석 사 학 위 논 문
Master's Thesis

타인의 목표 수정을 통한 학습 계획 향상

Improving Learning Plans with Peer Goal Revision

2019

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한 국 과 학 기 술 원

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전산학부

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Improving Learning Plans with Peer Goal Revision

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Korea Advanced Institute of Science and Technology in
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Approved by

Juho Kim
Professor of Computer Science

The study was conducted in accordance with Code of Research Ethics[1].

[1] Declaration of Ethical Conduct in Research: I, as a graduate student of Korea Advanced Institute of Science and Technology, hereby declare that I have not committed any act that may damage the credibility of my research. This includes, but is not limited to, falsification, thesis written by someone else, distortion of research findings, and plagiarism. I confirm that my thesis contains honest conclusions based on my own careful research under the guidance of my advisor.

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초 록

본 연구는 학습자가 동료 학습자와 함께 학습 계획을 세우는 방식의 이점을 이해하는 것을 목적으로 한다. 특히, 동료 학습자의 계획을 수정, 개선하는 과정이 학습자 스스로의 학습 계획 개선에 주는 영향에 대해 탐구한다. 본 연구에서는 학습 계획을 여러개의의 실행가능한 단계로 구성하는 방식을 고안하고 이의 효과성을 측정하였다. 또한, 이를 바탕으로 각 학습자가 1) 실행가능한 단계로 구성된 학습 계획을 세우고, 2) 동료 학습자의 계획을 수정하고, 3) 자신의 계획을 개선하는 워크플로우를 제안한다. 제안된 워크플로우에 기반한 프로토타입을 구현, 외국어 혹은 프로그래밍 언어를 배우고자 하는 학습자 10명을 대상으로 사용자 실험을 진행하였다. 사용자 실험을 통해 제안된 워크플로우의 긍정적 효과를 확인하였으며, 각 학습자가 다른 학습자의 계획을 수정하는 과정을 통해 이점을 얻을 수 있음을 확인하였다.

핵 심 낱 말 학습자, 계획, 개정, 미세 목표, 학습 계획

Abstract

This thesis' main purpose is to serve as an exploratory look into what benefits might emerge from socially making learning plans. After reviewing are series of related work, 3 research questions are proposed, asking whether revision of other learners' plans benefits the reviser's plan itself. First, a way of creating plans broken into small actionable steps was designed and tested. Based on this design and to answer the research questions a workflow of create, revise, improve is proposed. Extensive design and several iterations of a prototype made the foundation for evaluating the research questions on real users. More specifically, people who planned to engage in either learning a foreign language or a programming language were. With a small sample size of users, the experience and outcome of this workflow was explored and discussed. These exploratory user studies show good results and indication of the revision task can indeed provide benefits for the revisers themselves.

Keywords Learner, Planning, Revision, Microgoals, Learning plans

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Chapter 1. Introduction

1.1 Outline

The main purpose of this thesis is to take a preliminary and exploratory look into what benefits might emerge from socially making learning plans. After a literature survey on current approaches in supporting learning, we narrowed down our focus to previous research on microtasks and plansourcing as they might be relevant in making learning plans. Borrowing from these approaches, we proposed a design of microgoal-structured planning that can easily be understood by others. After running a pilot study with the design, we were able to ask some concrete research questions that mainly focus on whether helping other learners to revise their learning plans yield any benefits for the revisers themselves on their own plans. With further look into related works, we presented a workflow, "Create, Revise, Improve", for creating a learning plan with microgoals and improving learning plans through peer goal revision. Following that, We described our implementation details and several prototype iterations. Finally, we described our user study, evaluation method and results and discussed the limitations and future work of this project.

1.2 Personal Motivation

My initial interest comes from personal experiences of motivation in productivity. Where do I usually find motivation to be productive. There exists many scenarios in which motivation can be a significant factor in lack of productivity. One of these is picking up a new thing to learn. Whether that be to play an instrument, speak a new language or a skill relevant for school or work. Personally, a great motivation factor has always been the peers I can share my ideas, knowledge, questions, and so on with.

Trying to locate what specifics gave me a greater learning experience, three things come to mind: (1.) the knowledge and diverse experience of peers help overcome confusion and hurdles in understanding something new [ARFE10]. (2.) having a responsibility towards others help complete exercises and (3.)social interaction provides joy throughout the process of working.

This idea partly came to life through a class project. As it was a group project, it was quite difficult focus on the exact things I, personally, thought was the interesting and important questions to tackle. This project involved a question of how to motivate learners through social means such as encouragement and gamification.

1.3 Context

As we move into the era of online education and digital educational assistance, there arises an ocean of new questions and variations of old questions with it. Amongst popular questions, is then how to support the individuals, such as self-regualted learners[WBD+18]. How these general learning goals get tailored to the individual[LvdBCA18]. How we draw social benefits back into the individualised learning experiences[JJ11]. There is an intrinsic contradiction in trying to reach a worldwide quantity, with an individualised quality. The first thing before learning anything, is to know what and how to learn that.

It is to have a plan. Creating a plan for something you do not know is a difficult task in itself, so why not get help from others that might know.

1.4 Scope

Drawing from research in task productivity and social planning, a scenario of how this is relevant as a part of creating learning plans is discussed. Receiving plans from others increases motivation[ACMH16] in executing the plan. So, anyone receiving a plan benefits from that, but what about one who has to provide that plan, do they draw any benefit from it? The main idea for how to approach this comes from the microtask concept[ITLT18] and PlanSourcing[ACMH16]. Both of these results increased motivation in executing tasks and plans. In PlanSourcing strangers or friends will provide plans for the user based on their constraints. As a result the user receives individual plans without having to go through the initial hurdle of coming up with one by themselves. Plans were actionable and well received by the users, where both friends and strangers had each of their own advantages. Friends provide more personalised plans, while users find it easier to share personal information with strangers. Similarly microtasks makes larger tasks easier to execute and more flexible in what circumstances they can be executed.

1.5 Research purpose

Nowadays, with the vast amount of learning material available, it is very common to partake in online learning, either as part of offered courses or by oneself. Both of these requires the learner to have some goals[Zim02] in mind and plan accordingly to other priorities in their life, before digging into the hardship of learning. Current online offers still struggle to plan according to the individual. Previous research shows how breaking tasks into smaller pieces can help increase productivity and are more robust to interruption[CTIB15, ITLT18]. Furthermore, research on behavior change shows the effects of how peers can provide plans for one's goals in health-related goal setting and planning[ACMH16].

Naturally, a hypothesis would express a bettered learning experience however that would be measured. But to end at that, there are many stages of research questions that needs to be clearly answered before trying to answer if plans are executed, goals are reached, and what the learning outcome even is. So to tackle the questions before that, concepts of micro-goals and peer planning can provide a good foundation for ways to collaboratively create goals and do social "self" reflection.

In a scenario where a learner has to provide feedback or revise another learner's plan, can that revision support reflective behaviour in such way that it will also help the learner make their own plan more actionable. Hypothesis:

1. **Revising other learners' plans help learners create better plans for themselves.** With the underlying assumption:
   (a) Revising other learner's plans lets them reflect on their own plans
   (b) Reflection helps them design better plans for themselves

The explicit reflection behaviour will not be addressed, but is an assumption that can lead to a lot of interesting future work.

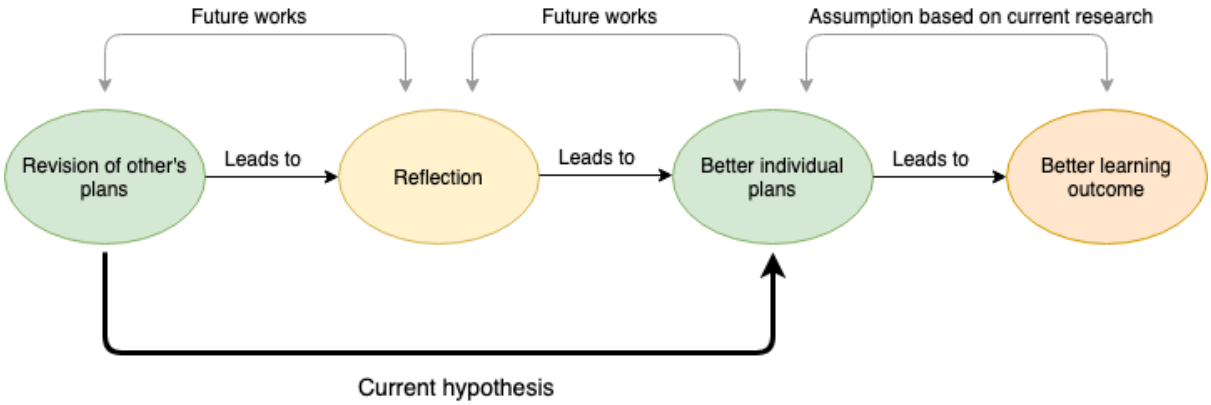

Figure 1.1: Sequential hypothesis of revision leading to better plans.

1.5.1 Research questions

By this we can propose three sequential quenstions that can helps us answer this thesis.

1. Does microgoal planning help learners break their plan into small and actionable steps?
2. Can learners provide feedback for other learners' plans, to make the plans more actionable?
3. Can learners make their own plan more actionable by providing feedback to other learners' plans?

Chapter 2. Background

In this section some of the current related works, that led to narrowing of the project scope, are summarised. What are the current approaches for learners to help each other plan, evaluate and execute, each others plans and goals for learning? Especially skills such as programming and foreign language learning are studied closesly, as they are popular, difficult, and yet easy to quantify and measure in many aspects.

Lack of motivation to plan and execute, new tasks or skills to learn. Current approaches incorporate both social and individual support to different stages of learning and productivity. All from social solutions using social reinforcement and sourcing of plans to making task structures which splits tasks into microtasks. But no one seems to combine such approaches, especially not within a learning environment.

2.1 Motivation and Social Motivation

Many systems already try to solve issues of motivation, productivity and behaviour change by incorporating social encouragement[PROKGP14, LC12]. Other areas where these kind of social interactions has been used as the main motivation factor include, behaviour change[PROKGP14, AAM16] and MOOCs[LHMM16]. In a 2012 study[LC12] show how social networks for learning help social engagement and help students in meaningful and productive learning. Because engaging with people online can mean many things, as users tends to treat strangers and friends differently[KDS16, ACMH16] In [JJ11] they investigate how socially self-regulated learning is a crucial motivation factor in collaborative learning. Learners showed motivation regulation through social means in collaborative learning. This includes social reinforcement and task structuring.

2.2 Learning

Mastery grid[GHSB16] provides a tool for feedback on learning introductory programming. With each milestone providing information on how much examples, quizzes etc. are studied. The results are compared and ranked in comparison to other students. This solution encourages competition instead of collaboration. Utilising competitive nature as motivation. So it does not provide detailed feedback on where or how to improve the approach.

In [LvdBCA18] proposes a document recommendation system for English learning as foreign language. Based on previous readings, the system recommend text that it find suitable for the learner. This motivated the students to read more and they increased their vocabulary. But this was unfortunately only done as a supplement to class teaching.

Several tools try to [TT11, CCY18] provides translation for English to the foreign language by changing a selected set of English words with foreign language the user is learning. This does not necessarily provide help in understanding different aspects of a new language, such as grammar, cultural context etc., as is use English context and not a natural context of the foreign language.

2.3 Microtasking

Play Write[ITLT18] is a microproductivity tool that breaks larger writing task into smaller microtasks. These microtaks are made to accomodate for small moments where the user has devided attention, namely using their smartphone. This approach similarly[CTIB15] shows that small tasks indeed helps users execute them. Because there are many ways to take advantage of one's time to increase productifvity[KJC+16]. Whether that is based on feedback, microtasking[TLL14] or a whole other thing[SWKT14].

2.4 Planning

In a lot of ways proper planning can help people overcome hurdles and complete the tasks they set out to do. Providing people with these plans in the first place shows to effect the actually execution[KKH+13], in that people are more motivated to get started and actually execute more tasks within the plan. Furthermore if people are to plan plan themself, providing them with a predefined vocabulary[KWT+18] increases not only quality of the plans they make, but also there motivation to do so. In PlanSourcing[ACMH16] they show that routines, preferences, constraints and goals are four useful categories of information that can enable the planners to generate more personalised and better perceived plans. When planning there are many things to consider, and making the whole procedure into a real habit[SCB15] can significantly increase the likelihood of those tasks to get done on a regular basis. Since a lot constraints in executing these plans comes from time-management[ND14], tracking and planning the time spent on exact is essential.

2.5 Reflection

This study investigate how a reflective approach to planning behaviour change can help peoples motivation. By asking "why" questions they aimed to engage people in their behaviour change planning. Reflective questions showed to keep people more engaged in the goal setting and planning of behaviour change. The dropout rate showed to be higher in their study compared to face-to-face methods. One suggested limitation is that reflective questions only work well on people with high motivation for behaviour change. So to motivate engagement[ECF+16] and reflection in behaviour change related to diet, focusing on one food at a time and have users reflect and interact enhances their learning as well. In general reflection[LKFK15] and feedback[YDGB17] carries with them a lot of benefit in especially behaviour change and then possibly also in increasing learning engagemnet.

Chapter 3. Building a Plan

3.1 Plan framework

As the aim is to let learners create personalised plans the framework has two main purposes to support:

1. Help learners create and structure a plan that is actionable.
2. Make a plan in which the personal goal is easy to understand for other learners.

Borrowing from micro tasks[CTIB15], the central type of element in our plan framework will be the micro goal. A goal small enough to achieve within a single study session. By this, learners will be encouraged to create small plans that are actionable, just as micro tasks has proved to be. As these plans are to be revised by peers the format should be recognisable and the plans easy for others to understand. Microgoals do not only make the format consistent and help learners to create actionable plans, but also have a limited size makes the peer revision easier. Breaking a plan into micro goals also makes the peer revision a series of micro tasks in itself.

To help peers revise for the individual and help the learner understand their own plan better, another important element is the possibility to clarify any kind of constraints. Constraints provide peers with information that helps them understand the scope of the learner's goal. Having such constraints have shown to help strangers create better personal plans for the individuals.

3.1.1 Constraints

In general constraints are any kind of limitation you have in performing a task or reaching a goal. Here constraints broadly includes any kind of limitation the learner might have in time they can allocate for their plan, what resources(e.g. books, videos, lectures and friends) they have at disposal, or any kind of prior knowledge that might influences the learning. Providing a time frame might help the reviser understand how the goal is broken down into the specific microgoals and steps.

3.1.2 Description

To provide detailed information on what the goal involves, learners make a short description of what the goal exactly includes. A one sentence title is often not enough to convey the full scope of an exact goal. The description in itself should aim to support the two pillars of the framework. A description made specific and concise will both help the plan to be actionable for the learner and understandable for the reviser.

3.1.3 Steps

Steps are the last and smallest sub element of a good plan. It is not defined of what exact size these should be, but it is somewhat free to the learner to choose. Ideally a step should be small and specific enough such that it is actionable in itself. The framework should therefor also aim to instruct learners to keep the steps that way.

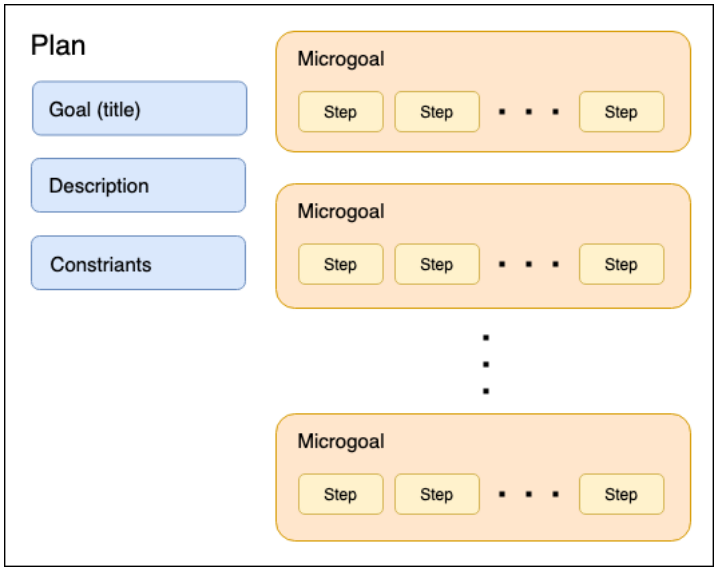

Figure 3.1: Illustration of what a plan consists of.

3.1.4 Microgoals

The term micro-goal is used to describe any way of breaking down one's planning into smaller, more achievable goals. It is does not necessarily follow a strictly defined structure, but should support a way of thinking about one's goals, planning learning.

It is adopted from previous research on microproductivity[3] (microtasks). Microtasks are decomposed from larger tasks to accommodate the small moments people have during their day. In the same way micro-goals are derived from larger goals. Each goal should collectively (and preferably independent) work towards a main goal. The point is simply to put an emphasis on having a small measurable goal instead of a microtask, that might not show results until the larger task is completed.

An Independent microgoal means that it should be achievable independent from other micro-goals within the same main goal. It should only be dependent on the knowledge of the goal setter prior to creating the main goal.

3.1.5 Defining a "good plan"

Outside of the principles supported by previous works we use the simple approach of SMART action plans as a way to evaluate how actionable a plan is. SMART[1] being an acronym for Specific, Measurable, Attainable, Realistic, Time-bound.

SMART

SMART is just one of many guidelines for making actionable plans. But it follow a few simple parameters that a plan has to meet.

1. The plan should be **specific**. It should be clear what the exact goal is, who it involves and why it is important.

[1] https://blog.udemy.com/smart-action-plan/

2. The goal should be **measurable**. This highly depends on the exact goal. There are various ways measure the success/completion of a goal. Whether it is concrete knowledge of a subject, performance of a skill or simply some amount of time spent.

3. The goal should be **attainable**. The learner should have the resources to actually reach the goal, any limitation or obstacles should be addressed in the planning phase, to make the plan actionable.

4. The goal should be **relevant**. More on the why of the goal. It should be relevant to the learner personally, not too difficult and not too easy to reach.

5. The goal should be **time-bound**. Having a deadline increases the seriousness of the goal and make the learner less prone to down prioritise it. Creating a goal with some sense of urgency increases motivation. E.g what can be done at the exact moment of plan creation to move towards the goal.

Other than ensuring a clear and actionable plan for the creator, it also helps create a plan which purpose is easier understood by others who will have to revise it.

3.2 Pilot testing

To test and decide on the best way to instruct people on creating goals, micro goals and the steps, a pilot study of these three stages in the plan creation was done. Deciding how to build instructions for each of the stages were done, over a few iterations by different methods. To determine how an overall goal should be described in a way that makes it understandable for peer learners and how they could best possibly create microgoals for it, a simple scenario and instructions were provided. First part was to give feedback on how easy the provided goal was to understand. What things needed to be elaborated, what things were unnecessary. From this, the following template of how to make a goal was derived. Second part was for users to create microgoals based on some simple instructions. Using feedback from users during multiple iterations, an appropriate series of instructions could be constructed. Decomposing a goal into microgoals is a difficult task for novice planners and therefor needs an appropriate supportive series of instructions. Last part was for users to create microgoals that includes steps, to see how they create the specific steps needed to reach a microgoal and if detailed instructions were needed.

3.2.1 How to make a goal

Goal Description: *Please provide a detailed description of what you want to achieve, including expectations of when this would be achieved.*

Prior Knowledge: *Please provide a detailed list of knowledge relevant to your goal*

Constraints (resources, time etc. the learner is limited by): *Please provide any constraints you have in planning for this goal. This includes: an estimate of allocated time(per day, per study session etc.), your available resources(devices, books, internet/no-internet, classes etc.)*

Preferences: *Please provide any non-critical constraints. Personal preference of media, time of day, place etc. for studying.*

3.2.2 How to decompose main goal into microgoals

What is a microgoal? *A microgoal is a very small (and independent) sub-goal decomposed from the main goal. It should preferably be achievable within a single study session, if learner has not stated*

otherwise. A microgoal can be anything that you find relevant for achieving the higher level goal. It is a goal, not a task. So any details on how it is obtained is not to be included. One way to think of this, is to find a sub-task, consider what the outcome is and success criteria. It is about what to achieve, not how to.

What is an independent microgoal? *The microgoals should also be, as far as possible, independent of each other, and only require what is stated in 'pior knowledge' and 'constraints'. And if not, please state any further prerequisite.*

A microgoal MUST include the following properties:

Description: *Short and precise description of what the goal is.*

Estimated time: *Estimate time of achieving this goal based on what you know of the learner.*

A microgoal CAN include the following property if it requires:

Prerequisite: *Any requirements in achieving this goal not specified by the learner. This can include assumptions of further knowledge, resources at learners disposal and so on.*

3.2.3 How to make steps for microgoals

Based on the microgoal and constraints, you should create a series of steps that sequentially moves the learner towards this goal. Scope of the steps highly depends on the specific microgoal, but by default should be specific and actionable. First step should be easy to pick up and do, where the others then follow naturally. These steps, combined, should then lead the learner to the specified microgoal.

3.2.4 Results

Through the pilot study, feedback on instructions and the plan structures were pretty consistent across all users. Major concerns/confusions included:

1. Relevance of prior knowledge and preferences.
2. Lack of examples what constraints could include.
3. Size of microgoals is difficult to keep very small and of consistent size.
4. Lack of detail in general instructions.

Though the general feedback on how to make the instructions and what the goals should included were quite similar, each user made widely different microgoals. Especially varying on the time estimations and detail of explanations.

3.2.5 Discussion

A key take-away from testing microgoal-structured plan is, several of the participants reported the experience made them think how this could be used in their own planning.

User 1	User 2
Microgoal: prototype on paper - Description: draw sketchs of the prototype on paper - Estimated time: 10 minutes	Description: find specific need of target users Estimated time: 1 hour - Description: find target users to interview Estimated time: 10 min - Description: prepare interview questions Estimated time: 10 min - Description: conduct interviews Estimated time: 40 min Prerequisite: interview skills

Table 3.1: Comparions between two users first microgoal in a plan for “creating a prototype”

Chapter 4. Design

4.1 Approach

Based on everything so far, we can start to design an imagined scenario where this could apply and where the hypothesis would be relevant. Of this, only the concrete workflow that aims to support the hypothesis will be implemented as a prototype and evaluated. The first coming design aims to create a scenario in which the Research Question is specifically relevant, that is more relevant in a longer research agenda.

4.1.1 Collaborative Planning

The term collaborative planning broadly describes ways for learners to collaborate on making goals and plans. In practice, this can widely differ in approaches. Two interesting approaches are (1.) learners collectively collaborate on planning for one common learning goal and (2.) within a small group of similar learners, they revise and reflect upon each others goals. **Version ONE:** A small group of learners, with a common goal, work together to form a "perfect" plan for their goal. Here, each learner will contribute with their own ideas to form one plan, all of the members can follow. **Version TWO:** A small group of learners, with similar goals, give feedback on each others goals such that each learner can reflect on their own plan and process. This approach makes plans more individual.

Collaborative Planning will be used to refer to a combination of the two. Mainly focussed around version 2, with a simplification of version 1 to support learners' goal making.

A "perfect" plan is simply one plan that aims to accomodate all learners needs. A compromise. So in a broad sense, it should be very general, flexible and easy to adapt. It will most likely not be the best for any individual, but it should be an aggregation of the same goals and serve as a reference for making individual plans.

There are two kinds of similarity between learners to consider (1: similar) they have the same goal or a big subset of their subgoals intersect, (2: like-minded) their process, type of learning, type of planning etc. are similar.

4.1.2 Social "self" Reflection

Social self reflection refers to the idea that social interactions, with especially like-minded people or people with similar interests, can initiate a certain amount of self reflection. Revising other people's plans or receiving suggestive inputs from other learner's might help one to think differently, more abstract or with a new perspective of one's own plans.

4.2 Workflow

Create, Revise, Improve!

1. Create a plan
   (a) Title

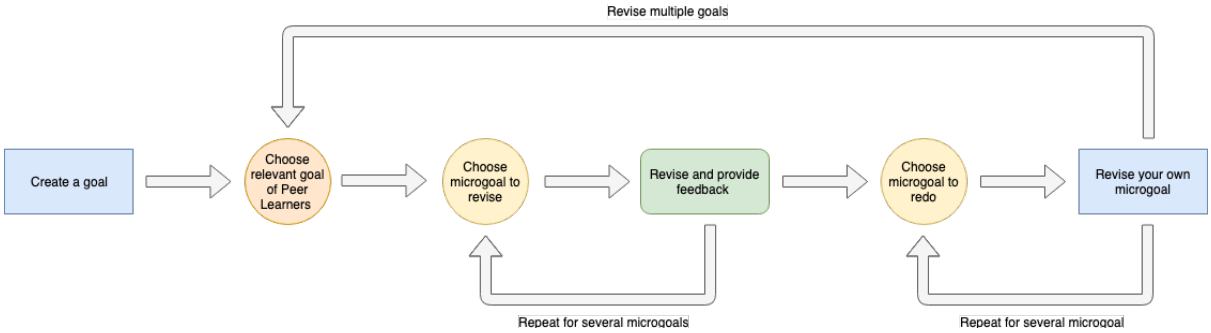

Figure 4.1: Caption

(b) Description

(c) Constraints

(d) Microgoals

(e) Steps

2. First step is revision of a plan

   (a) Commenting on description, knowledge, constraints

   (b) Upvote steps of plan

   (c) Edit steps

   (d) Delete steps

   (e) Add steps

3. Improve

   (a) Update one's own plan (related to revision)

   (b) Make new plan

The whole workflow consists of three main tasks, in order for the learner to create an improved plan. The first step is mostly just for the learner to create whatever plan they have in mind. There is no requirements of where this plan comes from, how difficult the subject is or the level of detail. The learner is provided with (or partly forced to use) a structure that aims to break the goal into smaller, more actionable microgoals, and also encourages the user to consider any constraints they have in achieving the goal and their current knowledge related to the goal. This structure also applies to the plans a learner needs to revise.

4.2.1 Creating a plan

The first stage is to create a plan for the desired goal. Where the goal title is the self-explanatory part of the plan, the remaining mandatory elements needs some elaboration on their role in the plan.

Learners are guided to create the plan in a top-down approach. Ideally the goal title leads to the description and constraints which then leads to the microgoals which then leads to their subsequent steps.

Description

The description is here, where the learner gets the opportunity to elaborate in detail what the exact goal is, and what they actually want to achieve. There are no requirements in what the description should include, but it is encouraged to keep it specific. The description provides a free-form that possibly can be used to the high level parts that needs to be done to reach the final goal or specific parts of the goal that can be left out..

Constraints

Constraints are used to clarify anything that might limit the learner in achieving the goal, the amount of time allocated to the learning or what resources they have to accomplish it. The purpose is not only for the learner themselves to understand their own goal, and its limitations, better, but also for the peers to make better revision. This element of the plan specifically helps support the two points of being attainable and time-bound in a SMART action plan as described in section 3.1.5. So the constraints element is an essential part for constructing an actionable plan from the beginning.

Microgoals

As shown in previous work, breaking bigger tasks in to smaller ones, makes the task more actionable [KKH+13, KWT+18] or result in higher quality work [ITLT18]. It might be natural to break plans into smaller goals, but by supporting this naturally, learners are enforced to keep a structure and think in ways that will make their plan actionable. A microgoal does not need to have a certain size, but it is encouraged that it should be attainable within a single study session, which is something to be provided in the constraints.

Steps

Steps are the concrete tasks the learner needs to execute in order to reach their goal. Steps are sub-tasks of a microgoal in the sense that a series of steps should lead the

4.3 Prototype Iterations

To describe the process of designing the prototype, the iterative testing and design choices have been broken into a few major iterations. Each iteration implementing and/or updating some important functionalities.

4.3.1 First iteration

First prototype was a simple mock-up of how the UI for the revision phase would look like and how the workflow of that exact phase would be.

Elements of microgoal plans and funtionality of the revision includes:

- Add suggestions to general goal requirements
  - Description
  - Knowledge
  - Constraints

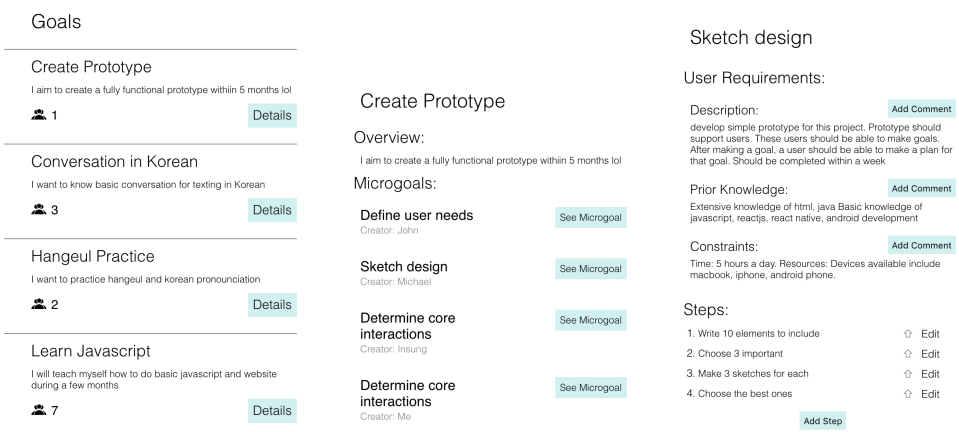

Figure 4.2: The three screens in sequential order from top left. Goals, microgoals and plan.

- Revise plan steps
  - Edit current steps
  - "Upvote" very relevant steps
  - Add steps
  - Add comments

This version was simple and static to test if users could understand the workflow of revision and recognize the difference in the goals, microgoals and a plan. First screen is listing goals made by other learners. Next screen is showing all the microgoals attached to the chosen microgoal. Last is the plan where users can do the actually revision.

Letting 3 people use the workflow for a few minutes and then provide feedback on whether they could understand the purpose and the relevance of the different functionalities. The most prevelant feedback included:

1. Prior knowledge was irrelevant, as the level of knowledge be inferred from the plan itself.
2. Find no use of "upvote" button. Confusing and obsolete.

4.3.2 Second iteration

First of all the feedback from first design was addressed. The prototype was then extended to incoorporate all teh phases of the work flow. Meaning goal creation, and goal improvement was added. Second iteration of the workflow prototype supports the three main functionalities of:

1. Creating the first plan
2. Revising another learner's plan
3. Redoing initial plan

The purpose of testing in this iteration, is to determine any confusion with instructions or functionalities and usability issues.

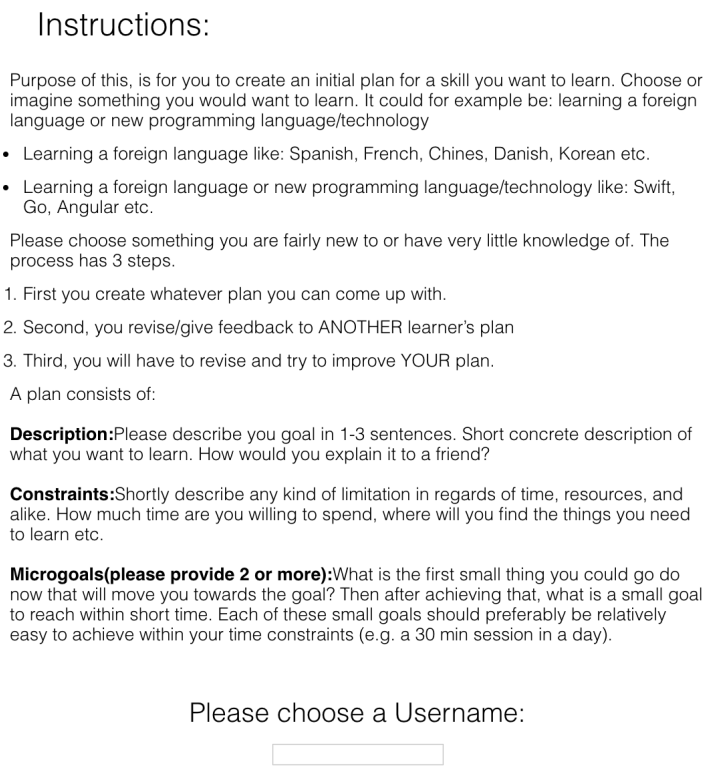

Figure 4.3: Instructions and "login" screen for creating a goal and starting the workflos

Outside of the instructions present on the first page of the prototype, users were partially guided through the process. At each of the three main stages (create, revise, redo) users were informed of their before and questioned about usability issues and in what way they thought the current step supported their planning.

Procedure:

Users were selected based on no criteria, and tests were conducted in person with sessions up to 30 min. Users were instructed through the process.

4.3.3 Results

Through testing several usability issues were addressed. These issues were mainly concerned around the revision of other learner's goal. All included:

1. Missing navigation buttons such as back button and "continue" on login page
2. No deletetion of microgoals on creation page
3. General lack of written instructions through the process
4. Tedious workflow while creating the initial plan.
   (a) Generally too many mouse clicks
   (b) Having to explicitly save every step

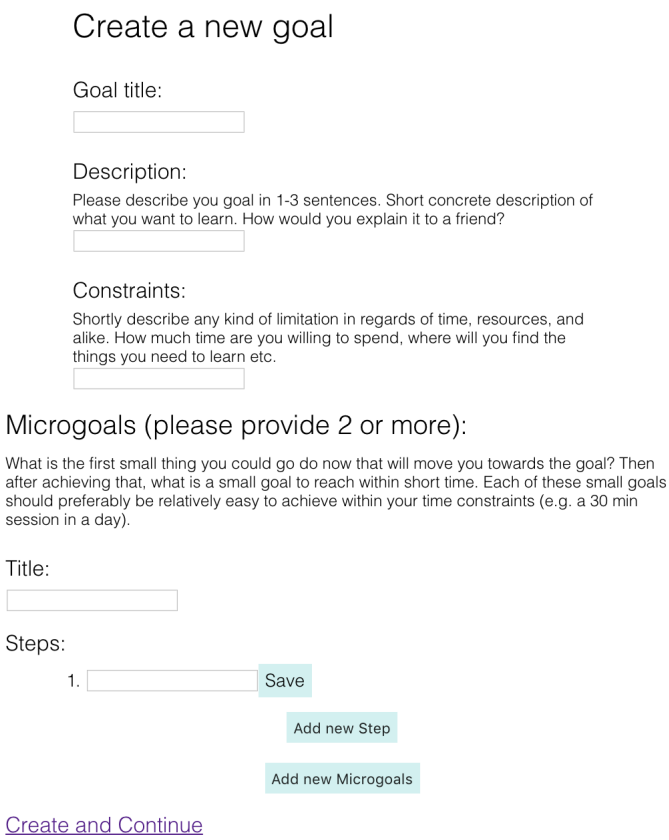

Figure 4.4: Goal creation page, with possibility to add multiple microgoals and steps.

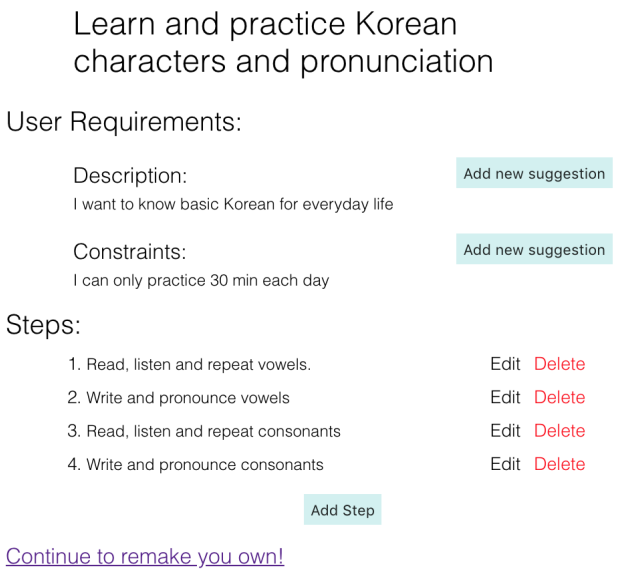

Figure 4.5: Updated plan revision screen. Now with "delete" functionality for the steps.

Questions	Answers
Did the provided framework help you create your first plan?	User 1: Yes. Helped me consider what small thing I could do first. User 2: Yes. Helped me break it into smaller parts.
Did revising another learner's plan help you improve your own?	User 1: I got ideas for what to add on to my plan. User 2: No.
After updating your plan do you find it easier to get started?	User 1: No. User 2:
If not asked to, would you have made a plan?	User 1: Probably yes. User 2: No. Would simply google.

Table 4.1: Post-testing answers from two of the users.

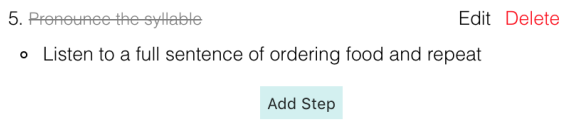

Figure 4.6: Visual indication of the suggestive edit made during plan revision

5. No indication of who owns the goals listed after creation
6. Uncertain of what suggestions for description and constraints should include
7. Edit for other learners was thought to do direct edits in their plan.
8. No support for reordering steps

User answer examples:

Type of goals: **Exactly the same**, *Similar*, Different

4.3.4 Third iteration

For the third iteration, several of the most important usability issues were addressed. These include:

1. Added Back buttons
2. Expanded instructions to all stages of the workflow
3. Save steps on "Enter"
4. Names of goal creator, to indicate it's someone else's

4.3.5 Results

Through testing several usability issues were addressed. These issues were mainly concerned around the revision and navigation. Most prevalent include:

1. No indication where in the workflow you are
2. Navigation between phases were unclera

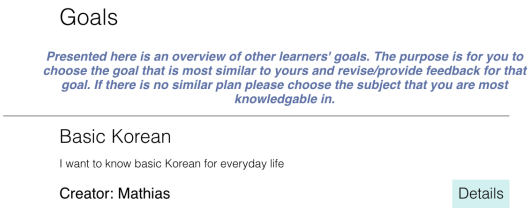

Figure 4.7: Example of instructions added at the goal list page and goal creator's username

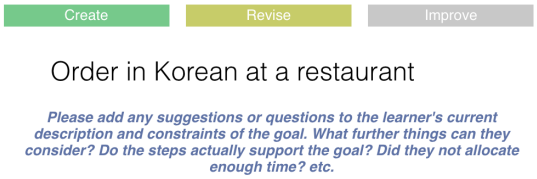

Figure 4.8: Indicator on the top of the page

3. Uncertain if description/constraint suggestion was received
4. No support for reordering steps

4.4 Last iteration

Few new functionalities were added to make navigation and revision easier to understand:

1. Added indicator of where in the workflow user currently is

This version was the final version used for conducting the user studies described in the Evaluation chapter. The prototype can be accessed at http://www.prototype.sixped.dk/login.

4.5 Development

The prototype is developed as a web application. This gives flexibility in being available for both desktop and mobile users. The whole concept is centered around microgoals, so ubiquitous availability of the study plans makes great sense in context of accommodating so called micromoments[3]. Development was done following the same timeline as the design iterations. The core of the design was the revision part and therefor the first to be developed and tested as well.

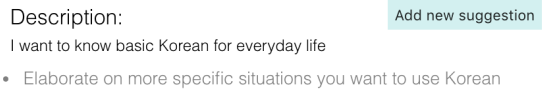

Figure 4.9: Example of instructions added at the goal list page and goal creator's username

4.5.1 Tools and Environment

The prototype is developed as a web application, using the Javascript library ReactJS[1]. ReactJS is an Open-Sourced modern Javascript library for building user interfaces. ReactJS has many advantages for building user interfaces, such as UI components, great performance, and easy integration with other services. To provide a quick and easy database Google's free solution Firebase[2] was used. Firebase and ReactJS are free(for this project size), has great performance and integrate well with each other.

4.5.2 Core Design (first iteration)

The first prototype consisted of three pages, each containing components and data relevant to each of them.

Goal page

The goal page is a simple list of components containing the most basic data of each user's goal. The component stores only the title and description, and provides a link to the page of that exact goal.

Microgoal page

Similar to the Goal page the microgoal page is a list of all the microgoal encompased by that exact goal. Each microgoal link to the revision page, referencing only the ID of the microgoal.

4.5.3 Revision page

The revision page contains two types of components: a Requirement component and a Step component. The requirement component was used for the description and constraints. Where as a list of step components was used for listing all the steps the specific microgoal has. The **Requirement component** consists of a longer text field meant for plan parts like description and constraints. The **Step component** is a list element and contains buttons for editing and deleting.

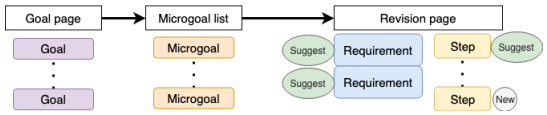

Figure 4.10: This diagram illustrates the three pages and their components, developed for the core design. Arrows indicate the link between the pages.

4.5.4 Full Design (last iteration)

Apart from the pages described in the core design, the Final design incorporated a creation page and an improvement page.

Creation page

Creation page uses slightly modified versions of the **Requirement component** and **Step component**.

[1] https://reactjs.org/
[2] https://firebase.google.com/

Improvement page

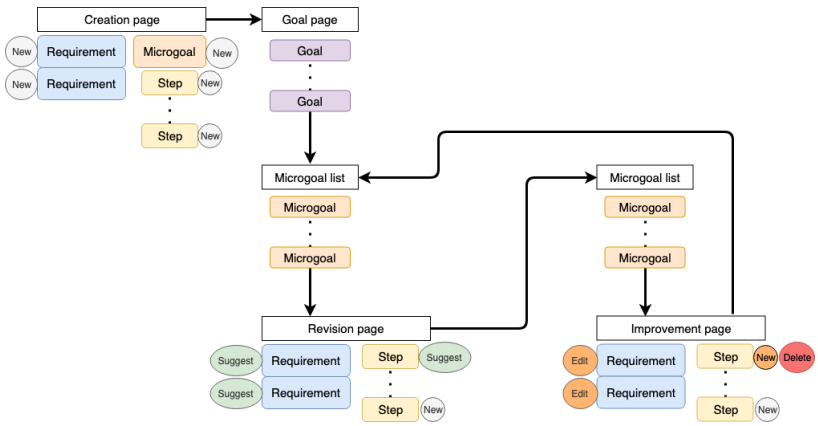

Figure 4.11: Shown here are the pages and components of the last prototype iteration. The arrows indicate links and dataflow. Circles and ellipses show

Chapter 5. Evaluation

The goal of the study is to investigate whether revising other peer learners' plans will help learners themselves to create more actionable plans. After updating, changing and giving feedback to other learners' goals, do learners reflect on their own plans and thereby improve them. Quality of feedback and revision, as well as what phase of workflow provides best improvement support, will be assessed too. Both how the learners perceive their plans and how the exact plans look like will be taken in to account.

5.1 Participants

A total of ten participants were recruited through group chats on Facebook and KakaoTalk, mostly consisting of international students at KAIST. 8 were male and 2 were female, all students (at bachelor or master level) with a background in engineering. The median age was 24 years old, ranging from 21 to 37.

5.2 Setup

The user study was conducted as a combination of participant observation and interviews. Data was mainly collected through the system on how did participants create, revise, and updated goals. Each participant filled out a questionnaire of their experience in the end of the study and discussed about tehir experience using the workflow.

- The interviewer first explained to the participants the purpose of the study and how to use the system.
- Users was further instructed in the purpose of the study, how to use the application, and that their information is anonymous.
- After the study, all participants was asked to fill out an online questionnaire (Post Study Survey).

The procedure for each participant had the general structure of:

1. Introduction:
   (a) Receive explanation of the purpose of the experiment
   (b) Receive explanation of the procedure of the experiment
   (c) Give written consent
2. Create an improved plan:
   (a) Create a goal
   (b) Revise a goal
   (c) Improve a goal
3. Post experiment questions include:

(a) How did the provided framework help create the first plan?

(b) How did revising another learner's plan help improve the learner's own plan?

(c) After updating your plan do you find it easier to get started?

(d) If not asked to, would you have made a plan?

To see full list of instructions and questions please refer to the appendix.

5.3 Results

The learners's engagement can generally be categorised into 3 different groups:

1. Learners making relatively extensive or detailed plans at the first stage, with no improvemnet at the third stage. **Showing behaviour supporting RQ1 and RQ2**

2. Learners making relatively small or not very actionable plans in the first stage. Then extend with ideas from plans they saw or revised.**Showing behaviour supporting RQ2 and RQ3**

3. User who engage in all three stages of the workflow, adds upon or makes their microgoals more actionable. **Showing behaviour supporting RQ1, RQ2 and RQ3**

5.3.1 RQ1: Does microgoal planning help learners break their plan into small and actionable steps?

Workflow supports goal decomposition

In the post user study questionnaire, all participants either answered "Agree" or "Strongly Agree" when asked if the workflow helped them decompose their goal into small and actionable steps. Through the revision phase one participant (**P1**) came to understand the decomposition through looking at other plans. The initial plan simply had this:

Microgoal: "Create a class in pyhton"

1. "Learn the syntax of python"
2. "Create variables"

After revising a plan for learning Javascript, **P1** almost directly adopted a microgoal to their own, helping them decompose the plan. Added microgoal looked as follow:

Microgoal: "Create comments"

1. "Create a line comment"
2. "Create a section comment"

Content of revision matters for improvements

In the first category of learners all agreed that the structure of having microgoals helped them make their steps more actionable. These learners also reported that the goals they revised were not very relevant of their own.

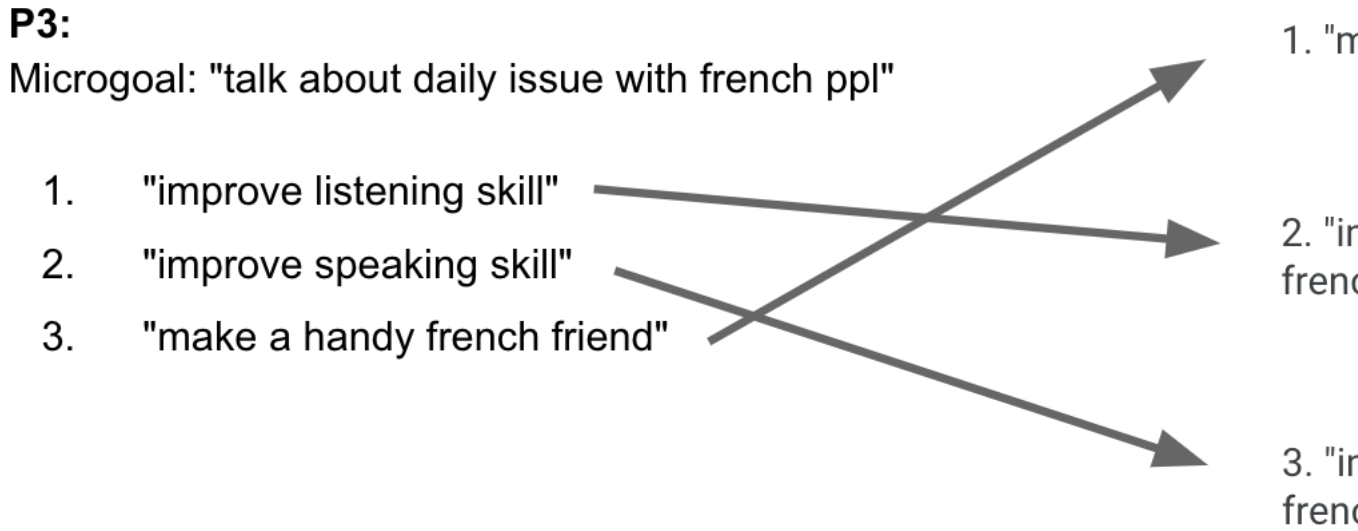

Figure 5.1: Here is shown how P5 revised P2's microgoal

P7:*"The plan I saw was for a level that I have already achieved and was therefore not quite as helpful."*

So the level of content of the plans matters for whether a learner will improve their plan in the last stage. They chose to revise a similar goal, but at a lower level. As an example, of the available languages, **P7** revised a goal of learning simple introductory Korean. Where as **P7**'s goal was to be able to follow a long in everyday conversations, as per the curriculum of their book.

5.3.2 RQ2: Can learners provide feedback for other learners' plans, to make the plans more actionable?

As seen in figure 5.1, feedback indeed could provide more actionable plans for the receiver. Here **P5** added concrete scenarios in which **P2** could exercise these skills. Furthermore they rearranged the order to make use of the last step in the later ones. This feedback not only makes the microgoal more specific, but also more attainable.

5.3.3 RQ3: Can learners make their own plan more actionable by providing feedback to other learners' plans?

Secondly there was generally two ways for learners to update and improve their plans; (1.) add new microgoal or (2.) update existing micro goal.

Updating a microgoal makes it more actionable

When learners would just update a microgoal, instead of adding a new, the steps would generally be more actionable than the ones created in the initial plan making. This could either be, by adding a new very specific step that would help them towards the microgoal, or by updating an existing one to be more specific. Examples include:

P3: *"Use duolingo" → "Use duolingo 8h per week"*

P9: *"Practice Vocab" → "Practice Vocab using flashcards"*

Revising and improving is not just copying

Several participants stated how revising other's plans inspired them to update their own. In the section above, **P9** updates one of their steps to be more specific. They even state:

> **P9:** *"When revising another learners' plan, I realised that I could apply this to my own plan as well."*

P9 furthermore explained how similar the goal they chose to revise was, as the other learner was practising vocabulary from the same book. But nowhere in the other plans are stated anything using Flashcards, which their exact update was. Another example, after revising plans for learning french, **P8** simply adds:

> Microgoal: "Try ordering in a restaurant"
>
> 1. "Go to a restaurant."

Though this is not very actionable, there was no reference to food or restaurants in any of the plans **P8** revised. This indicates users do not simply improve by example. They actively consider improvements that fit their goal.

From a good plan to a better one

One user, namely **P5**, showed extensive engagement in all three phase, compared to most others. Though the created microgoals were not that small, the steps were relatively actionable. They were quite general, but detailed enough to make it more specific. The learner added and updated several steps within their microgoals. These edtis usually extended the sequence of steps with more tasks, that were slightly more specific.

Microgoal: *"Go to korean restaurant and only speak korean"*

1. *"Read and listen to conversations held in restaurants when ordering and similar"*
2. *"Make sure I understand the basic vocabulary"*
3. *"Try to predict and understand replies"*
4. *"Go to a restaurant and order"*

Table 5.1: Example of **P5**'s added microgoal. Inspired from revision, but made more actionable.

Table 5.1 shows the additional microgoal of **P5**. **P5** revised 3 different plans within language learning. Only 1 of these plans mentioned *"Meet once a week for drinking Cafe to practice italian"*[**P2**] as a last step of having conversation with friends in Italian. **P5** draws example from this and adds an extended microgoal using a similar scenario. The microgoal has clear steps to perform in order reach that exact goal.

Chapter 6. Discussion

There are still a lot of uncertainties and questions regarding the results, design choices, testing, and further improvements. The current project still has a lot of limitations, not only in the intentional design choices, but also parts that has not been addressed or considered prior to the development and tests. Several of these points are discussed in the following sections.

6.1 Contribution

A brief insight into how peer revision can facilitate improvements in learning plans, not only for the revised but for the reviser as well. There were several parts that made this possible. Designing a plan structure supporting features from previous work on micro tasks and peer-planning, reflect on a scenario in which peer revision would be relevant, create a workflow that could support the hypothesis. Two main contribution were a microgoal structured plan design, helping learners create plans with little to no knowledge of a subject, and a workflow to revise similar plans and improve one's own. The workflow indeed showed interesting results for how revision also can be used as a way to improve learning plans. Learners could encounter very similar goals to their own, that helped them make more specific, possibly than what generic plan examples could have.

6.1.1 Structure and workflow

The design of a microgoal-based plan has been a core element through out the design. Though it has not been essential for testing the workflow, it supported people in creating an actionable plan. Enforcing a strict size (i.e. study time and period) is very difficult, as for some goals even the smallest sensible sub-goals might not be realistic to achieve within a micromoment as described in [CTIB15]. Especially with language learning that often requires a lot of repetition to fully reach even the smallest goals. It was not possible to enforce one size for all microgoal, since everyone has different ideas of how small you can break it down. Therefor, with some guidance, it was left to the individual learner to decide the size.

Additionally a plan had to include some constraints on time and resources. Initial the the purpose was to make it easier for peer learners to revise and give feedback. Learners used these constraints to revise plans. Both changing steps to consider the constraints, but also evaluate whether the other learner would actually dedicate enough time or resources to achieve their microgoals. Adding the constraints to their plan seemed to make them consider the size of microgoals and amount of them more thoroughly.

Learners were guided (mostly by the system) through the workflow of creating, revising and improving. There was a difficult balance in giving learners freedom to move around between phases and goals within phases. Learners would either browse through different similar goals before deciding one to revise, or simply decide on one and stick to that. No one returned to the revision after the improvement phase. Learners who went through multiple goals in the revision phase, used these goals to both improve their own and other's. Looking through different goals, they could use similar steps across different goals to provide feedback for other learners with similar goals. So moving between revising and improving might be completely unnecessary at this point. On the other hand having the freedom to switch between goal in revision phase showed to be an engaging way to both improve one's own plan, but also across the

other learners' plans.

6.2 Limitations

6.2.1 Revision and engagement

Through the revision there was no strict way or explicit help in choosing, other than a simple instruction to "choose a plan similar to your own". There was no personal recommendation of what plan to revise. Not all plans are equally good at facilitating improvements in the learners own plan. Results showed how relevant the plan is, both in topic and level, is important for the later improvements. So a more dynamic system, that supports revision choice in such a way that it is more relevant will possibly improve the revisers' plans further. This might affect the revision itself though. As the reviser might not be able to give proper feedback. Extending with more dynamic features might also help keeping users engaged. As the example of L5 in the results section shows, being engaged in all phases creates actionable plans both for reviser and revised. As instructions in the creation phase were rather generic, users had difficulty coming up with actionable steps. Making the creation phase more interactive might be a solution. Having personalised prompts when creating microgoals, asking questions guiding users towards more actionable steps will possibly create more engagement.

6.2.2 User studies

Do to the low number of participants and design iterations it is difficult to conclude anything indefinitely. Also, planning is a task that varies a lot between individuals. To answer whether revision can help the reviser create better plans for themselves, their own plans were compared. There are much more variations of a workflow in which iterations of their own plans could be compared. Maybe they could simply see examples before creating first plan or instead of revision. There are many altenative ways to compare to, ways fitted to the individual. Concluding whether this user study has shown the right results for everyone is difficult to say. One thing certain is that the workflow affect people differently and helped some more than others.

6.2.3 User Interface

One of the biggest limitations in testing the concept, was the prototype UI. Though it went through many iterations, and several with only minor issues, there was several design choices that proved itself to be non-intuitive.

6.3 Research questions

6.4 Future work

Other than addressing some of the questions described above, a series of future work is discussed here.

6.4.1 Perspective

Two important directions to consider in where this fits moving forward: (1.) what is the role within learning and (2.) how is the also relevant outside of learning. A great example of how peer feedback is used in learning environments is Peergrade[1]. Peergrade is primarily a tool to assist regular class teaching methods. Students grade and give feedback on each others work. This not only frees up time for the teacher to focus on teaching, but also creates opportunities for students to learn from each other. One could imagine a solution that not only targets class curriculum students or independent learners, but instead take advantage of the knowledge and work process of each type of student. Independent learners might expose class students to novel approaches and more challenging ideas than traditional class curriculum. Class students might help independent learners with in-depth methods and knowledge that might be difficult for them to obtain on their own. The proposed workflow is explicitly for planning scenarios but might be extend to the learning tasks themselves. Similarly a product like Peergrade might be useful in the planning phase as well. Students will not only have to follow a class curriculum, but can indeed, with help from the peers, create plans that divert from traditional curriculum a little but support the individuals better.

The workflow does not limit itself to create plans for learners. Novice learners often have little knowledge to create a plan, but many other tasks and projects might encounter similar challenges. Many people do not engage in much planning (or any at all) before starting a new project. Whether that be developing an application, writing an article, or engaging in a healthier lifestyle. Having a social way of creating plans and receive help is not only applicable in learning environments, but anywhere people need to do tasks they might not be familiar with.

6.5 Conclusion

In this thesis, we conducted a exploratory look into what benefits might emerge from socially making learning plans. Based on previous work, a way of creating microgoal-structured plan was designed and tested. From this initial design and testing, a research question of whether revision of other learners' plans benefits reviser's plan itself. To test the hypothesis a simple workflow of create, revise, improve was designed. Extensive design and several iterations of a prototype made the foundation for testing the hypothesis on real users. People who planned to engage in either learning a foreign language or a programming language. With a small sample size of users, the experience and outcome of this workflow was explored and discussed. These exploratory user studies show good results and indication of the revision task, can indeed provide benefits for the revisers themselves.

[1] https://www.peergrade.io/

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