7 groups, being behind on schedule or not being confident, can be very demanding.

Different kind of coaches

The interviews with CBTs, PLs and stakeholders led to the realization that different coaches handles this differently well.

Depending on the situation, e.g. you are not confident, or you are falling behind with the schedule, you can be in one of these need groups.

- The ideal coach

- The realistic coach

- The challenged coach

It was discovered, that coach confidence comes largely from being able to have good youth sessions.

A good youth session

For having a good youth session, these are the most important attributes:

- Correct information

- Correct structure

- Time management

- Fun atmosphere

The fact that the coach knows they have these qualities, leads to self confidence from the coach. This in turn, leads to better meetings with the youth.

The room for a digital solution

It is definitely a problem that so extremely few have smartphones.

This needs to be designed for. Either, I build only for the use case of having an app tailored for the coach training, where the donated devices can be used.

Alternatively, I design only for the users that does have a smartphone, and count that more will get smartphones in the future.

Thirdly, I can use a SMS tool, not building an app but an SMS-based service, which also could be an app. Such tools exists, and are compatible with multiple-choice questions, like VOTO Mobile.

3.3.2   Iteration #2

The desire perspective

Insight: "The app could be used on my spare time". This is particularly true, about the bonus quizzes that were produced during the week.

Insight: *Coach:* "I'll buy one" (a smartphone), *Response from other coaches:* "Whoa!"

The utility perspective

Ideation: "The app should have notes, not only quesitons"

The usability perspective

Low resolution screens, made the text be barely visible. This showed, that the app needed to be tested on a lot of different devices. This is particularly true, as on day 1, the coaches did not know how to zoom, which could cause accident refreshs, frustration or confusion.

The app needs to work offline! To be online on the phone is too expensive for the coaches, and too unrealiable to give a satisfactory experience. Also, during testing, relying on internet can cause a lot of problems, especially if the teacher is alone.

The learning perspective

The coaches had surprisingly high results, and at day 3 they wished harder questions when asked.

We responded by having harder questions, e.g. by introducing similar answers, and testing 4 alternatives instead of 3. This was appreciated.

The following analysis could be done:

Doing a pre-quiz: good for learning

When asked about what they thought about doing "Graduation" as a pre-quiz (before the session), 10/10 said they liked doing the quiz before, and that it benefited their learning during the session.

When asked why it helped, these were the results:

- "During session, it is easier to follow" - 10 (100%)

- "Giving the paper manuals before, scanning headings and pictures etc, would not help" - 10 (100%)

It was also tested to work in group or individually. The ones who answered, said that you learned more individually (3/3), and more fun doing it together (3/3). Doing it together, was enjoyable as it was "Very easy because of using different minds" and "We can collaborate to do better".

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This is indeed the preferred behaviour from Josefina, and the app should continue to encourage only using the app training or certification mode after having prepared via the manual. This way, the app is still assessment, but it is "learning by thinking", with feedback.

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With the Plan Tororo staff, it was shown how important the certification mode was: even though one group had 100% on their first try, and a person had 1 wrong answer, the person with 1 wrong answer got 100% on the certification, while the 100% group had 1 wrong answer.

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3.4   Insights

3.4.1   Iteration #1

Motivation of app

The scope of the app is to examine and strengthen the entrepreneurship the student already has. One important goal is to give good feedback.

The users are already motivated. Thus, I can follow Sierra's advise designing for the compelling context.

My compelling context is that I want to help you become an even better coach.

The better user point of view: don't just make a better coach training app - make a better user of coach training material.

For me, this means:

"Given a teaching situation among the youth group, a great coach can teach an entrepreneurship topic more consistent with what the coach material said."

"Given a question in the app, a great coach will get the right answer more often, and increasingly leverage the correct answer to their coach situation."

Entrepreneurship education considerations

The YoungDrive's entrepreneurship education methodology goes hand in hand with the presented theory. It's mottos are: "Dream big, start small", "Learning by doing" and "We have fun!" [**?**].

Both in regards to designing for the users and for the above reason, the app should be a complement to YoundDrive's existing training material and the structure of the program.

A challenging part of the work is that YoungDrive consists of both the practical skills of the entrepreneur, theoretical material of running a business, and an entrepreneurial mindset. Therefore, both how to assess knowledge, and build habits, needs to be examined.

3.4.2   Iteration #2

Insights

The app works for assessment!

Using the quiz before the session increases learning, slightly decreases fun of the session, according to coaches

Fun and encouraging

- The app works for assessment!

- Good for learning for the coaches

- A good indicator for Josefina

- A great way to scale the YoungDrive training in the future, both for online coach-training and the physical training

After the meeting with the partner and expert group, the following was concluded from iteration #2:

- The app is only working on assessment now, not for learning

- The need for a field app still feels relevant (especially for sessions long since the coach training)

- The potential for YoungDrive having online coach training is huge

Determine:

- Focus for the next iteration: design quiz app for learning, focus on field app (CI, CS, TM, FA), and design having an app that works stand-alone from the YD coach training in mind.

Discussing the importance of self-reflection after a youth session with Josefina, led to asking more of such questions in coach quizzes.

Josefina: "I have a problem: there is no way I can control them how they have prepared themselves for a youth session."

An app could be used, either before you start planning (to guide what you need to study the most on), or after you think you are ready (so you can assess and improve).

Bonus results: Testing the app outside the YoungDrive context

Back in Uganda, a test was done with refugee innovators, at the Humanitarian Innovation Jam.

Also, the app was tested on a university student from Makarere University

The test with the refugee innovatiors were surprisingly intriguing and successful.

It was found that refugee innovators says they would have a great need for such an app.

The university student from Makarere University scored 100% correct, in spite of not having any entrepreneurship training. This showed that guessing was possible, or that the quizzes were too easy.

Findings

Test with university student scored 100% correct, means that common sense can go a long way, and that the results can't be 100% trustworthy, and that multiple-choice questions has serious issues - this, we already knew during and before the coach training - but it needs to be taken care of

The app would be great and could actually work outside the physical coach training - with revision, be stand-alone, even being able to distribute online.

Now there are observable evidence for what the interactions from Iteration 1 showed:

- The purpose of the coach training should be to prepare the coach in having great youth sessions

- Therefore, this is what the quizzess should assess

- What it really means being a good YoungDrive coach, is having good youth sessions

- Josefina would have liked to be able to stop coaches from having taught, if they do not have 90-100 % correct information on the subject

- Today, Josefina can not assess this. This means that some coaches, are teaching incorrect information to hundreds of youth.

- Here, the quiz has a very good need to fill.

With all of these findings in summary, it can be concluded that an app for coach training, and an app to use before a youth session, could be the same app, since the purpose of preparing the coach to be great with its youth session is the same.

From the interviews, it was learned that while it *may* be technically possible, the teacher desires the app support her, not replace her.

3.4.3   Iteration #3

för learning och självreflektion, men ej för effektivitet

Deliberate practice: not satisfied. The lesson learned is that while the app is now designed for learning, it is not designed for speed. It took too long to get certified to be within the realms of deliberate practice.

Help them practice right. Goal: design practice exercises that will take a fine-grained task from unreliable to 95% reliability, within one to three 45-90-minute sessions.

If not possible, don't continue trying: split into smaller tasks, Sierra says.

While there was now an MVP for the coach training, there was not yet a MVP for the youth session; only an MP (minimum product, but not viable yet).

To improve effectiveness, it was determined that "learning by thinking", regarding metacognitive skills, could be beneficial. This would help the coach to analyze and evaluate its own learning, possibly improving faster in the app.

Bonus results

The Kampala test showed how well the app works for learning entrepreneurship also outside of the YoungDrive context. Some modifications would greatly improve this further.

3.4.4   Iteration #4

Add everything from the mindmap

4

Discussion

4.1 Technical development

4.2 Learning development

4.3 Discussion of Result

In three months time, an app was developed with precision to the needs and context of the end users. The design has been heavily influenced by the end users, from day 1 of the project, in conjunction with relevant research, and in balance to stakeholder goals and considerations, and supervisor advice.

The results shows that the ideal coach, according to the quiz app, would be a woman, since she has better knowledge in spite of having less formal education. She prepares more, is more aware of her own knowledge and has a better study technique, respecting the app feedback for meta-cognition and meta-memory. This can be seen by higher quiz results, faster learning, and more honesty in "Are you sure?".

It could be that first-time smartphone users have a disadvantage with the app, since they will not learn as fast as experienced users. The interactions shows however, that at the second session, almost all of the coaches felt intermediate instead of beginners, using the smartphone and the YoungDrive app. The quiz data verifies this, with no direct correlation between technical skills and quiz results.

The final version of the app shows users can get 100% on quiz results much faster that the previous version, where the score board had been improved. Since the target group in Zambia and Uganda was different, it is hard to say if it went faster getting 100% with the possibility of repeating only the wrong questions, asking "Are you sure?", and providing individual feedback. The qualitative study

does show however, that 100% thought the feedback was good for learning, and that they appreciate the app.

4.4   Discussion of Method

4.4.1   Working with technical constaints

Upgrading from version 1.2 to 1.3 during Iteratoin 3 was a good example of technical limitations. Since 1.2 did not work for old Android devices, a "better" version of software was not viable.

A lot of time where spent "wasted", and time during that iteration needed to be taken back by working the Friday night and Saturday, before the travel to Tororo.

4.4.2   Involving consultants to support the design process

Should
I ad-
dress
this,
what I
would
have
done
without
them?

4.4.3   Consequences of involving end users and stakeholders throughout the whole process

Product Benefit from involving users and stakeholders

Design thinking, human-centered design and service design, has been proven to be crucial for the success of this project. Service design thinking and methods, gave a framework to have all of these perspectives in balance and consideration, always with the end user as the most important person.

Support Benefit from inolving users and stakeholders

The fact that the end users and stakeholders has been involved from the start, made them feel ownership of the product. This has many benefits, among others that they *everyone* involved is satisfied with the *final* app, since they think that their opinions and expertise has been taken into consideration and implemented. This further increases trust, and the the likelihood of them supporting future work. Even more so, the end users are more likely to use the app, as they have been co-creators of the product.

Complications

I was not a designer. I was a computer expert with social skills, now needing to design and develop an app for a cultural and socio-economic context very different from my own.

In this regard, the technical aspect was but one. I *did* need to learn how to develop hybrid apps in JavaScript that worked offline, and had an online back-end. Those was the technical demands.

But more so, I needed to quickly become a good designer. Not mainly from a perspective of graphic design or interaction design, but *how* to explore, design, and implements what the user needs from the requirements "fun, user friendly, and good for learning". The approach to learn design from these perspective was to read extensive literature, consult a diverse set of experts, and be very humble and curious in interactions with the end-users and stakeholders.

This took me a long way, to the point where research, experiments, and constant improvements could lead to increasingly well-informed decisions.

I now have new-found skills in:

- etnologicy (getting to know and learn from people in a different culture)

- human-centered design

- design thinking

- service design thinking

- interaction design

- digital learning

- data analysis

It has placed high psychological pressure and leadership demands on me as a new designer, to:

- always be in charge of balancing all the different perspectives, with the end user's best in mind

- be able to change the planned process when new learnings or opportunities emerge (leading an agile design process)

- always implement new functionality from customer needs instead of designer or engineer bias

- continually design and run workshops and tests suitable for the target groups

The reason why this has been especially hard, is that simultaneously to learning design and technological skills, I have been in a different cultural setting than the designer is used to. This has also been extremely rewarding, at the same time exhausting.

4.5   Future Work

4.5.1   Bloom's Revised Taxonomy

From a question assessment, it is shown that all of Bloom's levels can be reached via the app, but two: create, and apply. This is because users can not create anything in the app, and they can not match knowledge towards what suits them. In

future versions of the app, mechanics of sharing content and co-creation would add value. This goes in line with Clark's research, which showed a positive correlation with learning and games that required multi-player collaboration [Clark, 2014].

4.5.2   Iteration 3

Self-reflection after a youth session Josefina talks about a different need: doing self-reflection after a youth session. She says that this is at least as important as the coach training, especially in cases where Josefina or other project leaders don't have the resources to visit the coaches physically.

It is determined that while physical follow-up meetings are essential, the app can be used to help the coach in a smart self-assessment and self-reflection. Also, on encounters with the teacher, it can guide the coach-teacher discussion.

This does not need to be a new app. Questions can be asked in a way that they are indeed meta-cognitive, encouraging learning by reflection.

Josefina mentions that when she is there to give feedback, it is very clear to the coach that he or she lacks knowledge and has not prepared enough.

An app with self-evaluation and monitoring, would help keep the coach thoughtful and give the coach important insights. They are described to sometimes overestimate their own knowledge.

Including coach guides in the app She also points out a problem with the training: it feels like some of the coaches forgets the coach guide, even if it has been improved and better integrated with the participant manual. Some of them, don't even use the coach guide.

This speaks for that the app should include quizzes for all coach guides as well. however, the test showed that coach guide should not be designed as a quiz, but better suggested as a drag-and-drop exercise.

When asked if the coach guide quiz are more important than the topic quizzes, she answers that the correct knowledge is more important, because that is the one that needs to be explained correctly to the youth.

Therefore, it should be moved into Future work.

She also says, that while it would be great if the training did prepare the youth more actively for holding youth session, it would not be something to implement in the first day. One idea would be to start with topic quizzes during the first days, and then introducing coach guide quizzes and similar themes. She mentions the challenge with time: Friday, the last day, should be dedicated to preparing a session. But the time has never been there.

5

Conclusion

In response to the research questions questions, the master thesis has:

Contributed to the domain of entrepreneurship education in a developing country context

Lorum ipsum

Demonstrated how certain technical constraints and design constraints can be overcome in a developing world context

Lorum ipsum

Provided methods of investigating usability and learnings with a digital training tool in the real-world training context

Lorum ipsum

Created new methods in service design, when co-designing digital artefacts in a developing country context

Lorum ipsum

Appendix

A

Appendix 1

Detta är ett appendix-kapitel. Jämför med appendixet i kapitel 3.

A.1 Original Time Plan

A.1.1 Before Uganda

Week	Focus
2	Workshop with Lena Tibell and Konrad Schönborn on Research questions & Proposal of method.
3	Start writing "Planeringsrapport". Study interaction design via guest lecture Jonas Löwgren, and reading the book "Thoughtful Interaction Design".
4	Interview with Take Aanstoot, Social entrepreneur in Kenya. Submission "Planeringsrapport". Education day in Service design in Stockholm (by Expedition Mondial). Meet Joachim Svärdh about Entrepreneurship research.
5	Approval "Planeringsrapport" with Camilla Forsell. Meeting with Lena Tibell and Konrad Schönborn (2016-02-02). Travel to Uganda.

A.1.2 In Uganda

Times specified are in local time to where I am. Uganda time (EAT - Eastern Africa Time) is 2 hours forward of Swedish time (CET - Central European Time). Meetings with Swedish partners are generally done via Skype, where Uganda meetings are preferrably done in person.

Note that during all of this time, writing the master thesis will progress. After the time in Uganda, the report will be a 100% focus.

1 day per week will be spent on report writing, including Analysis work for the meetings.

Week	Focus
6	**Cultural adaption**. Land, set up wifi, set up my apartment, learn about the YoungDrive organization, meet people. Be prepared for stomach disease. Get familiar with the transportation system in Kampala. Get familiar with the city. **Iteration 1**. Prepare Iteration 1 with Iliana. Start-up meeting with partners. Start report writing: analyze, collect material, sort, structure and plan.
7	**Iteration 1**. Prepare Interactions. Analyze Start-up meeting with partners. Write on report. in order to create *Questionairee guide*. Understand technical tools, without working on an app solution - the goal is to get familiar with the tools.
8	**Iteration 1**. Travel for Interactions. Do 8 face-to-face interviews, with no digital focus, hypotethical situations. Do minimum 2 field visits to understand the coach's situation, ideally living in Kamuli or Tororo a couple of days. This is a good opportunity to learn coaches how the tables and smartphones work.
9	**Iteration 1**. Analysis & Compilation. Thursday: Expert meeting (March 3rd, 6-7 PM). Friday: Partner meeting (March 4th, 11-12 AM). **Iteration 2**. Determine Needs. Ideation. Create low-fi Trigger material (pen and paper) and determine what the hi-fi (digital app) material should be.
10	**Iteration 2**. Design and Develop the hi-fi trigger material. *Half-time check-up with examinator.*
11	**Iteration 2**. Interactions, control group #1 & #2.
12	**Iteration 2**. Interactions, control group #1 & #2.
13	**Vacation** with fiancee.
14	**Iteration 2**. *Analysis #2* (What choices needs to be made? What path should be taken? Start formulate Customer path. If needed, document how people see apps, document limitations, document experience needs, document risks.) & Compilation. Thursday: Expert meeting (April 7th, 4 PM). Friday: Partner meeting (April 8th, 11-12 AM). Continued Development Creative Brief. Determine what actions needs to be taken outside of the development of the app. Create Behovsgrupper.
15	**Iteration 3**. Develop and Modifications phase.
16	**Iteration 3**. Develop and Modifications phase. Interactions: App Tests with Interviews & Measurements (with time allocated for late arrivals and missing participants).
17	**Iteration 3**. Interactions: App Tests with Interviews & Measurements. Analysis & Compilation. Friday: Partner meeting (April 29th, 11 AM) & Expert meeting (April 29th, 4 PM).
18	**Final analysis**. Finalize the app. Travel back to Sweden.

A.1.3   **After Uganda**

Week	Focus
19	Write on Master thesis report. Attend Auscultations.
20	Write on Master thesis report. Attend Auscultations.
21	Write on Master thesis report. Attend Auscultations. Find opponent for Master thesis.
22	Submission of report to examinator, after approval by supervisor. Examinator decides on date and time for presentation. Send report to opponent, and get the opponent's report.

A.1.4   **After Semester**

Week	Focus
35	Presentation of my Master thesis, with supervisor, examinator and opponent. Hand over publication approval to the administrator.
36	Opposition of another person's Master thesis.
37	Do changes to report if requested. Upload report to X-sys for approval (within 10 days). Write Reflections document and submit on X-sys within the 10 days. Publish master thesis in X-sys.

A.2   **Half-Time Evaluation Time Plan**

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