

Institutionen för teknik och naturvetenskap

Department of Science and Technology

Examensarbete

Digital Learning Designed for Entrepreneurial First-Time Smartphone Users

Examensarbete utfört i Medieteknik
vid Tekniska högskolan vid Linköpings universitet
av

Marcus Nygren

LiTH-ITN-EX--YY/NNNN--SE

Norrköping 2016



Linköpings universitet
TEKNISKA HÖGSKOLAN

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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.

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Due to a chain of lucky events, this master thesis took the approach of combining service design, thoughtful interaction design, technology, learning effectiveness research, and entrepreneurship.

For service design, I want to thank Peter Gahnström at LiU Innovation, who led me to Expedition Mondial, and I especially want to thank Susanna for being a great tutor.

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*Linköping, Januari 2020
N N och M M*

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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	when an entrepreneur goes through training
education	
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	describes the creation of digital artefacts
design	
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.

Expand.
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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 An app for the entrepreneurship coaches

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. [?]

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 a entrepreneurship coach training app. 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 Definition of success for the app

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

YoungDrive'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". [?]

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 [?], some facts related to entrepreneurship in Uganda are:

- Uganda is the world's most entrepreneurial country. (28% 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.

As Mitchel says about entrepreneurship [?], the motivation of entrepreneurship does not need to be solely wealth accumulation anymore. The activity of entrepreneurship contributes to society, in a way that is not captured by the commercial entrepreneurship literature.

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 are growing rapidly 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 [?]. 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 [?] says there are few empirical studies available, examples include among others Kuratko [?], Pittaway [?] and Bae [?].

Especially relevant for this work is the recent interest in interventions for teaching and learning entrepreneurship in the developing world: [?] [?]

First, Oviawe [?] 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 [?] 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 and Pihkala [?] 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. They could find that entrepreneurial activity seems to lead to better entrepreneurship education. Dickson's recommendations for enhancing entrepreneurship education practices were 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. [?] Thus, digital education shows both great potential and great considerations.

Brining research into reality

Clark [?] has done a comprehensive study, which motivates why a digital tool or game is a good thing by showing a .33 standard deviations in intrapersonal 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 [?] and Page [?].

Caring for the context

Luckin [?] emphasises the need to care for the context. Stickdorn [?] 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. [?]. 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. [?] For example, it has been shown that multiple-choice tests in e-assessment can be used to good effect [?].

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. [?] 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

Related work is presented in two parts: apps that have considered their development country context well, and previous apps that have been made for learning via assessment.

Digital tools in a developing world 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. [?]

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 environment [?]. 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 [?].

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

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limita-
tion
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- The app will be a compliment to the physical YoungDrive training, not a replacement.
3. How can test questions be developed to support entrepreneurship learning?
 - Solely existing YoungDrive teaching material will be 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?

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limitation
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- Limitation

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, which presents methods to analyse quantitative and qualitative data.

2.1 Methodological Framework

In the methodological framework, useful methods design for learning and motivation are presented, together with methods for creating a design process and data analysis.

2.1.1 Design for Learning

The following sections, are about how to design for effective learning [?], 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 section) 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 [?] 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.

Konrad: specify
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). [?] The taxonomy thus provides a framework for determining and clarifying learning objectives. See figure 2.1 from [?]. 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. [?]

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

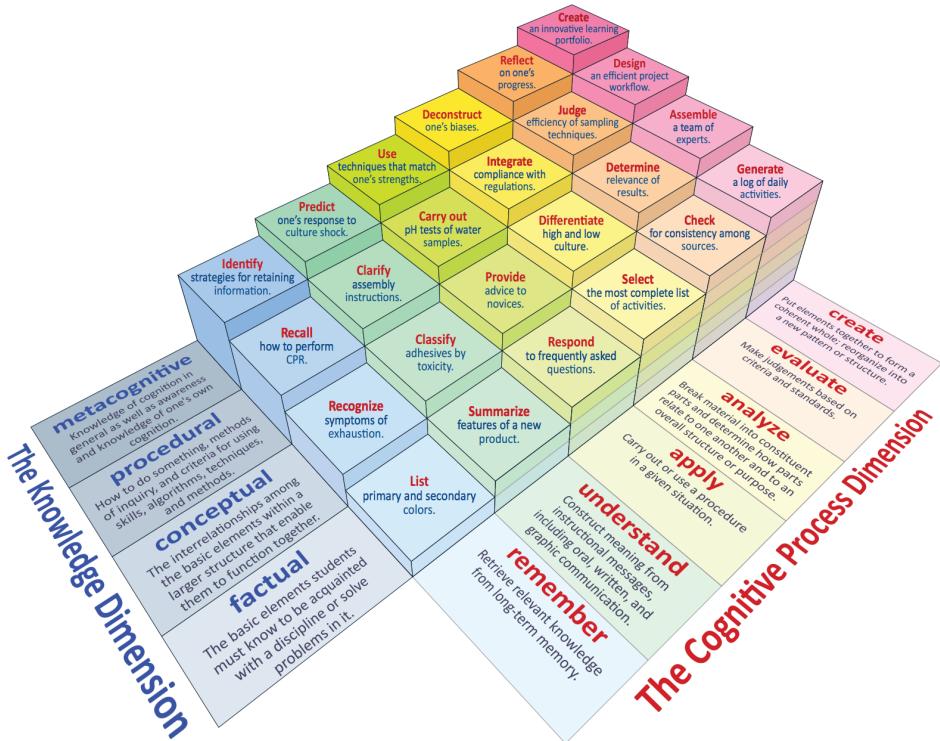


Figure 2.1: Bloom's revised taxonomy visualised with examples of different learning objectives.

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 [?] 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 [?] 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 [?] [?]. 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. [?]

Sierra [?] 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 2.2 from Sierra [?]. Sierra says, if you can't get the user to 95% reliability within this time, stop trying; you need to redesign the sub-skill. [?]

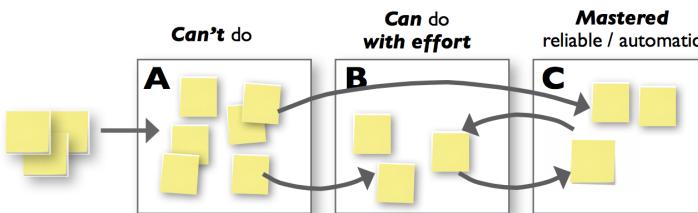


Figure 2.2: Moving skills from A (Can't do) to B (Can do with effort) into C (Mastered) can move different ways, depending on how effective the learning is. Deliberate practices focuses on A-B-C, while perceptual expose enables A to C. Reflection allows knowledge to go backwards, to get better at the 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 more and more difficult, 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. [?]

It shows that whenever a skill relies on intuition, we could try exposing the user a well-designed trial 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.

Konrad:
how?

Learning from Assessment

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

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

Moreover, it also has cognitive benefits. It can help to offer appropriate 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 appropriate feed-forward advice. Sitzmann ? has studied how questions used to prompt self-monitoring and self-evaluation benefit learning, showing gradual, positive effect on learning.

Moreover, research on fixed mindset (I can't do X) versus growth mindset (I can't do X yet) talks about how mindset guides behaviour. In a math game with Dweck's research ? as a base, students were rewarded by the mentality of "Not yet" and effort versus getting a grade on existing knowledge. Regarding learning, those exposed to a growth mindset mentality, previously having a fixed mindset, got superior results, especially those students previously having difficulties with learning. Regarding motivation, Dweck's research showed that high achievers played to the end, but in the growth mindset version those still played to the end, but so many more lower and medium achievers also stayed until the end. ?

Viktigt
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Learning by Thinking: Reflection & Retrieval Practice

Stefano [?] suggests 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 suggest that reflection as an activity that can be more effective than additional learning. This surely applies to the teacher as well, Luckin says. [?]

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

Deci [?] and Ryan [?] studies self-determination theory, Elliot [?] studies achievement theory, and Eccles [?] and Wigfield [?] 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). [?].

In terms of effective learning and expectation value, a growing research field is training transfer [?]. 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. [?]

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

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

Intrinsic load, needs to be dealt with if the effort is too high. Sierra [?] 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 load, is about the way information is presented to a learner, and should be handled via designing to support cognitive resources, Sierra says [?].

Germane load, 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. [?]

Scaffolding is a technique to step by step remove the support wheels for the user, e.g. present information in different ways. Clark's [?] 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 [?]. 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 superb to simple gamification, says Sierra [?]. 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 [?] [?]. Pink [?] says that the surprising truth about what motivates us is that drive is fostered by autonomy, mastery and purpose. Meanwhile, Clark [?] 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 suggest different design processes. For example, agile development suggests how to 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 [?] writes about design thinking and useful techniques in general, from his interaction design perspective.

Service design thinking connects various fields of activity [?], and its 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. [?]

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 [?].

With its user-centered focus [?], 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 [?]. 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 described 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 [?]. 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. [?] 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 increasingly towards socio-technical experts [?], 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. [?]

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. [?]

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 necessary relationships with clients, users, decision makers, and so forth. Based on all this, she creates a design proposal. [?].

2.1.4 Service Design Methodology

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

Principles

Stickdorn [?] 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 common 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 [?].

Nissar [?] 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*.

- 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 [?]. See figure 2.4.

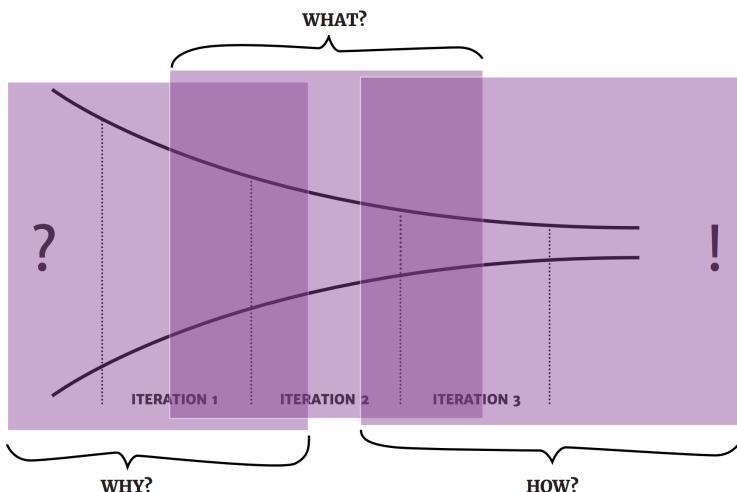


Figure 2.4: The iteration process consists of a number of iterations with different focus, starting with broad strokes, and narrowing down into a concrete product. Between iterations, the overlap between "Why?" and "How?", "How?" and "What?", signals that there is a learning process which means conclusions 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 [?]), 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 the current author and Expedition Mondial for the master thesis. [?]

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 step 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 - pleasureability, usability, utility and desirability), and quantitative 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 demos* (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 *lo-fi* 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 Data Analysis

This section presents relevant 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: [?]

1. Data acquisition (→ data are given)
2. Data enhancement (→ data are processed)
3. Visualization mapping (→ data are mapped to for example a geometry)
4. Rendering (→ 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.

Konrad:
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Calculating Correlation

Calculate means, follow formula. Cumbersome to do with all of the axes 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.

Pseudo-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 axes towards all the axes, 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".

Pseudo-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:

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 quantitative 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 quantitative 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/A"))

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, fa
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 [?] 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 the current author 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 Insights 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 projects. 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 entrepreneurship education program, and giving support.

The Linköping University team consists 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

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

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.

Add reference

For technical development for rural areas, Julien Tantge, 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.

Therefore, the whole design and development process will take place in Uganda, with several interactions with the intended users.

The work was carried out from Hive Colab, a co-working space and an innovation hub.

The interactions took place in either Uganda or Zambia, in the locations where training of the coaches and youth takes place.

There were a number of resources made available to support the work, e.g. the *YoungDrive manuals*.

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

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

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

Another challenge with being in Uganda compared to Sweden is that internet speed and access is worse, especially outside Kampala.

Include a photo or two showing the setting of the workshops / data collection

2.3 Understanding the YoungDrive participants

The following section describes roles, businesses, and coach descriptions for Uganda and Zambia.

2.3.1 Roles

The *country manager* trains the project leaders. It is also the main person responsible for partnerships and the quality of the YoungDrive program in the respective country.

The *project leaders* trains the coaches. They oversees the coaches, manages the coach training, and also collaborates with local stakeholders for quality assurance and to oversee daily operations.

The *coaches* trains the youth. In Zambia, a coach only has responsibility for training youth in the YoungDrive program. In Uganda, this is called a *Youth Mentor*, in contrast to being a *Community Based Trainer (CBT)*, which also trains the

youth in other programs and leads the youth saving groups. Most of the CBT's in Uganda holds sessions together with a Youth Mentor, or divides work between them, instead of being alone. The coaches are often volunteers, receiving a small scholarship from the partner organization. They are often business owners themselves. The coaches could be described as social entrepreneurs [?]. Many of the YoungDrive coaches (and youth) 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* are the ones receiving the training from the CBTs and the YMs, being encouraged to start their own businesses.

Country Managers

In Uganda, the country manager is Iliana Björling. She is located in the Uganda capital, Kampala, which is a strategic location because it is the same city in which the national office of the main partner, Plan International, is located.

In Zambia, the country manager is Josefina Lönn, who previously was project leader in Kampala, and has held all the trainings up to this point. Now, she leads the operations and has trained the coaches in Zambia, in the new role of country manager and project leader.

2.3.2 Social characteristics

According to statistics gathered by YoungDrive during 2015 evaluations, there are a number of considerations to make regarding the coaches in Uganda. This regards entrepreneurship experience, technical access, and language.

All of the Tororo coaches run a business (26/26 respondents), with a majority running more than one. This means, they do have practical experience of running a business outside of the YoungDrive coach training.

While all have a cell phone, smartphones are very uncommon - only 3 uses Internet on the phone, every day or weekly, mostly for Facebook or email. Regarding power, none (0/26) has power at home, 3/26 has solar, and only 4 can write on a computer. Taken together this means that their technical skills are low, and needs to be in consideration.

Regarding language, English can be used in the coach app. While about half of the asked Uganda youth can not understand (129/225), read (133/225) or write (132/225) English, most of the coaches in Uganda are proficient.

These characteristics can be used for youth and project leaders as well.

2.3.3 Tororo businesses

The coaches in Tororo are divided into three different regions. Based on region, income and experience, they run different kinds of businesses.¹

¹In Uganda and Zambia, a small-scale business is typically not registered. Thus, the coaches' definition of a business can be more generous.

In Tororo, the coaches' 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.

In Tororo, there are 2 Project Leaders. Christine's business ranges from: bakery, corn, pig farm and plastic products. Patrick's business ranges from: silver fish, beans, corn, and bird farm. In comparison, in Kamuli, there are 4 Project Leaders. 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.

Among the youth, 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%).

2.3.4 Zambia coaches

The Zambia coaches in Kabwe are better educated, and have better access to technology, compared to the ones in Uganda. Regarding sociology, ages ranged from 21-39 years old (26.8 average). 3 were mentioned as being shy during the interviews. They lived from 10-90 minutes outside of town (33 minutes average).

Regarding motivations for being a coach, 50% had an emphasis on benefiting the community, and 90% had personal reasons. The following statistics has been derived from the notes of the Zambian coach job interviews ?.

Care for oneself:

- Learn business
- More skills
- Get idea
- Expand business
- Benefit CV

Care for community:

- Empower
- Teach business
- Leadership
- Share
- Stop bad behaviours of youth

Regarding experience, 8 had trained youth before, 8 had been a leader before, 9 had business experience.

Regarding YoungDrive, they said they could handle training between 8-30 youth (19.8 on average) per group. They could have 1-5 groups per coach (average 3.0), totalling a range between 8-101.5 youth (average 59.8).

During the visit in Zambia, the coaches had not yet formed their youth groups, and started their own sessions.

2.4 Implementation

This chapter describes the implementation of methods for each iteration's interactions: in regards to data, data analysis, method, and method analysis. Figure 2.6 is made to assist the reader in which methods were used for each iteration, in terms of research and app tests.

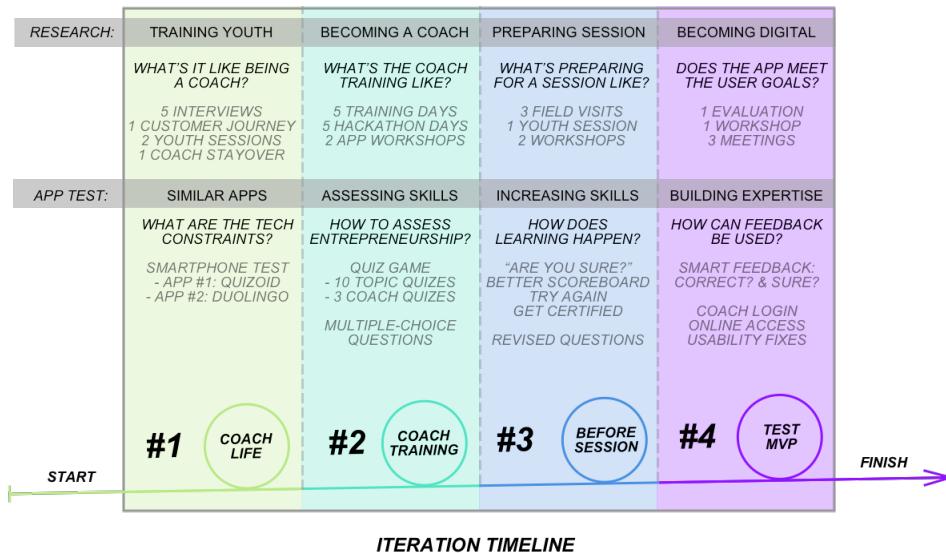


Figure 2.5: The iteration timeline shows the process from iteration 1-4, by different colors. Each iteration leads to a loop, with the design situation as the focus, in which interactions can happen that is related to either research ("What's ...?") and an app test ("How can we ...?"). This output from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

Methods w/ Analysis —

5 Interviews - Notes - Questionnaire for Customer Journey
 1 Customer Journey - Clustering - Personas
 2 Youth Sessions - Shadowing - Needs
 1 Coach Stayover - Empathy - Design Ethnography

5 Training Days - Observations - Understanding entrepreneurship training
 5 Hackathon Days - Interviews - Notes and Sketches
 2 App Workshops - Co-Creation/Co-Refinement - Sketches and Needs

3 Field

Activity App test observations (group)

App test observation (individual) - Affective reactions (5 Why's, think aloud)

Analysis: Interaction design evaluation (desirability, usability, utility, pleasureability)

Customer Journey Map - Activities - Behaviour

Written responses (individual) - Right/wrong - Time - Number of tries

Interviews - New insights

Data Collection w/ Analysis —
Customer Journey Map w/ clustering
Pre-study w/ Quantitative analysis
Written quiz responses w/ Quantitative analysis
Digital quiz responses / Quantitative analysis + Statistical analysis + Parallel coordinates
Quiz questions 1 w/ Bloom analysis Quiz questions 2 w/ Bloom analysis

2.5 Study Design and Data Collection

As a computer expert with social skills needing to design and develop an app for a unfamiliar cultural and socio-economic context, it was needed to quickly become a good designer.

The technical aspect of the project was but one. It was needed to learn how to develop hybrid apps in JavaScript that worked offline, and had an online backend. However, those are merely the technical demands.

It was 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 used to learn design from these perspective was to read extensive literature, consult a diverse set of experts, and be humble and curious in interactions with the end-users and stakeholders.

In the following section, the creation and implementation for a suitable design process is described, together with the study design and data analysis for each iteration of the project.

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 thought 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 [?], adjusted to agile methodology and interaction design, but aspiring to be a socio-technical 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.

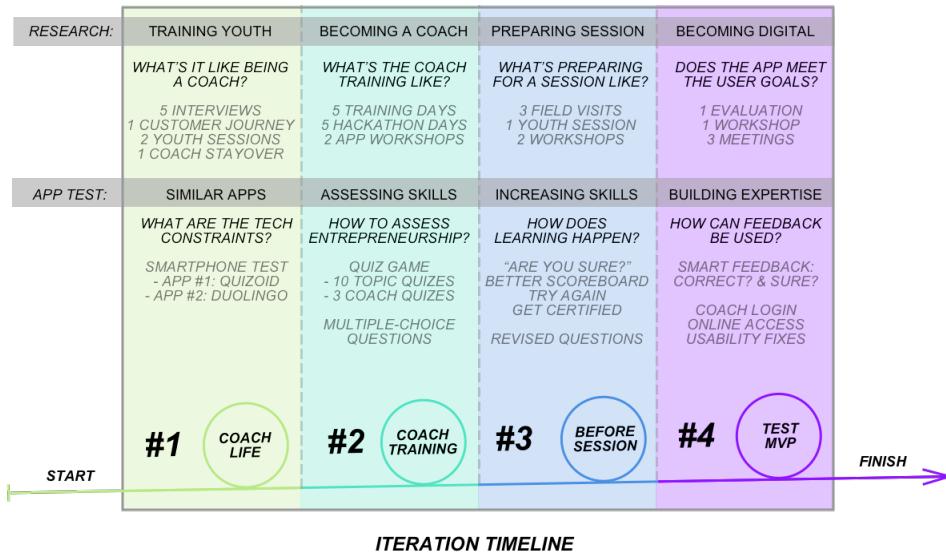


Figure 2.6: The iteration timeline shows the process from iteration 1-4, by different colors. Each iteration leads to a loop, with the design situation as the focus, in which interactions can happen that is related to either research ("What's ...?") and an app test ("How can we ...?"). This output from the loop, then gives force to the next iteration.

Implementation of Design Process

See figure 2.6. 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.

In Tororo iteration 1 it was chosen to observe the youth sessions. In Zambia iteration 2 it was decided to observe the coach training. In iteration 3 in Tororo it was chosen to observe the coaches preparing the youth sessions.

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.

2.5.1 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?".²

²A coach meaning either a Community Based Trainer (carrying out all the trainings), or a Young-Drive coach, depending on who was asked the question.

Lowgren's thought 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.

2.5.2 Iteration 2

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, always followed by a feedback round, so the app and the tomorrow's question set creation could be improved for the next day. 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.

Creation of questions

Project leader Josefina in Zambia refined Iliana's 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.

Trigger material used

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

Design workshop #1 in Zambia

The coach training started with me having a design workshop with the coaches, not showing them the app that I had created. The co-creation workshop was made to identify important functionality in the minds of the coaches.

1. Since the knowledge about smartphones and apps were low, I started by introducing these topics.
2. 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.
3. Using postits, they started with during limited time drawing the start view from the Facebook app.
4. Then, they were asked to draw what they thought happened on the friend icon click, drawing the view on another postit.
5. Then, the mission of the YoungDrive app was described. They were then divided into two teams, having limited time to draw the best imaginable YoungDrive coach quiz app they could. First, they designed the app from the top of their heads. They then pitched their results to each other.
6. 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.

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.

2.5.3 Iteration 3

Because of the many research and functionality needs, the study design of Iteration 3 became very important. A lot of development and ideation needed to be done.

Iteration 3: Purpose

Iteration 3 had an even more detailed scope. Since the app now succeeds with the first use case, the coach training, now the focus could be on "learning at distance".

Pedagogical model

It was chosen that "Are you sure?" + Improve would be included in the hi-fi material, a flip-card approach would be tested as a lo-fi material, and to "record answer via voice" could only be presented as an idea during a field interview (experts said there would be usability issues, and the 1st-time smartphone user agreed). The Gold/Silver/Bronze method was included into the hi-fi material.

Test on a Kampala entrepreneurship student

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

Test in Tororo

As Plan International staff are not allowed to support visiting coaches in the field during local elections, the co-project leaders in Tororo were consulted to carry out the field trips, so that it was still possible to attend the youth group meetings.

For the interactions, a big app test was held, a group interview was held, and then they were divided into co-creation workshop groups, with a presentation in the end.

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.

After the app tests, it was tested with a lo-fi prototype that the coach thinks aloud about the question, *before* receiving the multiple-choice answers. This approach proved to be great for learning, and could be a great addition to the hi-fi material. Interestingly, this test was done as a live quiz, and if the interviewee could not answer the question directly, the audience were asked and tested if they knew the answer (raised hands), and if nobody knew the answer, it was tested which of the multiple-choice alternatives they found most likely.

During the afternoon, we divided into 5 groups focusing on improving the app experience for the coaches.

On Wednesday, I met with the same coaches from the field visits. I wanted to see how they acted when I gave them the challenge: "Get 100% correct answers in one go, on the hardest quiz". A co-creation workshop ("Educator Dashboard") was held in parallel, with 3 CBTs and 1 project leader respectively.

2.5.4 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 [?].

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.

2.6 Application Implementation

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

2.6.1 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.

2.6.2 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.

2.6.3 Iteration #1

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

Devices are prepared

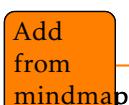
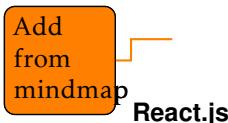
As most of the coaches did not have smartphones or tablets, enough smartphones and tablets were brought with me from Sweden, either donated, borrowed or bought devices. These were a combination of Android and iOS, smartphones and tablets, so the app could be tested on as many platforms as possible. During 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 Typeform³ 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.



2.6.4 Iteration #2

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

³examples include <https://showroom.typeform.com/to/ggBJPd> and <https://showroom.typeform.com/report/njdbt5/dIzi>

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 [?]).

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.

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 necessary 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.

2.6.5 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 integrations.

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 design was the best. For this, see Result .

This can be commented in the Future work

Add reference to Result

Login, Database, and Meteor upgrade

In order to store data per individual, a database and login would be needed. Meteor 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 implement. It forces username and password, and instead I wrote the login myself.

The front-end was not problematic, however, implementing server-client communication 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.

2.6.6 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.

2.7 Data Analysis Theory

2.7.1 Iteration #1

2.7.2 Iteration #2

2.7.3 Iteration #3

2.7.4 Iteration #4

Lägg till överallt data table

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. [?].

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.

Lägg
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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 resampled for each column that had 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 an overview of the pre-test data.

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 (several 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 showed similar means on the pre-quiz results, the two control groups were determined comparable.

To meet the challenges of using Google Sheets, a multivariate analysis 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 from various disciplines, 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.

2.7.5 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.

2.7.6 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 detective 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 be 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.

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Results

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

3.1 Developed Application

In figure 3.1 the end results of the app from iteration 1, 2, 3 and 4 are shown. The final app works on web or as an app, online or offline, on all of YoungDrive's Android and iOS devices. The app is fast to use, the back button on the phone can be used to go to the previous view, and the font size and images are consistent for each screen (which was not the case iteration 1-3, see figure). The goal was to provide a great learning experience, with a strong YoungDrive feel (embracing the values of fun, plus using the YoungDrive logo and colors)

The quiz flow iteration 1-2 was a standard multiple-choice quiz game, designed for assessment, but not for learning. In a scoreboard, they could see which questions they were awarded points for and not, with a total score. In the end of iteration 2, they were encouraged to go back to the start screen, to redo the same quiz again, or select a new one.

For iteration 3, thanks to recording both if they were correct and confident, the app can give very precise learning feedback (e.g. showing that the coach answered alternative B with confidence, but showing that A was actually the correct alternative). After giving feedback, the coach can train, and improve on incorrect answers and guesses, and when being 100% correct and confident, ideally take the whole quiz without faults.

Result

In iteration 3-4, the coach answers "Are you sure?" (yes/no) for each question.

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Figure 3.1: The app flow described as a timeline (A-I), per iteration (1-4). E.g. in iteration 4, login (B4) appears after choosing quiz to take (A4).

In the score board, they can read their answers, the correct ones, and how sure they were of their answers.

After observing their incorrect ones, and learning the correct answers, they try again.

Number of quiz tries is shown to the coach during the training to the coach for self-evaluation, but it is not a performance measure.

At 100% correct answers, they can get certified, by getting the whole quiz correct without faults. If they do anything wrong, they are put back into training mode, or select another quiz.

In Certification, the coach is encouraged to get 100% on their first, second or third try (receiving Gold, Silver or Bronze), to reward the coach for truly having learned the questions, and not provided guesses. They are then encouraged to select a new topic if they want to.

ScoreBoard

For iteration 4, it is realized that the combination between correct/incorrect and sure/not sure can be used for empowerment.

- rätt svar + säker = pluspoäng
- rätt svar + osäker = du gissade men hade rätt, var säker nästa gång
- fel svar + säker = måste ge feedback (väldigt intressant för Josefina)
- fel svar + osäker = du ahde rätt, det var ett annat alternativ, gör om

Översätt till engelska

Pedagogisk modell

Träningsläge: ta ett quiz, med "Are you sure?". Baserat på svar, låt frågor hamna i tre olika lådor: "Can't do", "Can do with effort" och "Can do effortlessly". Genom att fel frågor (Can't do) igen, och reflektera över Correct + Unsure, kommer till slut alla frågor vara på "Can do effortlessly". Då läser du upp "Certification".

Översätt till engelska

Om du har fel på en "Can do effortlessly"-fråga, flyttas du tillbaka till träningen, och får igen omfördela "Can't do" eller "Can do with effort" och "Can do effortlessly".

Frågor i "Certified", är frågor som coachen befäst genom att upprepat korrekt från "Can do effortlessly". Så coachen blir Certified i ett helt quiz, när den har rätt på alla frågor i Certification test. Då är den klar, och redo att lära ut ämnet!

Men coachen kan också välja att lämna quizet när som helst, och komma tillbaka i ett senare tillfälle. Detta handlar om att coachen ska kunna bestämma själv hur den vill bli bättre.

Målet är alltså att i coachens egna tempo, flytta över frågor från "Can't do" till "Can do effortlessly" till "Certified". Så planerar jag bygga expertis som YoungDrive-coach.

3.2 Iteration 1

Here the results from the qualitative and quantitative data for iteration 1 are shown, together with conclusions.

3.2.1 Qualitative data

Entrepreneurship education considerations

Through early interviews with YoungDrive staff, it is clear that YoungDrive's entrepreneurship education methodology goes hand in hand with the presented theory. Its 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.

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.

Stayover at Patrick: På morgonen visade Patrick mig hur han jobbar med deras tomt, var det odlas ris, och andra råvaror, deras djur, deras story från Syd-Sudan, till Kampala, till hyddan här i Tororo, och hans värderingar.

Efter en ungdomssession nästföljande dag besökte vi och hälsade kort på en av de 2 CBT:s vi har session med idag. Sedan hade jag och Patrick den obligatoriska review av ungdoms-sessionen, och jag bjöd honom på middag. Kl. 19 ringde hans fru (som har börjat få tecken av malaria) och skyndade hem.

Nästa ungdomssession fick jag besöka en annan CBT. Vi var tidiga. Sedan började jag prata med henne, och fick bra tillfälle att intervju henne och även förklara för henne vad jag gjorde där. Det blev underligt att förklara för henne: Patrick påminde, när jag tabbat mig, att ”Marcus, du måste förklara för X vad en app är”. Så hon fick låna min mobil, och jag förklarade att app var kort för applikation, och att för varje applikation har ett eget syfte, t.ex. ta foton. Jag bad henne klicka, svårt, råkade klicka åt henne, men sedan lät jag henne göra. Efter hon sett att det hon såg i skärmen var det hon såg på riktigt, blev hon jätteglad och började fundera vad hon skulle fota. Hon reste sig och gick runt hörnet, och jag följde efter. Hon fotade, efter att noggrann tänkt igenom, att hon fotade buskarna med frukt. Sedan sade jag hon kunde fortsätta fota, och då tog hon ett litet runt hus utanför.

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 Quantative data

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

After lunch, I held two workshops with the coaches. The first one continued from where the interviews, “A day as a coach”, using a customized Customer Journey Map. First, three personas were created based on the interviews: an “ideal coach”, “realistic coach”, and “poor coach” were named. I had created a timeline with “Before”, “During [the youth session]”, and “After”, and each post-it color represented one persona: John, Joan, and Suzan. They understood the timeline and personas they created very effortlessly.

The first workshop was finished with many important insights.

Workshop #2: Quizical and Duolingo

Quizoid and Duolingo were tested to understand the technical possibilites of the coaches.

The result was that the app can place itself somewhere in the middle of the two, regarding difficulty level.

Patrick [från YoungDrive] undrade om han kunde låna en smartphone under tiden jag var här.

Efter workshopen, berättade han:

“Vet du vad Marcus, idag har en av mina drömmar gått i uppfyllelse.” Det var första gången han använde en smartphone

Even for coaches that had never touched a smartphone before, some concepts were easily understood (like using the camera and Quizical).

Other concepts were harder (e.g. accidentally getting to the settings menu, unlocking the device, understanding Cut the Rope 2, or training languages using Duolingo with advanced interactions). Point and click is easily understood, whereas sliding is much more unnatural.

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Also, it's important that the app is fail-safe - but how do I avoid errors with the Android OS and iOS? A lot of training is needed to avoid errors, or I need to find another solution.

3.2.3 Conclusions

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.

Assessment of knowledge and skills is today mostly based on how good they feel can answer the youth's question, and how the audience reacts Is this a good way of assessing? I see two problems. First, the feedback comes only after a session is carried out. Second, it is a very subjective approach. Third, this feedback is not sent to Patrick and Christine, unless they're visiting.

Technology could increase accuracy and accountability Most coaches plan their next session during the morning, or immediately after a session with their group. Since a coach has somewhere between 7-10 groups (some even more), and the youth groups are at different modules, there is a lot of knowledge for the coach to handle - not only theoretical knowledge, but also the struggles of the youth, assignment presentations, workshops to be facilitated, etc.

It is easy for a coach not to do everything as planned or as specified in the manual. By an app, they could keep a record of the module content, and see when and if they do need to refresh their skills.

The users are already motivated to become a better coach. 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."

Insights

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What's it like being a coach? I iteration 1 fanns ingen digital ansats alls. Jag var i Tororo för att besvara "What's it like being a coach?". Upptäckte att vad det innebär att vara en bra YoungDrive-coach, är att kunna ha bra ungdoms-sessioner. För att ha bra ungdoms-sessioner, är din självkänsla och självförtroende enormt viktigt. Och det är inte alla coacher som har detta, och därför skiljer sig kvaliteten mycket, vilket Josefina upplever som en utmaning.

Jag började leta efter hur och var en coach-app kan underlätta. En aktivitet som alla coacher har gemensamt för lärande och avgörande för coachens framgång, är (1) coach-träningen (som jag redan visste var viktig), men framför allt (2) förberedelserna av en ungdomssession. Jag övertygade Josefina att vi skulle ha ett

mycket fokus på (2) än hon tänkt. Medan Josefina kan vara inblandad i (1), kan en app vara extremt viktig i (2), upptäckte jag under mina fält-besök på ungdomssessioner och intervjuer med coacher och projektledare.

Enligt Iteration 1: Självförtroende = empowerment Enligt iteration 1 kom självförtroende ifrån att under ungdomstillfället kunna ha: Correct Information, Correct Structure, Time Management, och Fun Atmosphere. Det är alltså detta appen borde testa och träna.

For iteration 2, 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 determined that Iteration #1, provided answers for research question #1, #2, and #3.

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

3.3 Iteration 2

Here the results from the qualitative and quantitative data for iteration 2 are shown, together with conclusions.

3.3.1 Qualitative data

Design workshop #1 in Zambia

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.

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!"

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The utility perspective

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

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 unreliable 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.

Testing Correct Structure, Time Management and Fun Atmosphere Josefina informs that Correct Structure, Time Management and Fun Atmosphere would be the most valuable to test after a youth session. She also notes, that *some* assessment could be made via the app before a session. Because of the reason that this thesis does not focus on after-session-evaluation, Correct Information is primary to improving on the other factors, which are secondary.

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

Bonus results: Testing the app on Kampala university student

The app was tested on a university student from Makarere University.

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.

3.3.2 Quantitative data

Results from the coaches

Day 2

Most coaches prefer tablet: 5 prefer tablet, 2 smartphone, and 2 computer.

Day 3

iOS no longer allows uncertified app install from computer: you need to have paid a license even for unreleased apps, being a "Trusted developer". This stops the app from being able to be installed on all the iOS devices, so that only the web version can be used.

Thus, only the web app was tested from Wednesday and onwards.

This was a problem, as the app regularly crashed at refresh because of low internet capacity.

Sometimes, it was needed to go to the other office where there was wifi, to refresh the webpage, and go back to the location. This of course would not work for Josefina.

Day 4

Tested using the quiz before the session. Using the quiz before the session increases learning, slightly decreases fun of the session, according to coaches. It is "Fun and encouraging".

Day 5

On day 5, the schedule was:

- "Goal setting" part 2
- App test: "Goal setting" after-quiz and "Graduation" pre-quiz.
- "Graduation"

In "Goal setting", one coach was an outlier to the other high results, scoring 9/19 answers correct.

Results from workshop #2

During this workshop, the focus was to examine what builds confidence among the coaches. The following clusters could be determined: "I believe in myself" (3 coaches), "I believe in God" (2 coaches), "I am well prepared" (4 coaches) and "I am certified" (1 coach).

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Bonus results: Testing the app on refugee innovations

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

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

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

3.3.3 Conclusions

The app works for assessing Correct Information! Since the coach training app was said to most importantly test Correct Information, secondly Correct Structure and Time Management, the iteration was considered successful.

Regarding the workshop # 2, for iteration 2 the focus had been to assess "I am well prepared", for the very purpose of building confidence, in regards to Correct Information.

The review from Josefina was: "The (YoungDrive coach training) app is a great tool to measure how much the coaches learned and understood from the daily training; it provides a clear overview of what the coaches truly understood and what they actually still don't completely understand. Based on that information I as a tutor can adjust the training for the following day to make sure that the coaches understand everything correctly. The app also works as a motivator for the coaches; it's clearly reflect their own daily performances. If they score high they become very happy and satisfied, if they score low they are eager to check their wrong answers."

Insights

- 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
- Multiple-choice is flawed in its current form

The insights on learning 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

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).

Focus for the next iteration:

- Score higher on Bloom's revised taxonomy, while still including multiple-choice questions in the app.
- 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.
- Try the Power of Yet approach in the app ("growth mindset" approach of "Not yet", versus fixed mindset and assessment)
- Test if the app created in Zambia could work also in Uganda
- All the quiz questions would need to be converted from the new (Zambia) manual to the old (Uganda) manual, since both structure and content had changed.
- Josefina was given a task to create a quiz "Are you ready for Session 9?".
 - partly to score higher on *Bloom's revised taxonomy*
 - partly to test if Correct Structure and Time Management could be assessed using multiple-choice

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 quizzes 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.

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

3.4 Iteration 3

Here the results from the qualitative and quantitative data for iteration 1 are shown, together with conclusions.

3.4.1 Qualitative data

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."

Verified relevancy of separating Training and Certification

When asked for an opinion, Josefina answered: "I like the idea that when the coaches have answered all of the questions correctly, they can consolidate the knowledge by the certification test, when the coach should get 100% correct on their first try."

Field visits

The first thought was to use Gold/Silver/Bronze in the Training mode, and "Are you sure?" in the Certification mode. User tests showed that the other way around was better.

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.

3.4.2 Quantitative data

Observable trends from the coaches

Usability: The most notable thing from the app test, was that the app was not user friendly at all for 1st-time smartphone users. There were a lot of bugs, e.g. resizing of the font size for each new question. This forced some coaches to try to zoom on the devices, even if they did not know how. This could in turn cause

refresh of the web page, and sometimes there was no Internet available. Thus, the data can not be fully reliable.

This was the first time true frustration was shown. Out of 23 respondents, 7 rated the app easy, 11 medium, and 6 hard. This was not viable.

Related to assessing Correct Structure and Time Management Using a "Are you ready?"-quiz the multiple-choice-structure was tested to assess and train Correct Structure och Time Management. This was not shown very effective. While it does test Factual Remember, e.g. "How many minutes should you spend on X?", since the answer to a lot of questions are retrieved from memory, instead of analyzing, questions often does not score higher on Bloom.

The data and observations shows that learning Correct Structure and Time Management via multiple-choice is not effective for learning. To score well on such a test, the coach would retrieve from memory using a clear mental image.

Related to mobile experience Before the quiz started, the coaches were asked to raise their hand if they felt proficient with using a smart phone. 8 out of 23 said yes.

After the quiz, 16 said they were proficient (25% increase), while 5 said low proficiency, and 2 said no (we don't yet feel proficient, still fear).

Field tests During field tests, 3 CBTs were visited, to further observe usage of the app after having prepared a youth session.

Some things were notable from the interactions with John:

- "Are you sure?" is understood intuitively (you can't progress without answering), but some coaches deliberately answer "Yes" even if they are not sure.
- Idea to highlight different words of similar answers, to increase speed
- In summary, if wrong, show the other alternatives either way, not only the wrong answer

It was also here, that it was first observed that this is a light version of both deliberate practice and perceptual exposure. It is just that the app as of now is quite inefficient, especially in terms of speed.

From the interactions with Juliet, this was discovered:

- Idea for future work: "Go to participant manual" within the app
- If correct and unsure, she says "I still feel good". "Include it in wrong, because maybe I was still guessing". (This later informed the Certification quiz-insight)
- Change button to "Become certified", to increase likelihood to press the button. As of now, it was not obvious.

When she did get certified, she said "I feel good". When asked why, she said: "They have appreciated what I have done".

Add idea for future work:
Show how a persons correctness level has increased over time

"Are you ready?" app test The next day, the three CBTs gathered at the Plan International office to do an app test on the hardest quiz.

Add results

3.4.3 Conclusions

For iteration 3, the coaches could not only assess, but also *learn Correct Information*, which was successful, but needs to be done more effectively.

It took an unacceptable amount of time to reach 100% proficiency on all the quizzes. This was especially evident, on the quiz on Correct Structure och Time Management, "Week 9: Are you ready?", when it took a coach 2.5 hours to reach 100% without errors. In iteration 2, when "Improve" did not exist, it probably would have taken even longer.

The focus had been on "I am well prepared", but also including "I am certified.". It was shown that most coaches does not care about "I am certified" (which the workshop already had shown), but that they do care about their learning progress and learning results.

Pedagogical model

There were four ideas originally, for the pedagogical model:

1. The coach result from Iteration 2: "Try again"-button. When clicked, your wrong answers are repeated.
2. If 100% on the 1st try, gold. On 2nd try: silver. On 3rd try: bronze.
3. Ask meta-cognitive questions, e.g. "How sure are you?", at the end of each question.
4. Record your answer to the question before you are shown alternatives.

Option 1, 2 and 3 were determined good after the interviews, while item 4 had too many challenges (difficult to use, difficult to implement, cumbersome).

To improve Deliberate practice: not satisfied. 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. This could be reinforced in various ways.

To improve effectiveness, it was determined that "learning by thinking", regarding metacognitive skills, could be one of the most beneficial methods. This would help the coach to analyze and evaluate its own learning, possibly improving faster in the app. Using the theory from ?, questions can prompt self-monitoring and self-evaluation.

Youth session 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).

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.

Data collection needs to be online

Data collection manually was not viable with coaches more than people, it got to hectic. To do it online means that there needs to be a database, but also a login, so individuals are traceable.

Collecting the data on Are you sure?

If there is one thing learned during the iteration, it is the notion of "data is knowledge, and knowledge is power". A realization is that both the developer, the coaches, the teacher, and the project partners can gain important insights. Adding "Are you sure?" to each quiz question, this was amplified, because now, also the coach's attitude can be evaluated. See more about this in the Discussion chapter.

Add reference

For the next iteration

- Divide the learner's expertise according to ?, "Can't do", "Can do with effort", and "Can do effortlessly".
- Increase the use of questions to prompt self-monitoring and self-evaluation
- Implement login and a database in a suitable way, to store quiz results online

3.5 Iteration 4

Here the results from the qualitative and quantitative data for iteration 4 are shown, together with conclusions.

3.5.1 Qualitative data

Everyone now thought the app was good and easy to use. The interview answers of what the coaches said about the app were clustered into areas of Learning, figure 3.2, Interaction Design, figure 3.3, and Service Design, figure 3.4.

Test with the Plan Tororo staff

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.

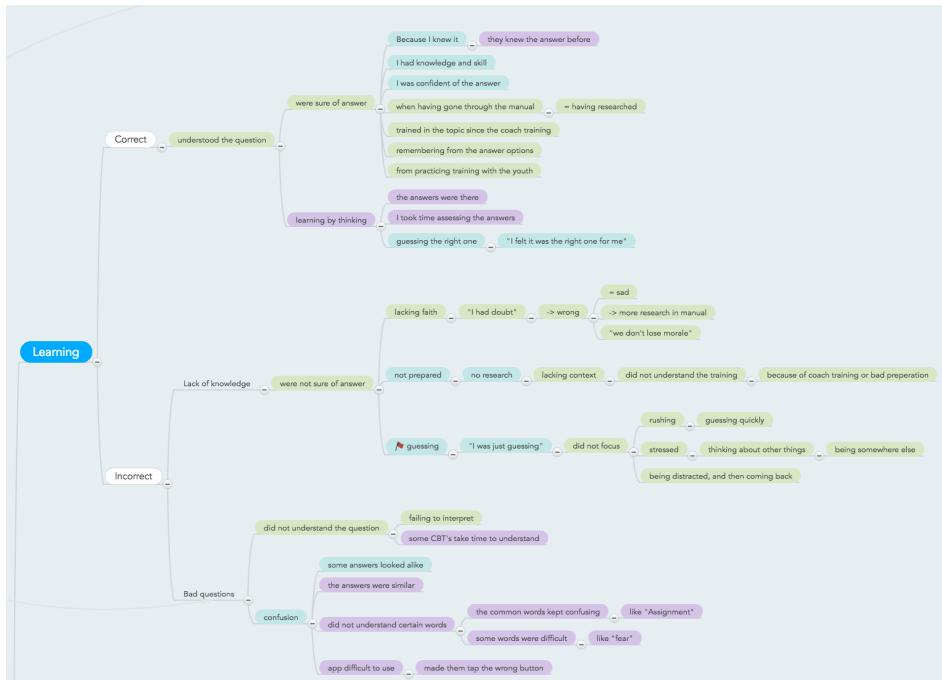


Figure 3.2: Coach comments regarding learning

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.

3.5.2 Quantitative data

Results from the coaches

Add table from Google Sheets

Relevans av att testa financial literacy: "Precis som med förra gruppen, verkar ekonomin vara det svåraste att förstå (dolda utgifter, hur gå med vinst), som youth." (från iteration 1)

Data observations

In this section, the conclusions from the different group characteristics are presented.

Early observations from the pre-test 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 preparation" and "Occupations 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.

There were a number of quick insights that could be drawn before the parallel coordinates visualization: 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 quizzes that were not Topic quiz 3 and Coach quiz 9, which might indicate high interest (if they did more than 2 quizzes) or confusion (if they did not do 3 or 9, but they did do other quizzes) 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).

First-hand insights before the parallel coordinates were that there was a strong correlation between pre-quiz results and quiz 9 try 1 (slightly visible also in quiz 3 try 1, but with more outliers). Also, with manuals there was a higher probability to finishing quiz 9 training + certification.

Statistical analysis

Statistical analysis unfortunately showed that none of the results were statistically significant to be notable using linear regression, or any of the other statistical methods detailed in the methodical framework.

Parallel coordinates visualization

The interactive parallel coordinates visualization could give many more insights, more faster than the static presentations in Google Sheets.

Youth mentor (brun), 6 st vs. CBT (blå), 14 st * Youth mentors has higher school level than CBT's * 1/6 Youth mentors had brought manual, compared with 8/14 CBT's * Only 1 CBT has above 2 (1 st 3) on School, while YM have (2st 0, 1 2st, 2 2st) * Inverse correlation: CBT old, YM young * There are no female Youth Mentors (i.e. 100% male Youth Mentors) * All of the YM's run their own businesses, compared with 5/10 for CBT's * Only CBT's said they didn't feel comfortable with smartphone (2 st) - because of age? * Seemingly no difference CBT vs. YM in when prepares for session * All YM prepares 2 times for session, while CBT can train also 3 or 1 time) * 13/14 CBT's gjorde quiz 3 try 1, 6/6 YM's * YM's och CBT's presterar lika på quiz 3 try 1 * CBT 6/14 st certifierade, YM 4/6 st

Quiz 9 (rött=CBT: * 6 CBT's gör ej Q9 try 1, 2 YM gör ej * YM är top performers på Q9 try 1 jämfört med CBT's * endast 1 YM klarade däremot träningen, medan

* YM's är bättre på quiz 9 try 1 än CBT's * Det är endast 1/7 som klarade quiz 9 training som är Youth Mentor * Antal försök man gjorde är likvärdigt, förutom

en YM som hade 12 försök (och klarade quiz) * Det var endast 2 st som klarade certifieringen, och båda dessa var YM och kvinnliga

Women

It is clear from the data that women: * Have lower education level than the men * Spread results on the pre-test (probably because of school level) * Half of them are around 25 years old, half spread out (up until 45 years old) * 2/6 har eget företag * Det är bara 1 som ej preparerar alls * 1 st som endast preparerar 1 gång, alla andra preparerar 2 gånger (3 st) eller 3 gånger (2 st) * Alla hade max 1 fel på quiz 3 på första försöket! * De som ej hade rätt, tog det bara 2:a (1 person) eller 3:e försöket (1 person)

* 3/6 gjorde certifieringen - kolla upp: började de?

* Alla förutom 1 tjejer gjorde svåraste quizet. De hade minst 42%! Varav 2 st hade 67%, 1 hade 50, 1 hade 42, och 1 hade 83

* Quiz 9 tjejerna hade mycket högre lägstanivå () än killarna (, och mycket högre högstanivå än killarna () - tiden är jämförbar, med svag tendens snabbare tjejer * Av de som hade 50% på 1:a försöket, gick det betydligt snabbare för tjejerna än killarna att jobba igenom quizet - tyder på att tjejerna är säkrare på materialet än tjejerna - dessutom är det bara 2 killar som fick över 50% på första försöket * Om du kollar tvärtom, så är det bara 1 tjejer som fick under 50% på första försöket, medan det var 8 killar * Quiz 3 syns ej lika tydlig skillnad (OBS: kolla vilken fråga de flesta hade fel på, och kolla om det skiljer sig mellan killar och tjejer) * Skolnivå verkar oberende på hur quizen blir, om man kollar quiz 9 * Tjejer, antal försök quiz 9 hade de 2 (2 st), 5 (2st, 12 (1st) försök innan de klarade - bland killarna var det 5 (1st) och 7 (1st). Men sedan så var det 0 av killarna som blev certified, men 2 tjejer (de som gjorde på 12 försök och 2 försök). Att antal försök skiljer sig mellan 2 och 12, men ändå klarar det, berättar att antal försök kanske ej korrelerar. Den på 12 försök hade 70% på försök, och jobbade igen de 12 försöken väldigt snabbt. * Den andra tjejens som klarade certifikation quiz 9 klarade 83% försök 1, (hade tillgång till hjälp), klarade träningen sedan på 2 försök.

Slutsats: * Anställ bara tjejer. De har högre kunskap och förbereder sig mer, trots lägre skolutbildning.

Use of participant and coach manuals

Användande av appen: * Vi hittade ingen korrelation quiz-resultat 9 första försöket om man fick hjälp eller inte, antagligen pga att man ej använder manuallen före

Certified quiz 9 Only two people were fast enough to get certified on the final quiz before the app evaluation ended.

Characteristics were: * Both of them used the manual * Both of them were CBT's, not youth mentors * Both were women * They were 24 or 26 years old * They had a good pre-test score (57% or 71%) * They had top scores (1st place and 2nd place (shared with one other)) on quiz 9 try 1 * They had high scores on quiz 3 try 1 (100% and 92%) * They prepared many times per youth session (2 or 3 times)

What didn't seem to matter: * Number of tries quiz 9 (12 vs 2 on Q9) * Time to pass training quiz 9 (35.5, slowest vs 12 minutes, below average) * When day

trained (1 trained same day, 1 trained the day before) * One had a business, one didn't * School level (1 S?, one S lower)

Other: * They were medium skilled on using a smartphone

3.5.3 Conclusions

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 than 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.

Add everything from the mindmap

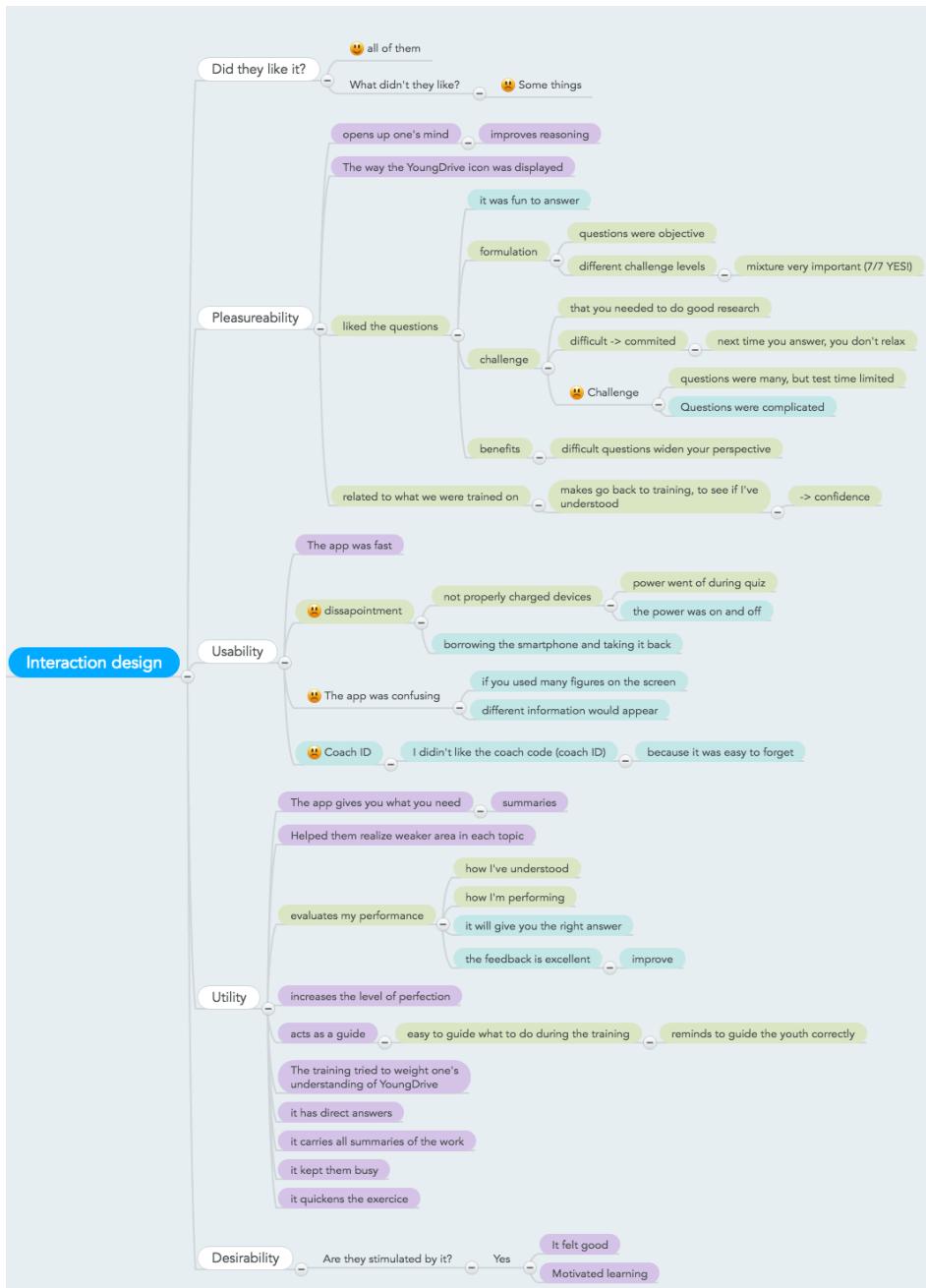


Figure 3.3: Coach comments interaction design

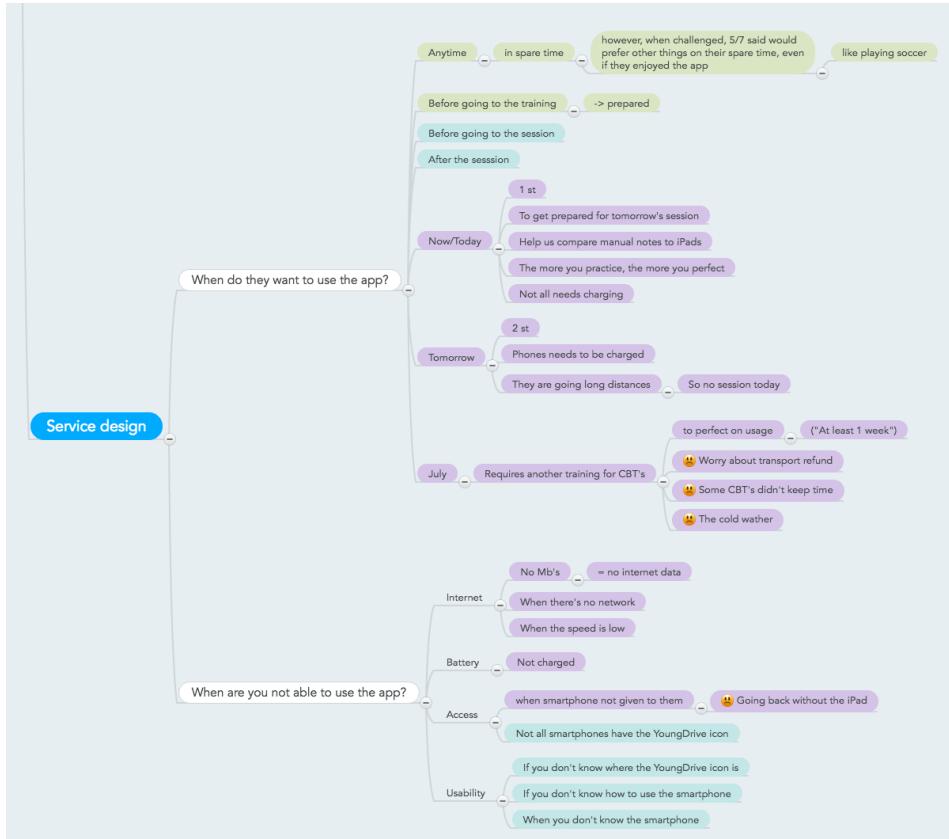


Figure 3.4: Coach comments regarding service design

4

Discussion

4.1 What in the development has been affected by the technical possibilities?

Online data collection

To test on all of the coaches in Uganda, it would have been preferable if data collection would have happened via the app instead of manually already in iteration 3, since there would be more than 10 test subjects, which had been the limit in Zambia. This was planned for, but technical implications with Meteor made it delayed.

Working with technical constraints

Upgrading from version 1.2 to 1.3 during Iteration 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 was spent "wasted", and time during that iteration needed to be taken back by working the Friday night and Saturday, before the travel to Tororo.

4.1.1 Implementation

Could have benefitted from Continuous Integration, passing tests before ready for production. Solved this by having a stage environment (since April 19th) where stage is YoungDrive-beta (branch Iteration 4), and YoungDrive is master.

Besvara
fråga

Does it
really
work
push-
ing
data
via
GroundD
after
15 min-
utes? I
don't
know.

Doing automated tests would have helped finding regression errors, things that had worked previously but not in a new version. This in turn, would have made interactions with coaches better, since the app would have been more complete.

Difficulties comparing quiz results between iterations

The idea was that app tests for iteration #3 would be carried out in a way that allowed comparison of usability and learning done between iteration #2 in Zambia and iteration #3 in Uganda. This was however never implemented during the app test. This would have been useful, but the coaches and the usage of the app in Zambia and Uganda was determined to be too different. For future work, more work should be put into how quiz results can be compared between different versions of the app and across different contexts and cultures.

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

From computer expert into a digital service designer

The study method used in this research 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:

- ethnography (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

Lägg till svar: how should the design be affected...

Förbättra
denna

- 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.

The fact that the end users and stakeholders has been involved from the start, made them feel and have actual ownership of the product. This has many benefits, among others that *everyone* involved is satisfied with the *final* app, since their opinions and expertise has been taken into consideration and implemented. The fact that they can notice this further increases trust, and the likelihood of them supporting future work. To conclude, the design has been affected heavily by the contextual constraints, to the point where the end users are more likely to use the app as they have contributed to making a tailor-made product for themselves.

Involving consultants to support the design process

When in Iteration 1: Week 7: February 23rd: Number of interactions for iteration #1 were cut down

Interactions canceled for week 7, the day before Wednesday-Friday, because of local elections.

"Det var tråkigt att höra att det inte blev lika många interaktioner som planerat.

MEN jag tänker: Det här är verkligen en del av lärdomarna att jobba med tjänstedesign i andra kulturer (som jag även tar med mig från vårt projekt i Kenya). Det går bara att planera till en viss grad, och det blir aldrig riktigt som man tänkt sig :) Man får vara beredd på att ändra planen i sista sekund, mycket mer än vad man behöver i sin egen kultur. Bra lärdom!" - Susanna, Expedition Mondial

This support has been on very much help, having a person familiar with working in a different cultural context before.

Iteration 2: The benefit of going for the YoungDrive training in Zambia

The original time plan stated that the interactions for Iteration #2 would have been in Tororo, and that it would not be possible to test the app during coach training whatsoever.

However, during a Skype meeting with YoungDrive project leader Josefina, it was announced that it would be possible to participate in the coach training in Zambia during Iteration #3.

Should I address this, what I would have done without them?

A new work plan was created, which would allow travel to Zambia and to develop the app and participate in the YoungDrive coach training together with the coaches.

Now, it was shown already at Iteration #2, that if I would have created the app myself, I would have assumed more functionality was necessary and requested.

- Short iterations are very effective, however not perfect
- Field hackathon, designing and developing together with the users, is fantastic
- I would never have come this far without the short iterations

Also, without the 5 days of the training, questions for each topic would not have needed to be created, and this would then have been a must-have for Future work.

The intense training in Zambia gave a lot of time to discuss and interact with the trainer, Josefina Lönn. One important contextual constraint that was noticed, was that Josefina did not want to be replaced, but appreciated having the YoungDrive to the point where the app should not replace her, even if it in the future would benefit YoungDrive in terms of for example monetary reasons.

4.3 How can test questions be developed to support entrepreneurship learning?

The initial plan was that YoungDrive would only produce questions for two YoungDrive training weeks, not all 10. To have questions for all of the weeks have greatly benefited the master thesis, and increased the value of the final product. If not all quizzes would have been developed and tested, this would have been a Future Work.

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.

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

Benefits of "Are you sure?"

The YoungDrive app is the first known application which uses this approach for the student's own sake, and not only assessment (reaching meta-cognitive on Bloom's).

Using the "Are you sure?" data for the coach If a coach is wrong and sure about a lot of questions, it might be the indication that the coach is teaching

the wrong information to the youth, which might potentially hurt hundreds of their youth's businesses. Also, the usage of quizzes (e.g. does the coach wants to improve via the app) can indicate the motivation of the coach.

From Iteration 3: Deciding on learning methods

There was a lot of work behind choosing the learning design methods in Iteration #3. The way to progress, was to brainstorm various solution, discuss them with experts, and then create trigger material and test some of these approaches.

Retaking questions that were wrong ("Improve") was inspired by deliberate practice ?, and is common in e-learning driver license softwares to learn traffic signs or how to act in various situations.

Showing the coach how many quiz tries they have done, was inspired by Linköping University's work with the e-learning tool NTA Digital, where they reward students with badges for getting 100% in few tries. Their goal with this kind of "gamification", is to reward students for studying before taking the test.

"Are you sure?" was inspired by a Swedish teacher, adding it to his multiple-choice quizzes at university, to determine if a right answer should award a point or not. The pedagogical expert for this thesis, Henrik Marklund, suggested that the teacher had overlooked a learning benefit of this approach: the student reflecting on their own knowledge, which is proved great for learning.

The positive effects of flipcards are known, however, its disadvantage is that it would prove difficult to analyze the coach answers.

It was discussed if multiple-choice answers should be completely abandoned, replaced with flipcards. Challenges were that the coaches had no previous knowledge of typing on a keyboard, and analyzing recorded answers would be too technically demanding. The integration of flipcards was discussed in various ways, see Future work.

From Iteration 3: Benefits with Feedback for Self-Reflection

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 självskräck (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")

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

This section explains consequences of involving end users and stakeholders throughout the whole process.

Att analysera (och inte bara ha i bakhuvudet) partners åsikter var jätteviktigt till frågeguiden iteration 1 - efter att jag gjort det, reviderade jag mina svar och förstod Expedition Mondials frågor och perspektiv bättre, för att lösningen var så uppenbar.

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.

Översätt
till en-
gelska

5

Conclusions and Future Work

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

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

This research shows that an app can be effectively used during and after training to assess and learn entrepreneurship. Furthermore, the app can also prepare coaches before youth sessions, training them both in entrepreneurship and preparing their lessons.

In *addition*, this has been done in a developing country context, with coaches having no prior smartphone experience. The app is used for coaches in conjunction with a physical entrepreneurship training today, and does not yet address the youth themselves, or replaces the physical training.

However, the research shows that both the teacher and the coaches greatly appreciate the support the app has given them. As entrepreneurship to its nature is practical in many aspects, one finding is how multiple-choice questions can still simulate real learning, by design solutions such as asking "Are you sure?", giving personal feedback, and formulating questions as scenarios.

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

As devices were limited, a goal was to make the app available on as many devices as possible. Creating a hybrid app using web technologies using Meteor made the app available both as a native app on Android and iOS devices, as well as on the web.

As internet is accessible but expensive and often used seldom, the app does not provide rich media or simulations, but focuses instead on creative design

possibilities using multiple-choice.

Most of the coaches being first-time smartphone users, letting them continuously test and co-create the app has created a tailor-made app from their needs and conditions. It may be surprising how simple design solutions using text and clear visuals can provide rich learning feedback.

That the app should work offline, and still be able to push quiz results when it gets online, has been a challenge. It can be hard to find good existing approaches for some technical platforms, but for Meteor plugins such as GroundDB proved very usable.

An insight is how quickly the coaches have increased their fluency with using the smartphone and the app. Even though the design at first needs to be very simple, as long as features are introduced slowly and as intuitive, the app could become more complex over time, to the point where no compromises needs to be made.

When it comes to overcoming cultural differences, learning from the expertise of local partners and tech companies can not be overestimated. They have been very willing to share previous mistakes, learnings and successes. This has saved a lot of time, and made the sparse amount of interactions and development time so much more efficient. Also, the value of getting to know the coaches on a first-hand basis has been greatly beneficial. The app has been designed together with them as co-creators, with a developed mutual interest and understanding, having a common goal of creating an app that works for their needs.

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

To investigate usability, observations using think-aloud in the real-world training context proved the most effective. In big groups, data could give tendencies on common problems that needed to be addressed. In smaller groups, ideas and precise feedback was more common. It helped having a framework to compare usability against, in this case the interaction design principles of desirability, utility, usability and pleasurable.

To investigate learning in the real-world training context, literature research and data analysis of quiz results was highly beneficial, but mostly when put into the context of the observations made in the real-world training context.

Surprisingly often, comparing research and expert opinions with what coaches thought was best for learning, was in unison. When this happens, the self-confidence of the designer can increase, and the designer can be more daring and experimental.

Having much testing and co-creation was a very rewarding approach. To make it truly testable, lo-fi and hi-fi prototypes should be used instead of hypothetical questions. While research before starting to develop is a great start, it was trying different solutions, all based on user advice, expert opinion and research, that gave great results.

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

Short iterations is a challenge, especially when time is sparse and the culture is different than one's own. Often in projects, testing is overlooked. In this project instead, service design helped to look at the users as not only testers, but as co-creators. This is not new in itself, but the creation of Digital Service Design, and methods within this discipline, were new. Examples include service mini-sprints and field hackathons.

Interactions with the coaches always included Service Mini-Sprints (see 2.1.5), allowing the most important feedback and insights to be addressed in the app and workshop formats already the next day. This allowed for very effective use of the sparse interactions with the coaches, and there was no need to wait for the next iteration to test the coaches' feedback.

The "field hackathon", in which the app was refined and tested each day of the coach training, was the most important piece of the whole master thesis. More than the opportunity to develop the app with the coaches, it had the extra benefit of giving the opportunity to observe the YoungDrive training and understand the coaches.

To use a service design approach when co-creating digital artefacts in a developing country context proved highly effective, and it is recommended that this is further studied. It does demand bravery of the designer to get to know the users so well, and design for their needs and dare to question the client, but in the end, as in this case, both the users and the client may end up more satisfied with the result.

5.1 Future Work

The future work section is divided by research question, and proposes additions that would strengthen the app goals (see 1.1).

5.1.1 Research question 1

5.1.2 Research question 2

#2 Replacing the teacher

In iteration 2, Josefina (the teacher) mentions that she does not want to be replaced by the app. However, there would be many benefits to YoungDrive if the coach training could happen 100% digitally, for example access in locations where YoungDrive currently has no funding.

How could it be done in practise? Also, when Josefina does not want to be replaced? In practice, a freemium model could be proposed, where it is possible to take the coach training for free digitally, but pay for a physical training. Currently, this contextual constraint has affected the app in the way that it should complement the physical training, and ease the burden for the teacher.

#2 Scaffolding the coach guides

Josefina says, after iteration 2, 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 utilize scaffolding: 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.

#2 Showing the match or mismatch between correctness and confidence more clearly

Lägg
till mer
om att
designa
för em-
power-
ment

One idea during the ideation of iteration 3, was to give the student two scores: one showing how correct they were, and one with how confident they were. You can be correct, but still not be empowered (you are unsure but correct). Similarly, you can be incorrect but confident (not empowered).

The reason for not having a "empowerment bar" (combining correct and sure, giving a summative score), was given by Josefina from YoungDrive: "The coaches might want to game the system to get a better score, or be confused by how they got their score". For this reason, the coaches have stated they are OK with getting minus points if they are sure but incorrect, which is easily understood by them and feels fair.

In the app now, there is still a struggle with coaches answering positive on "Are you sure?", even if they are not. Reasons are among others that they say they are *partly* sure, and sometimes that they think they will be more punished for not being sure *than* being sure and incorrect. As this is not the view of the teacher, this needs to become much more clear in the app.

#2 Designing the app for different Need groups

Already since iteration 1, different need groups have been identified. It is shown from the tests that the idealistic and realistic coach might be more probable to have a growth mindset, where challenged coaches might have a more fixed mindset. Research could inform how to design for these different mindsets.

5.1.3 Research question 3

#3 Self-reflection after a youth session

When discussing the goals for iteration 3, Josefina talks about a need she has noticed during the coaches' rollout in Zambia, where the app could help: 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.

5.1.4 Research question 4

#4 Assessing coach guide knowledge before the youth session

When asked about the Zambia coach rollout, Josefina points out several challenges. "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. 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.

#4 Using a flipcards approach

In the ideation for iteration 2, flip cards are discussed again, with Henrik Marklund.

In iteration 3, this was tested as a lo-fi material with successful results, but more work should be done.

In the ideation of iteration 4, a proposal was given that did not have time to implement. Therefore, the idea is described here:

At the coach's second quiz try (having assessed and reflected on the knowledge), flipcards could be introduced to assist the coach in retrieving from memory, before getting the multiple-choice.

For future work, when in Training after the first quiz try, The question should be shown *before* the answers are shown, and prompt the coach to think aloud about what they think the answer is, before receiving the alternatives. The coach might be hindered from progressing to the multiple-choice answers until the app has understood the coach has thought hard about their answer to the question.

This is a good use of scaffolding, slowly introducing complicated app features. The hypothesis is inspired from Bjork ?, that knowledge is strengthened if the coach retrieves from memory, versus looking up the answer or choosing the most likely answer.

#4 Förbättringar Träningsläge

From iteration 4, it was clear that the app was designed for learning and self-reflection, and not for effectiveness. Problemet nu, var att de tar certifikationsläget och inte får 100%, vilket är mödosamt och väldigt tidsslösande, då coachen igen måste gå tillbaka till Träning och nå 100% igen.

Tränings-läget behöver förbättras, och vara säker på att coachen verkligen är redo för Certification.

Ett problem är att "Improve" endast upprepade frågor som varit inkorrekt, och inte upprepade gissningar som varit rätt. Det gjorde att en coach kunde få fel på Certification quiz, för att kunskapen inte var befäst. Så vill vi inte ha det. Därför föreslår jag följande förbättringar i Future Work: Frågor i "Can't do", är frågor som coachen ej vet svar på ännu (t.ex. om svarat fel). Frågor i "Can do with effort", har coachen ett hum om (gissat rätt, eller gått från fel till rätt). Frågor i "Can do effortlessly", har coachen rätt och den vet att den har rätt.

Låt coachen välja vilken typ av frågor de vill upprepa.

#4 Förbättringar Certifikationsläge

From the end results of iteration 4, we can learn that notably the intrinsic motivation is high, deliberate practice is present, and the coach can feel the intrinsic reward of having pushed herself and learned the material. This is very positive.

This reaction, could and should be even more amplified. It is discussable if this should be done by simple gamification, but an opinion by a coach was that medals earned should be more visible and that sounds could strengthen the feeling of achievement. Also, the quiz list could show these results, increasing motivation to take other quizzes that you have not yet mastered, or to better your score in a topic where you had not become certified.

#4 Improvements training Correct Structure and Time Management

During all app tests (iteration 2-4), it has been shown that since Correct Structure and Time Management are both ordinal, the Training mode for such topics would be more suitable as interactive exercises than multiple-choice. The proposal is to first use drag-and-drop to place each activity of a youth session in the correct order, and then selecting the right time for the each activity. This assists the coach in creating a mental model, which can be used to retrieve from memory during the assessment.

#4 Scaffolding with Flashcards

After the coach's first new try, Flashcards could be introduced to assist the coach in retrieving in memory, before getting the multiple-choice. To do this after the first assessment, is partly because of technology scaffolding (introduce new concepts in steps), partly because the knowledge is strengthened if the coach retrieves from memory versus looking up the answer or choosing the most likely answer ?.

#4 Memory design

For the ideation of iteration 4, Henrik Marklund pointed out that if knowledge is to be memorized, memory techniques could be used. One such e-learning tool is Memorize ?. The tool has interactive learning modes, aiming to learn facts and terms with speed. This was underprioritized because of time constraints working with technical features that were not essential. Also, the idea was never proposed by users, only by experts. Moreover, the teacher opposed the idea of remembering answers that were not in the factual remember category. To do so, would oppose the learning objectives, which score higher on Bloom's revised taxonomy. However, to study how the coaches can remember better via an app, and learn memory techniques via the app, could be a future work which is advisable.

#4 Sharing with one another

In future versions of the app, mechanics of sharing content and co-creation would add value connected to Bloom's, reaching Create and Apply. Adding these game elements goes in line with Clark's research, which showed a positive correlation with learning and games that required multi-player collaboration [?].

5.1.5 Research question 5

#5 Educator Dashboard

Josefina has no means of accessing live quiz results today, as there is no educator dashboard developed. Instead, quiz results today needs to be transferred from a database into Google Sheets, which is cumbersome and not user-friendly.

There was not enough time to develop an educator dashboard, even if this had been a goal. Instead, low-fi trigger material was created, and co-creation stakeholder workshops were held, both for iteration 3 and 4.

In the future, this will be a must-have, and it ties well into YoungDrive's future wish of strengthening its quality assurance via monitoring and evaluation.

How powerful the educator dashboard should be might be a ethical discussion, where one could argue that me as a developer needs to be sensitive if I want the app to support the coaches to become better, and not be a tool for the project partner to fire coaches that doesn't have the same quiz results as others. As the combination of "Are you sure?" and correctness can give insight into the attitudes and care of the coaches, carefulness must be taken.

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 preferably 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 <i>Questionairee guide</i> . 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, hypothetical 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. <i>Half-time check-up with examinator</i> .
11	Iteration 2. Interactions, control group #1 & #2.
12	Iteration 2. Interactions, control group #1 & #2.
13	Vacation with fiancee.
14	Iteration 2. <i>Analysis #2</i> (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

Bibliography

- S. K. Abell and N. G. Lederman. *Handbook of Research on Science Education*. Psychology Press, 2007. Not cited.
- Quian S. Miao C. Bae, T. J. and J. O. Fiet. The relationship between entrepreneurship education and entrepreneurial intentions: A meta-analytical review. *Entrepreneurship Theory and Practice*, 38(2), 2014. Not cited.
- R. Bjork. Applying cognitive psychology to enhance educational practice. <http://bjorklab.psych.ucla.edu/research.html>, 2016. Not cited.
- I. Björling and J. Lönn. *Exjobbs-resultat: Coach-tränings-app*. YoungDrive, 2016. Not cited.
- R. O. Brinkerhoff. Making l&d matter. https://www.youtube.com/watch?v=_wUZZJV8lM, 2013. Not cited.
- F Brühlmann. Gamification from the perspective of self-determination theory and flow. Master's thesis, University of Basel, Switzerland, 2013. Not cited.
- Bruno V. Cheong, C. and F. Cheong. Designing a mobile-app-based collaborative learning system. *Journal of Information Technology Education: Innovations in Practice*, 11, 2012. Not cited.
- Tanner-Smith E. Killingsworth S. Clark, D. *Digital Games, Design and Learning: A Systematic Review and Meta-Analysis (Executive Summary)*. SRI International, 2014. Not cited.
- Hilera J. R. Burchino R. Jiménez L. Martínez J. J. Gutiérrez J. A. Gutiérrez J. M. de Marcos, L. and S. Otón. An experiment for improving students performance in secondary and tertiary education by means of m-learning auto-assessment. *Computers and Education: An International Journal*, 55(1069-1079), 2010. Not cited.
- E. L. Deci and R. M. Ryan. *Intrinsic motivation and selfdetermination in human behavior*. Plenum, 1985. Not cited.

- Solomon G. T. Dickson, P. H. and K. M. Weaver. Entrepreneurial selection and success: Does education matter? *Journal on Small Business and Enterprise Development*, 15(239-258), 2008. Not cited.
- J. Dirksen. *Design for How People Learn*. New Riders, 2012. Not cited.
- J. S. Eccles and A. Wigfield. Motivational beliefs, values, and goals. *Annual Review of Psychology*, 53(109-132), 2002. Not cited.
- A. J. Elliot and M. V. Covington. Approach and avoidance motivation. *Educational Psychology Review*, 13(2), 2001. Not cited.
- S. M. Fulmer and J. C. Frijters. A review of self-report and alternative approaches in the measurement of student motivation. *Educational Psychology Review*, 21 (219-246), 2009. Not cited.
- R. Godwin-Jones. *Emerging technologies: Mobile apps for language learning*. Language Learning and Technology, 15(2), 2-11, 2011. Not cited.
- R. Heer. A model of learning objectives. <http://www.celt.iastate.edu/wp-content/uploads/2015/09/RevisedBloomsHandout-1.pdf>, 2012. Not cited.
- Kolvereid L. Iakovleva, T. and U. Stehphan. Entrepreneurial intentions in developing and developed countries. *Education + Training*, 53(5), 2011. Not cited.
- T. R. Koballa and S. M. Glynn. *Attitudinal and motivational constructs in science learning*. Focal Press, 2007. Not cited.
- D. R. Krathwohl. A revision of bloom's taxonomy: An overview. *Theory Into Practice*, 41(4), 2002. Not cited.
- D. F. Kuratko. The emergence of entrepreneurship education: Development, trends, and challenges. *Entrepreneurship theory and practice*, 25(5), 2005. Not cited.
- Hugo Lopez. Parallel coordinates: Read out patterns. <http://une-terre.blogspot.se/2012/09/parallel-coordinates-read-out-patterns.html>, 2016. Not cited.
- Bligh B. Manches A. Ainsworth S. Crook C. Luckin, R. and R. Noss. *Decoding Learning: The Proof, Promise and Potential of Digital Education*. Nesta Operating Company, 2012. Not cited.
- J. Löwgren and E. Stolterman. *Thoughtful Interaction Design: A Design Perspective on Information Technology*. The MIT Press, 2007. Not cited.
- Busenitz L. W. Bird B. Marie Gaglio C. McMullen J. S. Morse E. A. Mitchell, R. K. and J. B. Smith. The central question in entrepreneurial cognition research. *Entrepreneurship Theory and Practice*, 31(1), 2007. Not cited.

- D. Nicol. E-assessment by design: using multiple-choice tests to good effect. *Journal of Further and Higher Education*, 31(1), 2007. Not cited.
- S. Nissar. Social innovation and entrepreneurship in uganda. why mobile services are growing fast in the area. <http://bit.ly/medium-article-expedition-mondial>, 2016. Not cited.
- M. J. I. Oviawe. Repositioning nigerian youths for economic empowerment through entrepreneurship education. *European Journal of Educational Studies*, 2(2), 2010. Not cited.
- T. Page. *Use of Mobile Device Apps in Product Design*. International Journal of Green Computing (IJGC), 4(1), 18-34, 2013. Not cited.
- D.H. Pink. *Drive: The Surprising Truth about what Motivates Us*. Canongate, 2011. ISBN 9781847677693. Not cited.
- L. Pittaway and J. Cope. Entrepreneurship education a systematic review of the evidence. *International Small Business Journal*, 25(5), 2007. Not cited.
- T. Ropinski. Tnm067 - scientific visualization: Chapter 1: Basics, 2014. Not cited.
- E. Ruskovaara and T. Pihkala. Entrepreneurship education in schools: Empirical evidence on the teacher's role. *The Journal of Educational Research*, 108:3: 236–249, 2015. doi: 10.1080/00220671.2013.878301. Not cited.
- R. M. Ryan and E. L. Deci. Intrinsic and extrinsic motivations: Classical definitions and new directions. *Contemporary Educational Psychology*, 25(54-67), 2000a. Not cited.
- K. Sierra. *Badass: Making Users Awesome*. O'Reilly Media, 2015. ISBN 9781491919071. Not cited.
- Bell B. S. Kraiger K. Sitzmann, T. and A. M. Kanar. A multilevel analysis of the effect of prompting self-regulation in technology-delivered instruction. *CAHRS Working Paper Series*, 8, 2008. Not cited.
- Gino F. Pisano G. P. Stefano, G. D. and B. R. Staats. Learning by thinking: Overcoming the bias for action through reflection. *Harvard Business School Technology and Operations Management Unit Research Paper Series*, 14(093), 2015. Not cited.
- M. Stickdorn and J. Schneider. *This is Service Design Thinking: Basics, Tools, Cases*. Consortium Book Sales and Dist, 2010. ISBN 9789063692568. Not cited.
- Agaze Dev Team. Magic json. <https://chrome.google.com/webstore/detail/magic-json/cajfcebiflndefndbnoeenjpiiagm?hl=en>, 2016. Not cited.

- W. B. Walstad and M. L. Kourilsky. *Entrepreneurial Attitudes and Knowledge of Black Youth*. Kauffman Center for Entrepreneurial Leadership, 1998. Not cited.
- E. Widmark and S. Nissar. Service design - en crash course. Expedition Mondial, 2016. Not cited.
- A. Wigfield and J. S. Eccles. Expectancy-value theory of achievement motivation. *Contemporary Educational Psychology*, 25(1), 2000. Not cited.
- Ince I. F. Karahoca A. Karahoca D. Yengin, I. and H. Uzanboylu. The use of deliberates practices on a mobile learning environment. 1, (241-249), 2012. Not cited.



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