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User Experience of Learning Systems: Enhancing Student Motivations for Frequent Mobile Language Learning Application Use

Master's Thesis
Espoo, 28 December 2020

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Tiivistelmä

Toisen vieraan kielen oppiminen vaatii aikaa, kertauksia ja erilaisia oppimismenetelmiä, joita pelkät kielenopiskelukurssit eivät välttämättä pysty tarjoamaan. Tästä syystä monet instituutit ovat sisällyttäneet digitaalisia tekniikoita opetusmenetelmiin laajentamalla oppimismahdollisuuksia virallisten luokkahuoneiden ulkopuolelle, esimerkiksi hyödyntämällä mobiilioppimista. Tohokun Yliopiston alkeistason kiinan kielen kursseille kehitetty mobiilisovellus, KoToToMo+, pyrkii mahdollistaa tämänkaltaisen ajasta ja paikasta riippumattoman opiskelun, nimenomaan tuntimateriaalien kertausta varten. Vaikka sovellus on saanut hyvän vastaanoton opiskelijoilta, sovelluksen käyttö on yleisesti ollut epäaktiivista ja kertaluontoista. Epäaktiivisuus on yleinen ongelma oppimisjärjestelmissä, mutta yleisesti myös muissa mobiilisovelluksissa. Hyvä käytettävyys ei pelkästään riitä käytön ylläpitämiseen, sillä käyttäjän tulisi myös olla motivoitunut ja sitoutunut käyttämään järjestelmää.

Tämän diplomityön tarkoituksena on tutkia keinoja lisätä opiskelijoiden motivaatiota harjoitella useammin kielenopiskelua KoToToMo+ -mobiilisovelluksessa ja osoittaa UX-suunnittelumenetelmien myönteinen vaikutus oppimismuotoilussa. Aihetta lähestytään käytännönläheisen suunnitteluhaasteen kautta. Työssä suunnitellaan ja testataan käyttöliittymäprototyyppejä, joiden avulla tutkitaan uusien ominaisuuksien vetovoimaa ja mahdollista vaikutusta opiskelijoiden kielenopiskelumotivaatioon.

Tulosten mukaan pelillisillä kokemuksilla on potentiaalia motivoida opiskelijoita ja luoda sitoutuneisuutta, mikäli uudet ominaisuudet olisivat yhtenäinen osa kurssidynamiikkaa ja tukisivat tapoja hallita ja seurata omaa edistystä visuaalisin keinoin. Tulokset osoittavat myös, että prototyyppien käyttö ja opiskelijoiden mielipiteiden huomioiminen suunnitteluprosessissa on hyödyksi, kun lopputuotteelle haetaan hyväksyntää ja rakennetaan keskinäistä ymmärrystä eri sidosryhmien välillä.

Avainsanat mobiilioppiminen, käyttökokemus, käyttöliittymä, käyttäjäkeskeinen suunnittelu, kielten oppiminen, oppimismuotoilu, pelillisyys

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Abstract of Master's Thesis

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Abstract

Learning a second foreign language requires time and various learning methods, which mere classroom hours might not be able to provide. Thus, many institutes have incorporated novel digital techniques in expanding the learning possibilities beyond formal classrooms, such as mobile learning. As a supplement tool for basic Chinese language courses in Tohoku University, mobile application KoToToMo+ was developed to enable time- and place-independent learning, specifically for reviewing the previous lesson materials. Although the application has been well received by the students, the usage is generally inactive, and reviews are one-time occurrences. Low engagement is a common issue not only in learning systems but in other mobile applications as well. High usability is not enough for maintaining the use, as the user should also be motivated and engaged to use the system.

This thesis aims to explore the means for elevating students' motivations to conduct more frequent language learning in the mobile app, KoToToMo+, and demonstrate the positive contribution of UX design methods in learning systems. The subject is approached through the design and testing of interactive prototype user interface features. These are used to investigate the motivational pull of the proposed features.

According to the results, gameful experiences have the potential in motivating students and creating more engagement. To do this, the features have to support the current blended learning dynamics, enable controlling and pacing the learning, and provide granular feedback about the individual learning progress. The results also indicate that the use of prototypes and integration of students' voice in the design process can be beneficial when building acceptance and forming mutual understanding between different stakeholders of an instructional solution.

Keywords mobile learning, user experience, user interface, user-centered design, language learning, instructional design, gameful design

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The COVID-19 pandemic definitely set limits to the research, but also the tone for the rest of the exchange experience. The support from my closest family was invaluable in times when it was difficult to keep my study motivations high.

2020 is definitely a year to remember, both in good and bad.

Espoo 28.12.2020

Jarmo Seppälä

Contents

Abbreviations and Acronyms

ARCS	Attention, Relevance, Competence, Satisfaction - Model
CALL	Computer-Assisted Language Learning
DSRM	Design Science Research Method
HCI	Human-Computer Interaction
LMS	Learning Management System
MALL	Mobile-Assisted Language Learning
MDA	Mechanics, Dynamics, Aesthetics - Model
OIT	Organismic Integration Theory
SDT	Self-Determination Theory
UCD	User-Centered Design
UI	User Interface
UX	User Experience

1 Introduction

Learning a second foreign language requires time, motivation, and various learning methods (Ushioda, 2013). In second or foreign language education, there is a need to increase student exposure to the target language input (Ellis, 2015). Frequent repetition, incorporation of sociocultural components (e.g., films, music), and contact with native speakers of the target language play a key role in long-term knowledge transfer and performance improvement (Dörnyei, 1994). This might not be possible to cultivate in a school classroom, where instruction time is often limited. Therefore, mere classroom hours might not be enough to attain mastery in a foreign language.

The development of digital technologies and wireless connection speeds have increased the opportunities for foreign language exposure (Kukulska-Hulme, 2009). Consequently, many institutes have incorporated novel digital techniques as an attempt in expanding learning possibilities beyond formal classrooms (Rega, 2015). Given the vast coverage of mobile devices, educational institutes have observed a growing interest in using smartphones as a medium for accessing learning materials, with some institutions even developing tailored mobile applications specifically for language learning (Ohkawa, et al., 2018).

In the beginner level Chinese courses at Tohoku University, a mobile application, KoToToMo+, has been developed as a review tool to complement the textbook used in the classroom. The application allows students to review the learning materials through a variety of tasks that enable reading, speaking, listening, and typing. The application is often used to prepare for bi-weekly quizzes. Recently, KoToToMo's user interface (UI) has been updated to enable students to track their study progress. Students found the new visualization functions useful, but according to the current learning habits and classroom survey feedback, there seems to be some issues in frequent utilization. Students have uncertainties in knowing whether one's language abilities have actually grown, based on the conducted reviews. Some students also tend to procrastinate and conduct the learning tasks in KoToToMo+ only once, usually right before the bi-weekly quizzes (Ohkawa, et al., 2018).

The gathered student feedback and learning statistics indicate that the current measures in the user interface are not enough to provide positive user experiences (UX) that motivate for frequent and consistent learning. Lack of repetition is problematic from a learning point of view as well, as frequent learning activities has been demonstrated to be a more effective way in retaining the information long after the course has ended, compared to an intense last-minute "cramming" before the exam (Dunlosky, 2013).

The issue with the application utilization is a common challenge in designing engaging mobile products; users' baseline expectations for digital experiences keep getting higher and different mobile applications constantly compete for student attention (Wilson, 2020). The importance of user experience design in educational media has been identified, with a growing interest in understanding users' internal motivations to use interactive products and mobile applications. This interest is spawned by low engagement rates. A system yielding high level of usability is not enough to engage and motivate users (Tondello, 2016); the interaction should deliver experiential outcomes, such as enjoyment, emotional attachment or control over goals, which are especially important in mobile learning contexts (Jones, et al., 2006). Therefore, user needs have to be explored beyond "traditional" usability requirements. With mobile devices being used in educational settings to an ever-increasing extent, these new types of experiential needs garnered the interests of instructional designers as well. For broad and long-term adoption, the experience of using a mobile application really matters (Kukulska-Hulme, 2007).

Prior studies demonstrate positive effects of game-like features in engaging the students, but systematic and scientifically validated studies are scarce (Tondello, 2016). This includes field trials in investigating long-term motivational effects of mobile applications in blended learning settings (Baldauf, et al., 2017). There are open questions on what game elements and combinations are most likely to be effective in motivating learners in particular contexts (Dichev, et al., 2015). How to design for such user experience that sparks more volitional attitudes for repetitious exercise in an m-learning application?

This thesis investigates ways for elevating students' motivations to conduct more frequent language learning in a mobile application, KoToToMo+. The subject is approached through the design of interactive prototype user interfaces featuring game-like elements. The research method used is design science, as it has been demonstrated to provide a structured framing for creating e-learning artifacts (Östlund & Svensson, 2018). In this thesis, design science is applied to the design of the prototypes, and to generating knowledge about how user-centered design methods can be used to provide positive effects to the learning experiences. The results can be viewed as the contribution to the growing body of knowledge around the importance of UX design in the field of learning and instructional design. During the COVID-19 pandemic and social distancing, UX design will arguably play an important part in the educational field, as the institutes are making efforts to maintain continuity for learning in online and e-learning environments. Thus, this thesis provides a systematic and timely documentation around the subject.

In the following chapter, KoToToMo+, theories of motivation in learning and experiential needs in mobile devices are studied to gain better understanding of the topic. This knowledge was used to formulate the research questions, as well as the appropriate design strategies for KoToToMo+. Chapter 3 presents the conducted design phases and applied methods. The results of the study are presented in chapter 4, followed by conclusions and discussion in chapter 5.

1.1 Research questions

The first aim of this thesis is to illustrate a way of research towards design artifacts that can be used to generate more positive learning experiences in a mobile language learning application, KoToToMo+. The objective entails contextual, pedagogical and experiential aspects.

Contextual aspect aims to identify the learning patterns in the current version of KoToToMo+ and whether there have been noticeable learning patterns or issues in the application use. This is discussed in the section 2.1. Pedagogical aspect introduces instructional methods and motivational factors that contribute towards positive learning experiences. These are discussed in the sections 2.2 – 2.3. Finally, the experiential aspect discusses interactional aspects and mobile affordances in affecting users engaging with mobile applications and learning applications. These are discussed in the sections 2.4 – 2.6. Thus, the first research question is formulated as follows.

RQ 1: *How can experiential needs be used in a mobile language learning application to contribute to more positive learning experiences?*

- RQ 1.1: *What problems are related to the use of KoToToMo+ in learning the basics of Chinese?*
- RQ 1.2: *What pedagogical and motivational factors affect positive experiences in language learning contexts?*

- RQ 1.3: *What are the "experiential needs" affecting user retention in mobile learning applications?*

The second aim of this thesis is to see how the chosen methods supported the design of new application features that could afford motivational experiences and cultivate longer engagement.

RQ 2: *How did the selected method support the design of engaging new features for a mobile language learning app?*

The answer to this question requires evaluation of the method after it had been used in the design and demonstration phases of the prototypes. Essentially, this question means evaluating how well the method was able to produce relevant information to elevating student motivations for more frequent use of KoToToMo+. This is discussed in the chapter 5.

1.2 Scope

This thesis focuses on increasing motivation in mobile language learning systems. Answering the research questions, while including skill-based mobile learning applications other than language learning, would have been out of scope. The thesis also leaves the discussions about motivation gained from the physical classroom hours or from teacher to a lesser degree.

The study will exclusively focus on the students of beginner level Chinese, who have no prior knowledge of the Chinese language. As learning a foreign language requires years of practice and dedication, this thesis will not provide insight on how to attain fluency in a language but provide hints through motivational application features that could engage the students for a longer period of time to study. However, the focus is on increasing learning inside the frame of the course curriculum during one study semester. Investigating sustained application usage after the course is finished is not in the scope of this thesis.

The students only use smartphones for reviewing the learning materials. Thus, this thesis leaves out the discussion of motivational features in other mobile learning mediums, such as laptops, tablets or game consoles.

Outbreak of the COVID-19 pandemic in early 2020 set limits on interacting with actual students and users of KoToToMo+, limiting the possibilities to gather qualitative data. Given the force major, the goal of this research is to find proof-of-concept level results rather than statistical significance.

1.3 Research Approach

This research follows the nominal process of Design Science Research Method (DSRM). Design Science is a research paradigm where the knowledge of a certain problem domain, its contexts and solution, is accumulated in the design and application of an artifact. This artifact manifests in the form of a construct, a model, a method, or an instantiation, which is then used to solve the studied problem. (Hevner, et al., 2004)

The DSRM introduces a methodological framework for executing design science, illustrated in the figure 1.1. The methodology draws from prior research on conducting

design science, formalizing the means of conducting and evaluating design science research (Peffers, et al., 2007, p. 73).

The DSRM follows six distinct phases. The first phase is about identifying the research problem and arguing the value of solving it. The problem can arise from a theoretical or an applied background. In this thesis, the problem was presented by the Tohoku University Center for Data-driven Science and Artificial Intelligence. Next, objectives for the solution are drawn from the problem definition, which can be done through explicitly articulating the solution requirements. This is discussed in the literary review chapter and defined in the section 4.1. In the third phase, the clarified requirements can be used in conjunction with the existing theory to design an artifact. This is discussed in the section 4.2. Then, the artifact's ability to solve the problem is demonstrated in a suitable context, with knowledge of how to utilize the artifact – the results of the demonstration are presented in the section 4.3. In the last phase, the artifact is evaluated against the original solution objectives, and how well it supports solving the research problem. The results are communicated to the practitioners of the field, for example in the form of scholarly publications. In this thesis, the contribution is evaluated and discussed in chapter 5.

The DSRM method allows the researcher to start from any of the first four steps, depending on the case. For example, a possible entry point could start from the demonstration phase, where the researcher starts by seeing how an existing solution is used in its context, evaluates the solution and then iterates back to designing a better solution. Two types of contributions are defined as research outcomes from a DSR project: the knowledge contribution and the designed artifacts. (Hevner, et al., 2004)

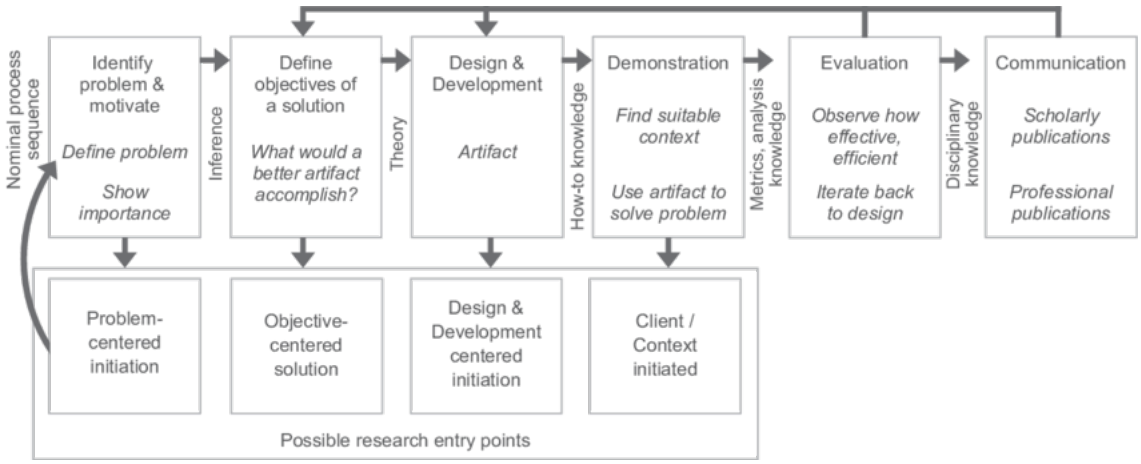

Figure 1.1: The Design Science Research Methodology (Peffers et al. 2007, p. 54).

2 Theoretical Constructs & Prior Studies

This chapter introduces the conceptual background for human motivation in learning and user experience considerations for m-learning apps. This requires a basic understanding of how school courses are designed, and how the emergence of mobile technologies have affected the way people acquire languages.

The later sections discuss the attributes that make digital products engaging to use, and how they can be used to build more engagement in language learning. The discussions include how game-like elements can be used as a leverage, giving examples from relevant studies.

The literature overview was used to gain a deeper understanding on the problems presented in the sub-questions 1.1, 1.2 and 1.3. Theoretical constructs are looked through the lens of language learning. Hence, the empirical part is not meant to answer how to design for motivational experiences in other skill-based learning contexts.

2.1 KoToToMo+

In the beginner level Chinese courses in Tohoku University, a mobile application, KoToToMo+, was developed as a review tool, used in between formal classroom lectures and bi-weekly quizzes. The application enables the students to study at any point in time and encourages repetitious language exercise. The application has been in use since 2017 and is constantly being developed and updated to meet students' learning needs. The application is available for public use and can be downloaded from the App Store or Google Play (Ohkawa, et al., 2018).

This section discusses how KoToToMo+ is used and what feedback the application has received, based on the interviews with the language teacher, KoToToMo+ project owner, as well as student survey data and statistics from 2018 semester.

Figure 2.1: KoToToMo+ – a mobile language learning application for studying Chinese

The learning activities include listening practices with multiple choice questions, sentence compositions tasks and pronunciation tasks where the students record their own speech while watching short videos. The user interface will also provide encouraging feedback upon successful task completion. The completed tasks can be retried as many times as the student wants.

KoToToMo+ was built for the purpose of enabling intermittent learning, by allowing learning contents to be studied in small portions throughout the day, independent of time and place. This way, the application enables the students to make use of the gap time between the formal classroom tuition and quizzes. To support this, KoToToMo+ enables users to check the course progress, see a visualization of one's own learning status per chapter and question, and immediately resume from previously studied chapter when opening the app.

Statistics of KoToToMo+ use are gathered in a web service, "Visualizer", which was specifically developed for administrative use, allowing the language teacher to track learning patterns and behaviors. Visualizer gathers individual user data and displays student statistics, such as number of repetitions, time used to task, inactivity, etc. (Ohkawa, et al., 2018)

2.1.1 Users

Tohoku University has eight basic level Chinese courses, with a total of 30-40 attending Japanese students. The students are mostly freshmen, taking the course as a second foreign language. Most of the students reside close to the campus area, but a considerable amount commute from longer distances. The students come from various backgrounds, including engineering, education, law, economics and science. All of the students who have attended the Chinese classes have had smartphones, meaning that they have been able to use KoToToMo+. It may be assumed that the students are savvy in terms of mobile device use.

Students using KoToToMo+ can be roughly separated in to two groups: those who study only once a week and those who study more than once. According to the 2018 statistics, the vast majority of the students conduct chapter exercises only once per week, with only 9% percent of the students practicing one or more times a week (Ohkawa, et al., 2018). These two groups could have differences in motivation in terms of repetition learning. However, it is possible that some students might possess some prior knowledge and feel they do not need to practice more than once.

2.1.2 Context: The Blended Learning Environment

The basic level Chinese courses make use of blended learning, in which mobile educational materials are used to complement the physical classroom hours. The gap time between classes and quizzes are allocated for self-studying. The blended learning model format follows three distinct phases, rotating in two weeks cycles in which one chapter from the book is covered.

Figure 2.2: 3-phase language learning method used in a blended learning environment for basic level Chinese

In the first step of the model, students participate in the physical classroom instruction hours, during which new chapters and contents are presented by the teacher.

In the second step, the students use KoToToMo+ in their own time for practicing pronunciation, listening and sentence composition that are based on the previous classroom materials. Students are required to complete the tasks in the application at least once.

The third and last step is the bi-weekly quiz, which is conducted in the classroom. The teacher then gives individual feedback after the quiz and the cycle is then repeated. However, the students are able study any chapter in KoToToMo+, regardless of the class progress.

2.1.3 Use Cases

Use cases in KoToToMo+ center around pronunciation, listening and sentence composition activities. The students are also able to check their learning progress in each respective chapter. In pronunciation tasks, the students first watch short videos of Chinese conversations, and then use the smartphone mic to record their speech. In listening practices, the students first listen to audio clips and select an appropriate answer from the multiple-choice list. In the sentence composition tasks, the students form Chinese sentences by dragging and dropping individual words in place.

There are certain preconditions before interacting with the learning materials. Many students only study in their home or in the campus area, usually right before the bi-weekly quiz. Students rarely study while commuting; possible reason could be that practicing pronunciation in public places (e.g., bus, train stations) is considered inappropriate.

Progress of one's studies and class progress are indicated in two ways: general completion percentage of chapters and number of repetitions in single tasks. Students can confirm their learning progress of each respective chapter and individual task through progress bars, indicating the completion rate.

When the student completes a learning task successfully, the task is then checked out as *"clear"* in the UI. The yellow progress bar for the task then advances. For every five repetitions exercised, the color turns into a darker shade of yellow, indicating a degree of strength in memory. The color turns back to a lighter yellow if the student has not practiced the task for a while. The class progress is indicated by the number of students undertaking a particular chapter. This enables the student to see what others are currently studying, thus building the tension to catch up (Ohkawa, et al., 2018).

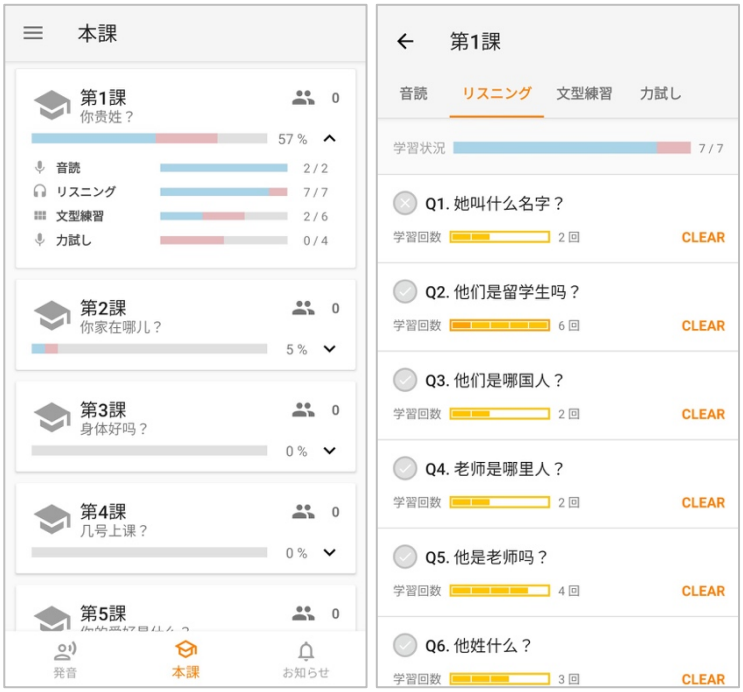

Figure 2.3: Tracking the progress. Left image indicates chapter progress and whether the answers are correct or incorrect. Right image shows the progress bar that demonstrates the memory strength of a single task.

2.1.4 Current Feedback & Learning Patterns

Questionnaire data and user web analytics data collected from the 2018 spring semester showed that the application was generally well received but learning durations and retention over a longer period of time could not be confirmed (Ohkawa, et al., 2018). There are some distinctive learning patterns and reoccurring student feedback that give an indication of varying motivation levels.

With the recent updates in the user interface, students can track their study progress within the application. However, students report being uncertain about how much repetition is enough to notice the increase in language proficiency or to do well in the quizzes. Consequently, many students undertake the tasks only once, since one time is mandatory.

Students also tend to postpone their learning, with the majority of the students procrastinating and studying the assigned chapter usually right before the classroom hours; this shows as a peak in the Visualizer's analytics data, which tracks student interaction activities throughout the week.

In addition, the results of the survey confirmed that the application could be further improved and enhanced, as some of the students expressed their wishes for getting notifications of current week's homework and reminders to do reviews, in order to not miss the deadlines. Comments such as *"The panda character in the app is cute"* hints that students were delighted by the user interface aesthetics.

These results inform about some issues in the overall learning experience, but not necessarily in the learning materials provided by the application itself.

2.2 Designing Instruction for Language Learning

To understand how and why KoToToMo+ was developed, it is important to have a basic level knowledge of instructional design fundamentals, and how digitalization has shaped this field over the years. In this section, instructional design and the affordances of mobile technologies in pedagogical solutions are the subject of discourse.

2.2.1 Principles of Instructional Design

Instructional design is the process by which learning products, both digital and physical, are systematically designed, developed, and delivered to provide engaging experiences in acquiring knowledge. Instructional design is based upon principles of how humans learn, specifically the conditions under which learning occurs. Gagné (2004) defines instruction as a set of teaching events that are embedded in purposeful activities that facilitate the processes of learning. Some of these events are commonly thought out to be external conditions to the learner, embodied in the display of printed papers, lectures, or group activities. However, learners' internal mental states, like directing attention, rehearsal, reflection, and monitoring progression have a major impact on the learning outcome. Therefore, the purpose of instruction is to arrange these external events in a manner that supports internal mental states, facilitating the process of transforming information to its way to long-term memory.

Gagné defines nine distinctive events of instruction, based on the internal and external cognitive factors contributing to learning. These events include examples that are typical in language learning classrooms.

1. *Gaining attention.* An effective way to gain student attention is to start the lesson with a thought-provoking question, interesting fact, or visual stimulus. Dörnyei (1994) suggests avoiding language lessons to settle into too regular or routine activities by introducing unexpected, novel, unfamiliar events, and breaking up the static environment by switching seating formations and making students get up and move.
2. *Inform about the learning objectives.* This means clearly stating the goals of a given course. Students have to know why they must actively participate in the activities. The objectives have to be clear and tied to real-world applications and benefits. An example in language learning would be that students will acquire knowledge of specific grammatical rules that provide a basis for more advanced conversations (Ellis, 2015).
3. *Stimulate recall of prior knowledge.* Recalling and applying previously acquired knowledge plays an important role in transferring it to long-term memory. In classroom activities, the students should know what skills and knowledge they will be applying and how the subject is connected to the information already in their knowledge base.
4. *Presenting the stimulus.* Each learning activity, exercise, and piece of content should tie in directly to the specific learning goals and objectives. The task-based structure of a language course directs the focus on one core objective at a time, allowing the students to master them individually before moving onto the next (Ellis, 2015).

5. *Providing guidance*. Teacher's mentoring and guidance are important in order to prevent students from committing incorrect information to their memory and becoming discouraged or frustrated with their learning efforts. Appropriate coaching directs towards desired learning behavior.
6. *Eliciting performance.* Students should be given opportunities to demonstrate they have acquired new knowledge. Teachers can elicit this by helping students to participate in activities that are beyond their current level of language proficiency (Ellis, 2015).
7. *Providing feedback*. By giving the students personalized and corrective feedback, they have increased the ability in identifying their strengths and weaknesses (Ellis, 2015).
8. *Assessing performance*. Assessment of student performance should be done early and often, not only to gauge their progress but identify knowledge gaps and weak points in the instructional design implementation. In language learning classrooms, this is often done with proximal goals, such as quizzes and examinations (Dörnyei, 1994).
9. *Enhancing retention and transfer*. Students must be aware of how they can apply the knowledge in real-world scenarios. In addition to learning semantic meanings of words and sentence structures, a crucial aspect to language learning is pragmatic meaning (e.g., contextualized meanings that arise in acts of communication), which requires the students to view the foreign language as a tool for communicating and to operate as a communicator (Ellis, 2015).

2.2.2 Language Learning in the Digital Era

Information and communication technologies have transformed organizations and redefined the knowledge and skills required by society to succeed, even shaping how foreign languages are taught and learned in schools (Gagné, et al., 2004). This subsequent development also introduced a concept of computer-assisted language learning (CALL), which is the search for and study of applications of computers in language teaching and learning (Levy, 1997, p. 1). Originally, CALL reflected a field that was based on programmed instruction and behaviorist premises on language learning, i.e., drill-and-practice type of tasks conducted on desktop computers. With the internet becoming an indispensable medium of information delivery, CALL grew to include online blogs, use of apps, virtual learning environments among others (Jarvis & Achilleos, 2013). Contemporary learning environments are incorporating these types of online tools as a natural part of the course curriculum. Instructional designers not only have to consider how the students are learning the language but consider the interaction between the learner and the technology through which they are learning (Stockwell, 2012, p. 6).

Online tools and electric learning (e-learning) environments have created opportunities for distance learning, which can be defined as the technological separation of teacher and the learner, freeing the student from the necessity of traveling to a fixed place, at a fixed time, to meet a fixed person, in order to be trained (Valentine, 2002). When the distance between the teacher and learner increases, designing effective instructional solutions require more intentional approaches to teaching than just remotely delivering course contents, as the teacher is not readily available to provide support and motivation. (Piña, 2018).

Given the fast internet connectivity and mobility of modern devices, learners are no longer constantly tied to their desktops or laptops to tune in for learning but are more frequently turning to use mobile devices for support (Kukulska-Hulme, 2009). As with

many past technological innovations, instructional designers have adopted mobile technologies within their learning solutions, giving birth to such terms as *"m-learning"*. There is no agreed definition of m-learning, partly because of the rapid evolution of the field, as well as the ambiguity of the word *"mobile";* it is unclear, whether mobile relates to mobile technologies or the general notion of learner mobility. m-learning can be seen as a way to augment learner's knowledge, behaviors, or skills while maintaining the mobility of the learner independent of time, location, and space (Haag & Berking, 2014).

The widespread availability and use of mobile devices in education eventually led to the acronym mobile assisted language learning (MALL). MALL differs from computer-assisted language learning in how mobile learning is conceptualized in terms of learner's experiences, highlighting such attributes as device ownership, informality, movement, and context that will always be inaccessible to *"traditional"* distance learning methods (e.g., accessing and interacting with course materials through a computer). Described in this way, m-learning seems to belong more to learners than it does to teachers, although most learners struggle without a teacher's direction and guidance (Kukulska-Hulme, 2009). New types of learning habits have a direct impact on questions of instructional design and learner autonomy; how to design software to support its appropriate use in a context, where the ability of the learner to use learning materials is removed from sustained contact with the teacher? (Stockwell, 2012, p. 31)

From a pedagogical perspective, m-learning can be described as the strategies, practices, and styles of instructions that facilitate learning outside of formal tuition. The impact of tablets and smartphones has shifted the focus from planned instruction to performance support, which is a discipline harnessing this informal way of learning and making it intentional. Performance support can be additional information or refresher knowledge on a topic, delivered to the learner just-in-time and on-demand (Haag & Berking, 2014).

2.2.3 Affordances and challenges of mobile learning

To decide what type of mobile technologies to use in education, instructional designers should first identify the issues in learning and then investigate mobile devices systematically, pointing to specific device capabilities and affordances. In the field of human-computer interaction (HCI), affordance indicates the easy discoverability of perceived action possibilities (Norman, 2013, p. 18). As the affordances can be based on the combination of both hardware and software capabilities, many features and qualities are unique to smartphones and tablets. For example, camera, GPS, and internet connectivity can afford to augment reality by overlaying still imagery, audio, or video over real-world objects in support of a learning activity. Touch screens, calendars, and push notifications affords reminding – they can be used as event triggers and alerts that elicit immediate responses to engage with a learning activity. (Haag & Berking, 2014)

These on-demand and contextual affordances have introduced a *"microlearning"* approach to skill-based learning, which mainly involves engaging in small learning units and short-term-focused activities (Hug, 2005) – similar to how learning materials are presented in KoToToMo+. Microlearning materials are typically chunked into bite-sized contents, that can consist of short videos, podcasts, or flashcards. Small learning units provide a narrow enough focus that does not require excessive effort or time to consume. In addition, the content is also easily and immediately accessible. (Tipton, 2020)

Given this "just-in-time" nature, m-learning has also proved to be ideal to implement mechanisms for spaced learning, or "spaced repetition systems" (SRS). Spaced learning is a learning technique that makes use of increasing intervals of time between subsequent reviews of previously learned material (e.g., flashcards). Existing mobile applications,

such as Anki, often utilize spacing algorithms; every time a question is answered, the user tells the program how well they were able to remember the answer – whether they forgot it completely, made a small mistake, remembered easily, etc. The program algorithm uses this feedback to decide the optimal time to show the question again. This spacing is effective both on the level of the initial content presentation as well as a refresher or reminder training and has been proven to be efficient especially in foreign language vocabulary acquisition. (Haag & Berking, 2014)

Simultaneously, students who engage with mobile learning apps, findings suggest that the level of engagement is mainly superficial or casual (Ushioda, 2013). Many practitioners also believe that short-focused tasks that require explicit target language knowledge do not support efficient development of target language proficiency (Loewen, et al., 2019). This might reflect the affordances of mobile devices as pedagogical tools, given the possibility to practice bite-sized learning content while on the move and the difficulty of using small screens. No matter what the inherent motivating properties and affordances of mobile technologies or apps for language learning might be, what matters is the motivation that students bring to mobile language learning, and how this can be meaningfully supported and facilitated (Ushioda, 2013).

2.3 Understanding the motivation to learn

Motivation to learn is a complex phenomenon involving various sources and conditions. Motivation is generally defined as that which explains the direction and magnitude of a certain behavior, i.e., what goals people choose to pursue or avoid and how actively or intensively they are pursued (Keller, 2010, p. 24)

For language learning, motivation can be viewed as the students' goal orientation towards acquiring a second (or third) foreign language (Dörnyei, 1994). Motivation is one of the main determinants for success in foreign language learning (Ellis, 2015). Much of the motivational sources are specific to a context, meaning that they are rooted in the student's immediate learning environment (e.g., how engaging the teacher is), whereas some other sources might originate from a succession of the student's past experiences in the social world (Dörnyei & Clement, 2001). This chapter presents key concepts and constructs related to motivation, tied into the language learning contexts.

2.3.1 Self-Determination Theory

Self-determination theory (SDT) is an empirical approach to investigating human motivation and growth and asserts that individuals have an innate drive for learning. The theory focuses on different orientations of motivations and contends that intrinsic motivation leads to well-being, enhanced performance and engagement (Ryan & Deci, 2000). In the context of language learning, intrinsic motivation is associated with higher target language performance and proficiency, as well as intercultural competence (Davis & Bowles, 2018). These attributes are the byproduct of basic psychological need satisfactions: these are autonomy, competence, and relatedness (Ryan & Deci, 2000). SDT asserts that if these universal needs are fulfilled, people will function and grow optimally, including in other fields than language learning. For people to make their inherent potential reality, the social environment has to nurture these needs. The needs are described below.

- *Autonomy* refers to the experience of behavior as deliberate and self-endorsed; students are autonomous when they voluntarily dedicate time and energy to their

studies. Autonomy is diminished when the individual feels their actions are controlled or limited, both through positive and negative control, such as extrinsic rewards or punishments.

- *Competence* refers to the experience of effectiveness, as a result of purposeful behavior. Students are competent when they feel capable in meeting the challenges of their schoolwork. Competence is diminished with negative, unconstructive feedback and inappropriate tasks, e.g., in terms of the level of difficulty.
- *Relatedness* refers to the universal want to interact, be connected to others, and experience a sense of belonging. In the classroom, relatedness is deeply associated with a feeling of being respected and valued by the teacher and peers. Negligence or disconnection from others can diminish the relatedness. (Niemiec & Ryan, 2009)

When language teachers structure their teaching to target intrinsic motivation, they are adjusting the teaching to include more target language communication, free expression, authentic language experiences, as well as various perceptions and beliefs. Enhanced student engagement and positive learning outcomes are the result of fostering these basic psychological needs, e.g., in the form of student choice and freedom of expression, constructive teacher feedback, meaningful communication, and the application of culturally relevant pedagogy. (Davis & Bowles, 2018)

2.3.2 Qualities of Motivation

Learners might have various reasons for studying a language, which consequently manifest as a range of different motivations. Individuals who are motivated intrinsically will perform an activity in the absence of external pressures simply because the activity is inherently satisfying, interesting, and fun to do. Intrinsically motivating activities seem to be more desirable in terms of long-term learning, instead of short-term motivation driven by extrinsic rewards. (Ryan & Deci, 2000)

One of the key concepts in SDT is goal internalization, a process where learners actively integrate extrinsic, or externally motivated goals and behavior into intrinsic, or internally motivated goals and behavior. This internalization process is described in Organismic Integration Theory (OIT), which is a mini theory contained within the SDT. OIT has seen use in second foreign language learning to understand reasons and motivations why students choose to study a language (Noels, et al., 2000).

According to the OIT, extrinsic motivation varies depending on how value of a learning activity is *internalized* and *integrated*. Internalization is about the degree of value felt from conducting a learning activity. Integration describes the personal transformation process from external regulation to one's own self-regulated version. As an example, homework and quizzes are externally regulated activities. Internalization occurs if the student sees the value and importance of doing the homework and practicing for the quizzes. Integration in this case is the degree to which the student perceives performing these tasks as their own choice. (Ryan & Deci, 2000)

The spectrum of motivation described in OIT spans from amotivation to controlled motivations and finally autonomous motivation. *Amotivation* describes an impersonal orientation to learning a language, indicated by the belief that the time and effort required to achieve proficiency is too big. Next on the spectrum are the two types of controlled motivation, which require external rewards and greater intervention from outside (e.g., from teachers, parents) in order to maintain. One of these motivations, *external regulation*, is indicated by a belief that the student has no personal choices to make and has to comply

with external demands; examples include merely fulfilling curricular requirements by seeking out a passing grade, or the fear of teachers getting angry if the students do not speak out in the class. Students with *introjected regulation* perform in their language class out of ego threat. Examples include fear of failure to achieve, desire to enhance one's self-esteem by showing off, or a desire to please parents, teachers or peers. (McEown & Oga-Baldwin, 2019)

Motivations that require less external effort to maintain are autonomous. One of the autonomous motivations are characterized as *identified regulation*, which occurs when the students recognize the value of language learning, adopting it as a personal goal, e.g., in enhancing one's career (van Roy & Zaman, 2017). *Integrated regulation* is seen where students have started to internalize positive attitudes towards the learning tasks, integrating them into their conception of oneself. However, the activity is still not performed for the activity itself, but because of the desirability of the outcomes (van Roy & Zaman, 2017). *Intrinsic regulation* is a representation of fully intrinsic motivations, where students experience interest, joy and purpose while learning a language (McEown & Oga-Baldwin, 2019). This can include interests in delving deep into grammar rules and understanding how the language developed over the years (van Roy & Zaman, 2017).

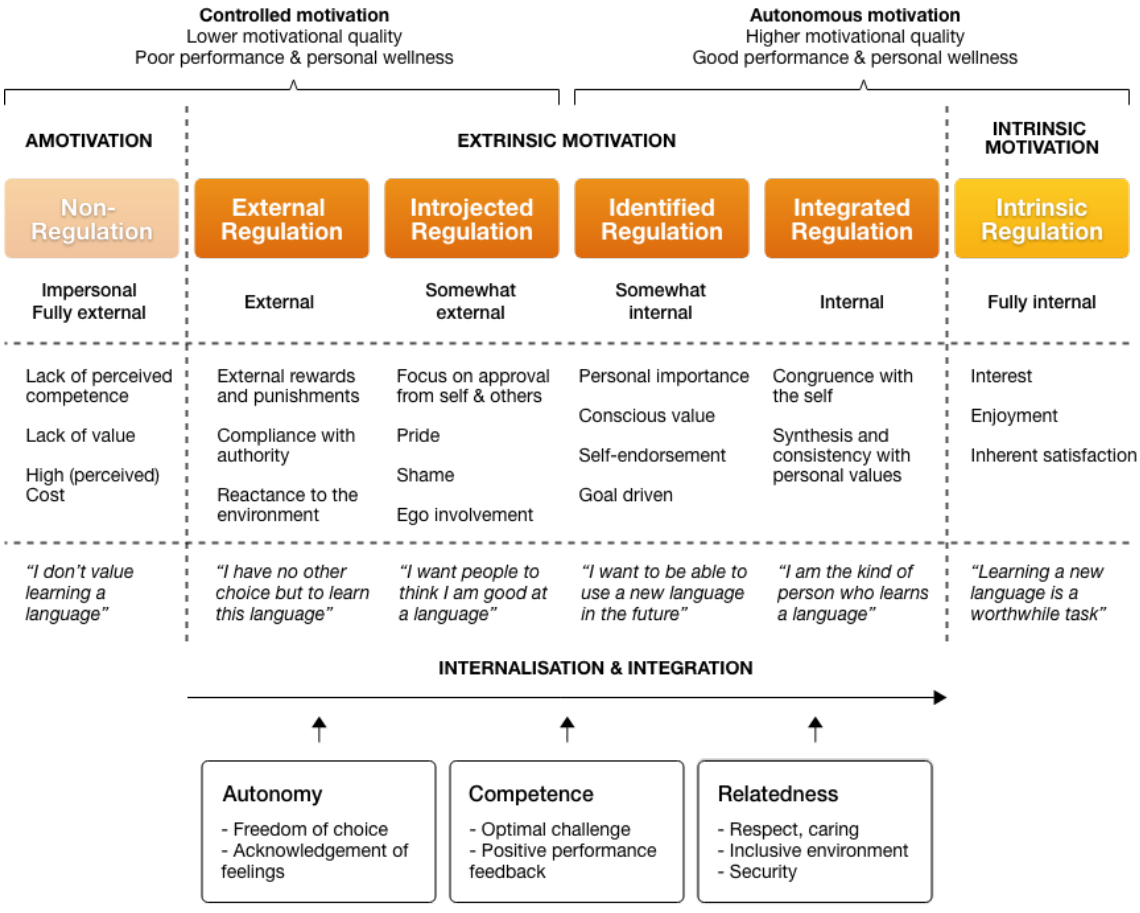

Figure 2.4: The organismic integration continuum of motivation regulation. Quotes of the language learning attitudes were adopted from McEown & Oga-Baldwin (2019)

The regulations differ in many ways, but they are not unconnected. Students may act for a variety of reasons, meaning that the motivation is simultaneously autonomous and controlled in varying degrees.

OIT offers a wide perspective on different extrinsic motivations. It describes the potential of internalization and integration processes resulting in autonomous choice of performing an activity for its intrinsic joy and value. Compared to motivation controlled purely by extrinsic rewards, autonomous motivation is considered higher quality in terms of achievement and well-being, involving deeper engagement with the learning materials. (McEown & Oga-Baldwin, 2019). Although intrinsic motivation is key in long-term and sustained learning, extrinsic rewards can still be used to support the internalization process if these rewards are used to inform competence, rather than trying to control a certain behavior. For example, communicating a message of a job well done, the teacher's purpose is to satisfy students' sense of competence, enhancing the intrinsic motivations (Reeve, 2006, p. 652; Dörnyei, 1994).

In mobile language learning, many learners have found frequent exposure to the target language important. Such exposure can itself prove to be intrinsically motivating, when instilled with the feeling that one is actually learning and making progress, regardless of the levels of cognitive engagement. What seems important is the extent of which mobile technologies can engage learners' feelings and emotions in a positive way, regardless of whether the engagement is deep or casual. (Ushioda, 2013)

2.3.3 Self-Regulated Learning

Intrinsic motivation is associated with self-initiated and self-directed learning, which are core to what is called self-regulated learning. Motivation and goal internalization are required for successful learning, but they alone are not sufficient to sustain long-term learning; motivation must be coupled to a set of self-initiated and self-regulated process skills. (Vanasupa, et al., 2010)

Self-regulated learning theory addresses the development of these skills. These are illustrated in a model proposed by Zimmerman and Campillo (2003), who introduced a cyclical model of self-regulation processes. The continuous feedback cycle consists of three phases: planning phase, performance phase, and evaluation / self-reflection phase. Within each phase, students can apply different strategies and effectively use feedback to improve their performance.

In the planning phase, students set achievable learning goals and strategies to pursue them, as well as assess their own beliefs of their efficacy and expected learning outcomes. In the performance phase, the student implements the strategies to make adjustments to their learning approaches via self-monitoring and self-control. Self-control process includes time management, help seeking and self-instruction. This process is paired with self-monitoring, which is metacognitive observation and recording of an individual's own learning. Self-monitoring provides feedback for the self-control process, enabling the student to re-develop or modify their learning strategies. In the last phase, self-reflection, students evaluate the effectiveness of their learning strategies and examine their satisfaction on the learning activities. Feedback from this phase contributes to the next self-regulated learning cycle. (Zimmerman & Campillo, 2003)

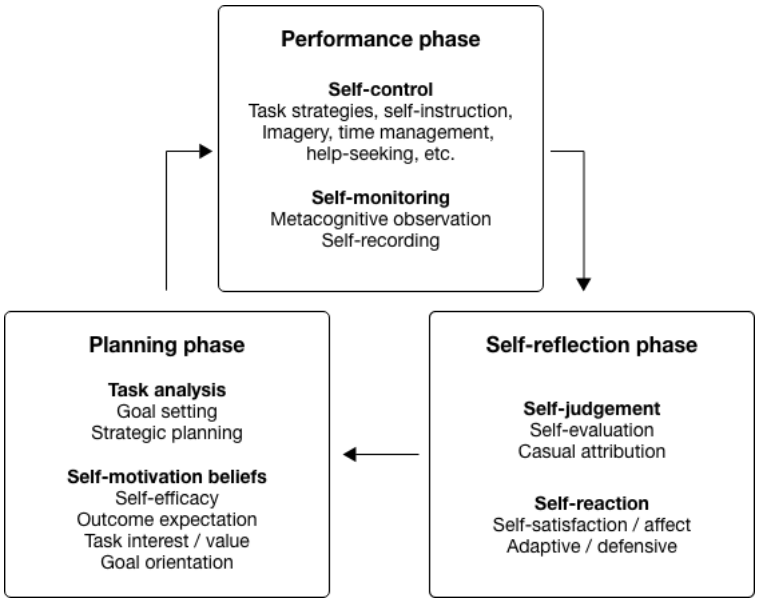

Figure 2.5: Zimmerman and Campillo's three cyclical phases of self-regulation.

It could be argued that learning environments that meet students' basic psychological needs also fosters an individual's capacity to realize and alter their behavior around learning through initiating, monitoring, controlling and evaluating their learning – in other words, self-regulate (Vanasupa, et al., 2010).

2.3.4 Motivational Design Framework - The ARCS Model

Instructional design mainly focuses on identifying learning requirements and strategies for designing learning environments, but less on how to design for students' motivation in a systematic and well-reasoned way (Keller, 2010, p. 31). For this reason, Keller developed a motivational design framework, "ARCS", to complement instructional design on how to motivate learners in completing the courses. Motivational design can be perceived as a subset of instructional and learning environment design (Keller, 2010, p. 24).

The objective of ARCS is to make theory and research of the field of motivation more easily applied to actual instruction. The model is a synthesis of propositions and guidelines from various motivational theories (including SDT), which are clustered into four components: attention, relevance, confidence and satisfaction. Each of the categories imply certain process questions that an instructional designer might ask in attending to the problem of student motivation. (Keller, 2010, pp. 61-62)

The ARCS model is not a conceptual theory of motivation, but a collection of practical strategies that build upon prior theoretical work (Dostert & Müller, 2020). In KoToToMo+ the user interface navigation, task formats and order of the learning materials have been developed according to the ARCS model. Thus, the components of the model deserve a brief introduction and how they were used in KoToToMo+ in the attempt of making the learning activities more appealing and engaging. Descriptions for each component are described below.

- *Attention* component is about managing and directing the students' attentive focus throughout the instruction. This is done by creating curiosity through stimulation of perceptual arousal, for example showing emotionally engaging videos. Curiosity is increased through inquiry arousal, by asking the students questions and

providing thinking challenges. The student focus is maintained through unexpected events or variability in presentation styles (Keller, 2010, pp. 64-66). In KoToToMo+, attention is managed by making the students move between cycles of passive and active elements, e.g., watching short videos, which are then followed by practice activities, such as pronunciation tasks.

- *Relevance* is based on personal meaningfulness and considers how the learning material relates to the student's life; how to bridge the gap between learning contents and the real world. KoToToMo+ aims to facilitate this through connecting the tasks to the textbook materials. In a general sense, relevance refers to things that are perceived as instrumental in meeting needs, personal desires and goals – this said, relevance can come from the way something is taught, not necessarily from the content itself (Keller, 2010, pp. 66-68). One of the reasons for developing KoToToMo+ was the interest in using well-available tools (smartphones) and familiar media formats (e.g., short videos), enabling the students to review the classroom materials "on the go" and dictate when to learn.
- *Confidence* focuses on developing expectations for success among the students, which allows them to take control of their learning process (Keller, 2010, pp. 68-70). Knowing the expectations and growth in skills correlates with the students' feeling of competence (Ryan & Deci, 2010). KoToToMo+ allows for small steps of growth during the learning process by chunking the learning materials into short segments for better comprehension. Corrective feedback comes in the form of popups that are displayed right after the student submits an answer, telling the student whether the answer was correct or not.
- *Satisfaction*. Learning should feel rewarding or fulfilling to the students for what they achieved during the learning process (Keller, 2010, p. 70). Satisfying or positive consequences of instruction can result from both extrinsic and intrinsic matters (Ryan & Deci, 2010). These could come from for example finishing a course, receiving a certificate, working with other people or being stimulated by feelings of challenge and accomplishment. This creates continuance to learning and positive recommendations of the course to others (Keller, 2010, p. 71). In KoToToMo+, satisfaction manifests in visual elements signaling completion; the student can see a *"Clear"* tag next to the completed chapters, as well as the number of conducted repetitions per individual task.

Adaptations of the ARCS strategies have been successfully used in many computer-based and online instruction settings for elevating student engagement and motivations (Keller & Li, 2018). However, given the nature of MALL, it is undeniably more challenging to intentionally design for motivation; managing and directing student attention can be more difficult in situations, where learning is spontaneous and informal, i.e., not bound to formal classrooms. As discussed in the section 2.1.3, students using KoToToMo+ were generally pleased with the ease of use and the visuals, but they tend to procrastinate and rarely engage with the application more than the required bare minimum.

Despite the practical strategies described in the ARCS model, it is possible that the model does not give enough focus for the instructional designer to understand the complex needs that the mobile interaction entails. For example, feelings of fun, device "coolness", control over goals and ownership (in terms of integrating new technology to daily activities) have an effect on user motivation and consequently to retention rates (Jones, et al., 2006). Efficient m-learning solutions can facilitate these experiences by accounting practice to mastery and performance support into the design, while focusing on how mobile technology can add the most value to the particular learning context (Haag & Berking, 2014). The experience of using the application requires further investigation.

2.4 User Experience Design

User experience (UX) design can be defined as the process used to craft products that provide meaningful and relevant experiences to an individual user. This involves the design of the entire process of acquiring and integrating the product to one's daily life; aspects of branding, functionality and usability have to be carefully considered. For this purpose, the field of UX design brings together strategy, user research, cognitive science and visual design (Interaction Design Foundation, n.d.). UX design is the industry practice and application of Human-Computer Interaction (HCI) theories. While the intended outcomes of goals and scope can differ, research in both the academia (HCI) and industry (UX) deal with fundamentally similar objects; the understanding and design of interactive digital systems and their human users (Reeves, 2014). In order to discuss the methods used in the discipline, the term "UX" needs to be described.

In the design of interactive systems, UX is often associated with pragmatic aspects, such as usability assessments of user interfaces, i.e., how easy they are to use. Highly usable interfaces are defined by their learnability, efficiency, memorability, tolerance for errors made by the users, as well as satisfaction gained from the interaction (Nielsen, 2012). Since the early 2000's, emotional responses have garnered an interest in contemporary user interface design; the interest arose within designers and researchers, who started to shift their focus from developing desktop tools for professionals to new interaction environments, where discretionary users and non-professionals became more dominant (Shneiderman, 2004). Usability is only a quality attribute of a user interface. UX is a broader concept and covers factors beyond just usability (Nielsen & Norman, 2006). Such factors include delightfulness, which refers to the positive emotional affect when a user interface delivers pleasurable experiences on top of usability, reliability and functionality (Fessenden, 2017).

Emotional responses have been acknowledged in the many definitions of UX. For example, Alben defines UX as the entire experience in using a particular product or an interactive application; how it feels in the users' hands, how well the users understand how the product works, including how they feel when they are using it (1996). ISO 9241-210 (2010) defines UX as the human perceptions and responses that result from the use or anticipated use of a product, system or service. Nielsen Norman Group (2006) gives a more macro-level description of UX, considering it as all of the aspects of the end-user's interaction with the company and its respective services and products. Hassenzahl and Tractinsky (2006) present three perspectives in understanding user needs associated with modern interactive devices and interfaces:

- *Beyond instrumental* quality attributes aim to grasp and describe users' needs to achieve their behavioral goals addressing also the hedonic aspects (stimulation, identification, evocation) that the product or service fulfils.
- *Emotion and affect* deals with the users' internal states as a result of the interaction with a product. Preventing frustration and dissatisfaction has always been a core objective in HCI - what is new in UX research is a focus on positive emotional outcomes such as joy, fun and pride.
- *The experiential* perspective interrelates and interacts with emphasizes the situatedness and temporality of technology use and considers the users' unique and complex experiences as a whole, extending over time with a definitive beginning and end.

While it is not possible to guarantee a specific experience to each individual, it is possible to design *for* the experience; come up with a design that can positively influence personal

and unique experiences (Hassenzahl & Tractinsky, 2006). This requires thorough understanding of user expectations, needs and behaviors through systematic and investigative approaches, executed in an iterative manner. Much of UX design is about practicing empathy, in order to support the process of understanding how people perform tasks and achieve goals that are important to them (Farrell, 2017).

2.4.1 User Experience of Learning Systems

Teachers and learners are increasingly reliant on digital tools to support learning, but they often fail to adopt the technology as originally intended. Usability is a critical aspect of any successful software system, as well as learning systems – teachers may be faced with challenges trying to determine how to assess student learning in their LMS, or they might spend time determining workarounds to administer lesson plans. Learners might experience difficulties in navigating the LMS, for example in finding homework details (Earnshaw, et al., 2018).

However, the development of digital learning solutions not only face challenges in usability, learning contents, and pedagogy, but overarching user experiences related to the interaction. As users' baseline expectations for digital experiences keep getting higher, user experiences of digital learning tools are becoming a more prevalent factor in maintaining learner engagement and motivation (Wilson, 2020). Hence, there has been a growing interest in understanding users' internal motivations to use interactive products (Tondello, 2016). Both instructional design and UX research place the user (or the learner) in the center of the focus when designing a solution. But not much has been said about how UX design can work together with instructional design to leverage the learning experience. Benefits of mobile learning in terms of ease of access and cost-effectiveness have been underlined, but further qualitative research should be conducted on content delivery, UX design, and defining interconnections between formal and informal learning settings. (Kapros & Koutsombogera, 2018, pp. 5-7).

As discussed, UX research has typically focused on the experience of an individual user, specifically on other aspects than learning, such as playfulness, and fun. Instructional designers should consider establishing these types of UX goals for their learning solutions, for the students to find them engaging (Haag & Berking, 2014). However, it should be noted that it is possible to perform tasks that evaluate the functional usability and enjoyability of an application without investigating its actual educational usefulness, i.e., did the students actually learn anything while enjoying the interaction experience (Kapros & Koutsombogera, 2018, p. 5). Although web and mobile interfaces mediate nearly all of the online learner's course experiences, UX research efforts in online learning contexts have typically lagged behind when compared to other types of interactive systems, such as e-commerce solutions. This might reflect the differences between the online learning systems and their non-academic counterparts; online learning has to attend to instructional approaches, learning outcomes, and order of content. Learning is in the heart of an online course, not user satisfaction (Reid, et al., 2016). While it would be important to establish UX goals, they should be conceptualized from an instructional design point of view (Earnshaw, et al., 2018). Relating to the Chinese courses at Tohoku University; how could KoToToMo+ inform about the learning objectives, present the stimulus and provide feedback in such a way that makes the students want to use the allocated self-study hours for learning with the application?

A big part of designing for positive learning experiences is about improving learning outcomes and the quality of the learning experience by supporting and enhancing cognitive and affective processes that learning involves (Peters, 2012). Cognitive processes in

learning include such mental efforts as attention, managing cognitive load, rehearsing new information in working memory, and retrieving new knowledge from long-term memory after the learning (Gagné, et al., 2004). Affective processes include all feelings and responses related to emotion-filled behavior, knowledge, or beliefs. Affect can alter perceptions of situations and the outcomes of the cognitive efforts (de Jong, et al., 2009, pp. 10-26).

In interactive system design, pragmatic qualities, such as the ease of use can be used to support the cognitive processes, as they help the users to attain particular goals in the system, thus enhancing productivity. Hedonic qualities, such as the attractiveness of the user interface, have implications towards affective processes, as users might experience pleasure and fun-in-doing (Shneiderman, 2004). In short, pragmatic systems are generally used for extrinsic purposes, e.g., completing a work task, whereas hedonic systems are associated with intrinsically motivated intentions, such as seeking joyful experiences and having fun (Zaharias & Chatzeparaskevaidou, 2013). As the user-product relationship evolves over time, these hedonic aspects of UX eventually seem to gain more weight over the pragmatic aspects (Kujala, et al., 2011).

Both pragmatic and hedonic aspects have become increasingly important in m-learning application acceptance, motivation, and long-term utilization. It seems feasible to investigate what are the most common characteristics in both learning and user interface design domains that satisfies learner's experiential needs.

Design for short term-goals

One of the design goals of educational software is to keep students engaged over the course of an academic year (Ritter, et al., 2018, p. 41). UX design has similar aims in maintaining user engagement, but the objectives are different from instructional design – one supports satisfaction from immediate interactions, the other highlights the satisfaction from long-term learning gains (Joyner, 2018, p. 82). Extrinsic rewards, such as communication of job well done, can be used to reinforce, stimulate, shape, and maintain a certain behavior, especially in drill and practice type of exercises (e.g., vocabulary repetition). However, Keller describes the challenge being that the school rarely provides resources for extrinsic rewards of any substantial value (2010, p. 71). In user interfaces, extrinsic rewards can provide moments of instant gratification for sticking with the system (Kipp, et al., 2018, p. 52). Mobile devices can afford the means to convey these moments e.g., via notifications, virtual rewards, progress bars, etc. (Haag & Berking, 2014)

Design for various forms of feedback

Feedback holds the same meaning in both user interface and instructional design domains, as it can be used to provide information on the outcome and correctness of an action (Joyner, 2018, p. 95). In user interfaces, feedback can be immediate, occurring right where and when the action occurs, or it can be actionable, informing about the degree of success in completing a task (Deterding, 2015). In learning contexts, the feedback should be non-controlling and informative, in order to induce the learner a sense of competence (Reeve, 2006, p. 652). As an example, the learning experience in an educational software designed for dyslexic children was positively influenced by a feedback mechanism that explained the reasons for students' errors and "nudged" them towards the correct answer (Shneiderman & Plaisant, 2004, p. 33). However, to remain interesting and engaging in any interactive system, such as games or online shopping, good feedback should vary between actionable, informative, and "juicy". The latter has been described to be continuous and bountiful, making the interaction feel alive – almost as if the system reacts and

responds to everything the user does (Gray, et al., 2005). In interactive systems, juiciness can be injected by enhancing the small steps of action through exaggerated auditory and visual effects. This type of feedback can make the user feel powerful and in control, while also instilling a sense of curiosity and surprise (Deterding, 2015). Juice is not essential for the gameplay, but it might be essential for the game's success. A good example is the immensely popular puzzle game *Candy Crush Saga*, which showers the player with lots of cascading audio and visual feedback when they successfully match sweets in a group of three or more.

Design for ease of use

Good interactive systems are defined by their usability, which is supported by such factors as graphical consistency (e.g., in colors, icons, menu hierarchies), informative feedback and error handling (Shneiderman & Plaisant, 2004, p. 74). Animation and motion can be helpful in providing subtle feedback, navigation metaphors and to signal a state-change (Laubheimer, 2020). Such systems can attract user attention and reduce the cognitive load on the user while they are performing tasks. Instant feedback and seamless interaction give the feeling of effectiveness and control (Szalma, 2014) and also contribute to the fun-in-doing (Shneiderman, 2004). From an educational perspective, the user interface should lessen the attention paid by the students to course administration or deadlines, in order to increase and maintain attention to the course contents and learning (Joyner, 2018, p. 92). It seems that usability can support both cognitive and affective processes of learning by reducing cognitive load, capturing and maintaining the student's attention to course contents, as well as preventing frustration from undermining the pleasant interaction experiences (Shneiderman, 2004).

Design fun & compelling features

In games, fun experiences during interaction lead to attentive absorption and emotional investment (Deterding, 2015). This is true for learning as well; affective processes, such as the feeling of fun and enjoyment, are important in influencing student engagement and attitudes towards learning (de Jong, et al., 2009, p. 25). In day-to-day user interfaces, such as e-commerce websites, delightful experiences might surface from a quick and hassle-free shopping experience (Shneiderman, 2004). However, in repetition-heavy learning interfaces, where the same interaction tasks are often conducted over again, effective design is about reconstructing the experience around the learner (Haag & Berking, 2014). The tension is to keep the student from being cognitively burdened by the user interface while avoiding too repetitive interaction experiences that lead to disengagement (Ritter, et al., 2018, p. 41). In both motivational design and interface design, attention and cognition can be tied to the task through unexpected events, surprises when completing a task, alternating question formats, and visual variability (Deterding, 2015; Keller, 2010). However, the interface aesthetics (e.g., attractive graphics and animations) cannot distract the users from the task at hand (Shneiderman, 2004).

Design for user control

The attention for affect in modern learning environments is the result of several developments in education, one of them being the change from teacher-directed planned instruction to learner-centered approaches that embrace learners' initiative and informal means of learning. This involves giving more responsibility and control over the learning process to the learners (de Jong, et al., 2009, p. 25). Similar to user interface design, giving the

user the capability to control the settings and preferences is equally important. Just as wearing clothes is more than just staying warm, applications and interfaces are a personal statement (Shneiderman, 2004). By promoting personal choices and opportunities to represent one's own identity in the user interface, the sense of autonomy can be supported (Zhang, 2008). In its simplest form, this could be the ability to turn notifications on or off, set privacy controls, etc. (Szalma, 2014)

2.4.2 User-Centered Design Process & Methods

When educational technologies are custom designed for a particular audience, the end users must be a focal consideration in the development process, because the user is primarily in control of manipulating the application (Wilson, et al., 2018). As discussed, users of interactive systems and applications have complex and sometimes ambiguous needs – these can be tackled with user involvement and iterative design.

To solve complex issues, UX design includes a cyclical model of design and development, labelled as user-centered design (UCD) or human-centered design process. UCD places the user at the center of attention, where the design process becomes a dialogue between the designer and its users, with the end product acting as a mediator (Norman, 2013, p. 221). The four activities of user-centered design are defined as 1) understanding and specifying the context of use, 2) specifying the user requirements, 3) producing design solutions to meet the requirements, 4) evaluating the design against requirements. After the evaluation, the process allows iteration back to any previous phase, until the final design satisfies the user's needs. This cycle is illustrated in the figure 2.6.

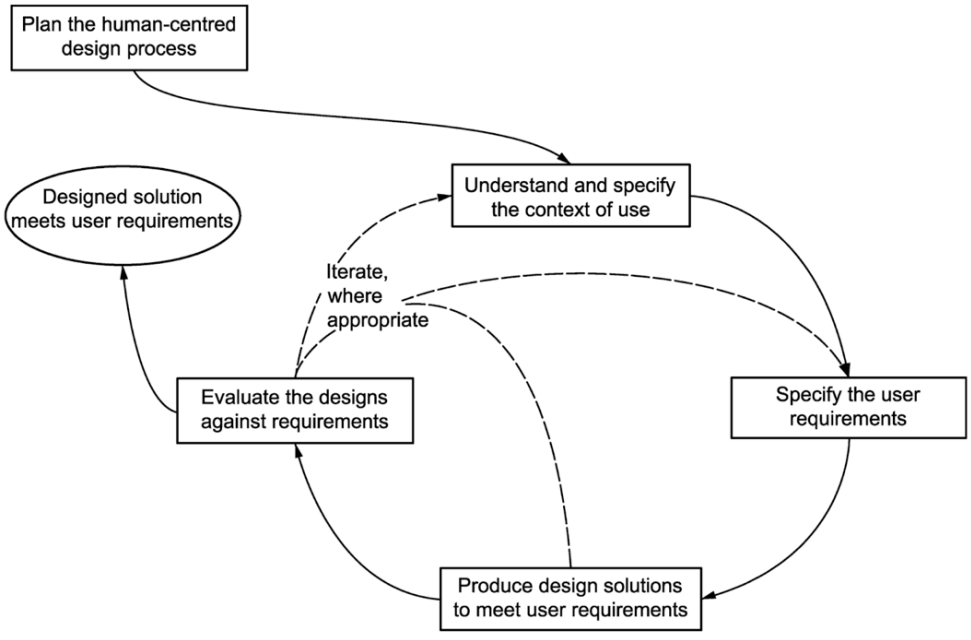

Figure 2.6: Human-centered design process (Finnish Standards Association SFS, 2010, p. 29)

UX designers typically make use of generative tools, such as interviews, surveys, ethnography, personas, and journey maps, which can be used in different phases. End result is an articulation of who the problem is being solved for, and in what contexts (Farrell, 2017).

Collecting data about the context of use can be done by using qualitative interviewing, where either groups or individuals are interviewed to gather information about their experiences. This type of data provides rich insight towards end user's issues but analyzing the data can be laborious (DiCicco-Bloom & Crabtree, 2006). Data collection can also be quantitative, for example in the form of questionnaires. Questionnaires can be used to gather user data on a larger scale in a short amount of time, but reliability and validity of the data is not as high as in qualitative methods (Boynton & Greenhalgh, 2004).

Specifying user requirements requires analyzing the gathered data and organizing it into a set of requirements. This can be done through affinity diagramming, which refers to organizing related facts extracted from the data into distinct clusters (Pernice, 2018). Categorizations may include visual representations of contexts, roles, physical environments, and action sequences (Holtzblatt & Beyer, 1993).

Producing design solutions to meet the user requirements is usually conducted in some form of user interface prototyping. This can include a set of paper drafts, that are refined based on user feedback. It is also possible to experiment with wireframes, which are visual representations of interface structures – these are of higher fidelity than paper prototypes but lack the functionality and visual elements of more advanced prototypes (Earnshaw, et al., 2018). Another possibility is to use software tools to develop high fidelity prototypes, such as clickable mockups. They can provide more authentic interaction experiences for the test participants – this enables the designer to pinpoint a specific component to test, for example focusing on the flow of an activity or ease of navigation (Coyette, et al., 2007).

Evaluation of the designs against the user requirements usually includes a usability testing phase. Usability testing is an act where *"representative users attempt representative tasks in representative environments"*, using anything from paper prototypes to implemented software (Lazar, et al., 2010, p. 263). Usability can be evaluated in the form of expert-based testing, automation or user-based testing. Expert-based means enlisting a usability expert to conduct e.g., a heuristic evaluation against a set of predefined design principles. Automated testing makes use of software to compare the target user interface against a set of usability guidelines. User-based testing can include asking the user to complete a task and prompting them to think aloud during the interaction - meanwhile the researcher observes the user and the interaction process. The results of usability tests are analyzed in order to find out which features of the prototype and its interface still need to be iterated (Lazar, et al., 2010, pp. 267-273).

It is worthy of noting that the possible methods that can be used in the different phases of user-centered design are not inferior or superior to one other - they can always be tailored to fit into a given situation or context. The field also has other research approaches that are closely related to user-centered design, for example action research and cooperative design (Sanders & Stappers, 2008). The lines between these fields are sometimes indistinguishable and the perceived differences are often semantic.

2.5 Games & Gamification in Education

Positive interaction and learning experiences can be often found in games, which are purposefully built to optimally afford motivation and enjoyment, whereas most contemporary education is not (Deterding, 2015). The notion of games in education was briefly noted when examining the characteristics of motivational learning and interface design in the section 2.4.1.

Learning often takes place intuitively and spontaneously while playing. Learning might not always be the main intention when interacting with a game, but the result of

engaging in repetition, trial and error, and overcoming challenges (Rega, 2015). Hence, many interactive learning systems have sought out gamification to be the possible solution to target the dropping levels of motivation observed in learners (van Roy & Zaman, 2017).

Gamification is concerned with the transfer of game design elements in other contexts than games (Deterding, 2015). Gamification aims to keep the end users engaged with the products, as well as motivated to perform and maintain certain behaviors. Consequently, gamification has been particularly useful in marketing (Zichermann & Cunningham, 2011), having found applications in such domains as health and wellbeing, eco-friendliness and education (Deterding, 2011).

There are plenty of frameworks, interface patterns and models attempting to formalize the elements of gamification. One of them is the MDA model, which categorizes gamification elements to mechanics, dynamics and aesthetics. *Mechanics* are the rules and levers of the gamified environment, which represent the processes that stimulate the engagement of participants. These can be point accumulation, badges, levels and leaderboards. *Dynamics* are the interactions that participants have with these mechanics, for example in the form of competition, self-expression or achievement. *Aesthetics* represent the experiences and how the participants feel during these interactions, such as pleasure or connection (Zichermann & Cunningham, 2011).

In interactive educational systems, the transfer of game design elements attempts to exploit the motivational power of videogames to promote participation, persistence and achievements (Richter, et al., 2015, p. 23). These game elements aim to provide positive feedback, with the mechanics typically manifesting in the form of points, badges, etc. However, gamification should not be about transforming routine activities into a game through predetermined interaction patterns, but to redesign the work processes with game mechanisms for a more fun and enjoyable experience (Deterding, 2015). Just by adding game elements as external regulations will likely cause detrimental effects on learners' intrinsic motivation. It becomes critical for the designers to understand how and under which conditions gamification can work. (van Roy & Zaman, 2017). In schools, the feedback regarding success is traditionally given to the learners in the form of quiz and exam grades. Gamification can change this by chunking the long-term goal of success into many smaller objectives, allowing students to focus on the next step and get immediate and granular feedback as they complete individual activities (Dichev, et al., 2015).

It is easy to notice, how many concepts in gamification research are tangential and complementary to some of the guidelines and constructs in instructional design. However, gamification is a relatively new concept that has not yet been examined and implemented to the same extent as the ARCS model (Dostert & Müller, 2020). This is not to say that these paradigms cannot coexist. Learning solutions based on the ARCS model can contain gamification strategies in interest development and improving engagement (Thurston, 2018). In this sense, the ARCS model could be considered as an overarching layer of understanding motivational issues, whereas gamification strategies can be used to create interactional level motivational pull. Despite the rising popularity of gamification for educational purposes, there is still little evidence about its pedagogical effectiveness (van Roy & Zaman, 2017).

2.5.1 Gameful Design

Many of the existing gamification frameworks appeal to motivational psychology and highlight its importance in the design process. However, the same frameworks and methods often lack the scientific consensus and granularity, as they put little focus on formative research and iterative prototyping, as well as advocate the use of predetermined design patterns, such as points, badges and leaderboards, which are often disconnected from users' personal goals (Deterding, 2011). Many designers have tried to distance themselves from negative connotations associated with gamification and talk about *gameful design* instead of gamification. Gameful design is about integrating gamefulness into the activity; it is about intentionally designing for game-like experiences from the bottom up, by using game design thinking, rather than concentrating on external game mechanics. For this purpose, Deterding (2015) introduced a method for gameful design through the *lens of intrinsic skill atoms*.

Grounded on game design and SDT, the method aims to mimic the way games motivate people through elements that meet their basic psychological needs (autonomy, competence, relatedness) in a non-game system. In skill-based activities, such as playing video games or language learning, gameful design should primarily target user's the feeling of competence. Gameful design embraces the hedonic qualities of interaction that are characteristic to the contemporary definitions of UX, and includes *curiosity*, *arousal* and *attentive focus* into the constituents of intrinsically motivating experiences for gameplay (Deterding, 2015). These needs more or less correspond to the *Attention* component of the ARCS model, where the student curiosities are stimulated through perceptual and inquiry arousal and maintained through variability of the learning content (Keller, 2010, p. 110). Gameful design should not make the interaction experience any more difficult than it already is but provide skill-based challenges that are inherent to the activity, repackage and present them in an interesting and motivating way. Gameful design in a learning context should identify what are the skills or information to be taught and then design appropriate challenges and game mechanics around them. The method builds on to the concepts of intrinsic integration, skill atoms and design lenses. (Deterding, 2015)

Intrinsic integration means that the learning materials are embodied in the system as fun gameplay, supported by the fulfillment of the basic psychological needs. Overcoming a challenge in a game requires and supports acquiring new concepts and skills to be learned. This also makes pedagogical sense, as gameplay embodies exploration and scaffolded learning by doing. Gameful design should build on top of player goals that are inherent in the system. (Deterding, 2015)

Design lenses are a "*way of viewing the design*". The lenses are a set of cards, which practically combine a memorable name, a concise statement of a design principle and a set of focusing questions to allow the designer to take on a mental perspective, rather than use predefined guidelines or existing patterns to provide solutions. Design lenses have one or two main motives that they support, most of often competence. The lenses can be used to brainstorm new ideas around the existing game dynamics (Deterding, 2015). As an example, a design lens of juicy feedback targeting player competence and curiosities, is described in the figure 2.7.

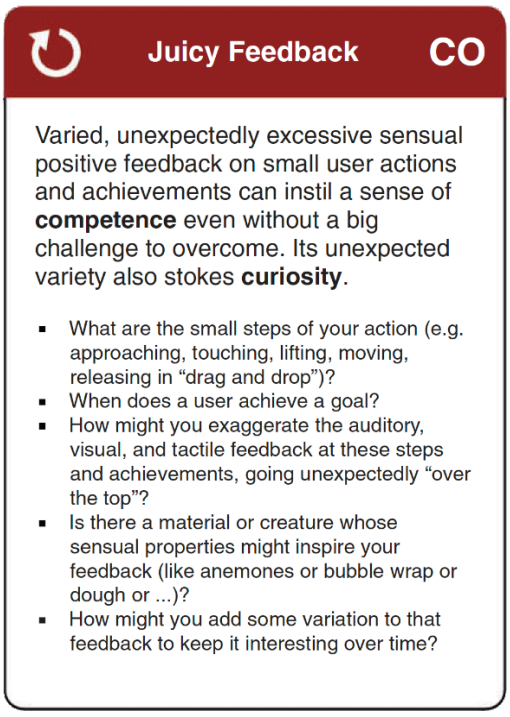

Figure 2.7: Example of a design lens (Deterding, 2015)

Skill atoms is a representation of a feedback loop in the system, based on the skill-based activities of an interactive game. The users take on an action, after which the game stimulates the chosen action, forming an input to the system's rule engine, eventually giving feedback to the user - the users then integrate this information to their mental models of the system. Through multiple run-throughs of this "atom", the user masters its skill; be it hand-eye coordination or understanding of rules. (Deterding, 2015)

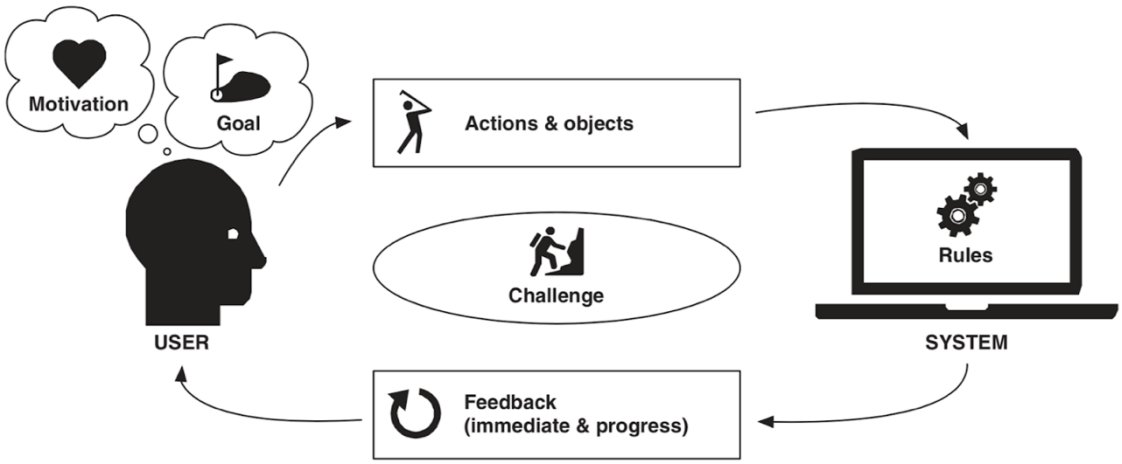

Figure 2.8: Schematics of a skill atom (Deterding, 2015)

To give an example from the sentence construction task from KoToToMo+: the user's *goal* is to get the sentence grammatically correct. The *action* is to drag the scattered words in place (*objects*), whereas the *rules* specify the correct order. The user gets *feedback* in the form of encouraging pop-up messages from the panda character. Now, looking through a juicy feedback lens; could the panda character react to user input in a more varying, unexpected or exaggerated way, for example depending on how much time was used to complete the task.

2.5.2 Existing Mobile Language Learning Applications

A handful of gamified language learning applications have seen success commercially and in educational settings. This section gives a brief overview of the gameful features of Duolingo, including an example of a study where a similar application was implemented specifically for a blended-learning class.

Duolingo

One of the most successful commercial language learning applications is Duolingo, which is a free language education platform accessible to any web-enabled device, most often used in mobile devices. With over 300 million users, it is one of the most popular m-learning apps for language learning, with a reasonable amount of academic research in investigating its motivational ability and educational effectiveness (Loewen, et al., 2019).

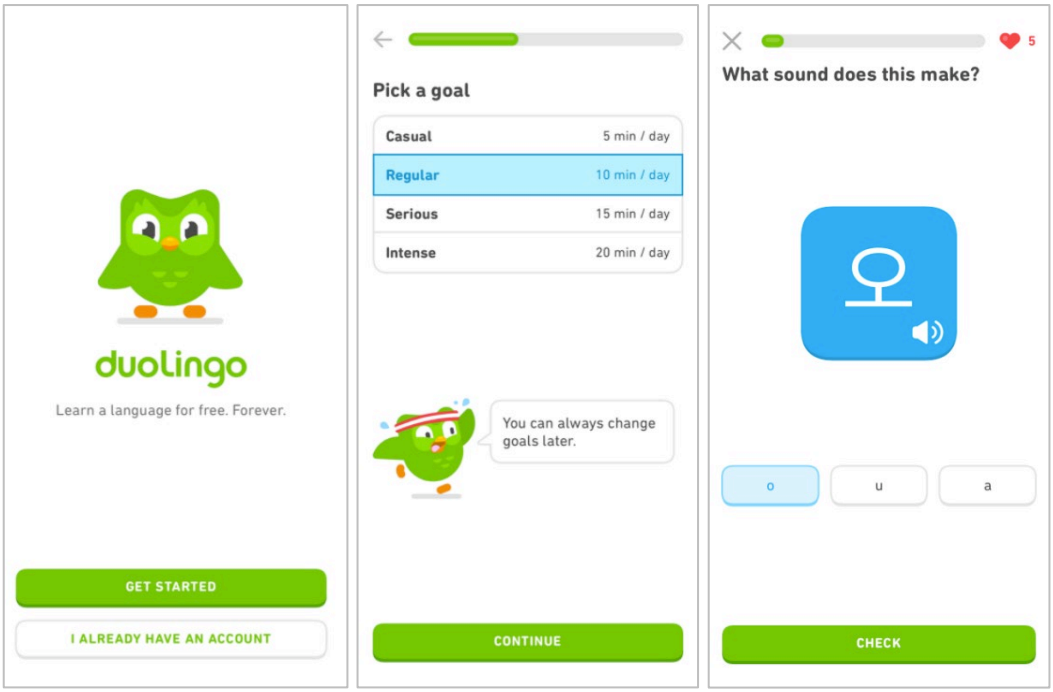

Figure 2.9: Duolingo makes use of gamification in many forms, such as affective visuals, personalization and engaging feedback loops. (Duolingo Inc)

When opening the application for the first time, the user is greeted by Duolingo's owl mascot, after which onboarding begins. During the onboarding, new users are asked to set a daily language learning goal, ranging from 5 to 20 minutes. Next, the user is asked about their motivation ("*Why are you learning a language?*").

Duolingo presents learning targets in skills, which are divided into bite-sized lessons (e.g., one lesson on phrases, two lessons on food). New sets of skills become available as previous skills are completed. Within a lesson, Duolingo employs several activity types, which mostly consist of vocabulary translations, multiple-choices and typing exercises. When conducting the tasks, the feedback primarily consists of displaying the correct answer, or indicating a "*correct / incorrect*" evaluation.

To make repetition more motivational, learners earn experience points (XP) when completing a lesson, as well as achievements, which are given out when a user completes a certain number of actions or a specific action. Reaching daily XP goals are rewarded with streaks, with the length of streaks indicating consecutive days of study. Maintaining

a streak or attaining achievements are rewarded with in-game currency, “lingots”. These lingots enable users to hold a streak or purchase in-game items for the owl mascot.

Duolingo also features social networking features, such as community discussion boards, where lingots can be used to reward other people. More competitively oriented social features allow the user to follow friends’ progress on a leaderboard and receive push messages when a friend has overtaken the position. (Loewen, et al., 2019)

A mobile application prototype for English classes

While commercial mobile gamified applications for language learning have been demonstrated to be successful in engaging students to study, knowledge about their use and suitability in a blended learning setting is scarce. Although Duolingo supports its use in schools, it has some pedagogical shortcomings, as it primarily relies on decontextualized grammar-translation exercises and drills (Loewen, et al., 2019). Additionally, the capabilities afforded to teachers are limited in freedom and flexibility in its functionalities.

There are a handful of other m-learning solutions that are handcrafted to suit specific classroom dynamics. Baldauf et al. (2017) developed a gamified m-learning prototype for English learning and tested it with 13-14-year-old German speaking students, in order to investigate the general requirements and acceptance of students and teachers. Like in the commercial products, such as Duolingo, the features in this prototype included word translations, as well as competitive and social features, e.g., 1-on-1 challenge mode, quick chat for sending emoji-based reactions to other students, experience points and leaderboards. The prototype was tested with 39 students during the course of one school semester. The results indicated improved engagement among the students with the language learning materials, who perceived the quick chat, challenges and rankings as fun and motivating.

To design and develop a mobile solution for blended learning settings, Baldauf et al. (2017) suggest using competitive approaches that exploit class community, quick communication among the students (instead of a normal chat functionality), mobile notifications of newly published content or reminders and ways of providing comprehensive feedback (e.g., showing sample sentences of using a word).

2.6 Synthesis: Motivational design strategies for KoToToMo+

The experiential needs affecting user retention in mobile applications seem to revolve around pragmatic and hedonic interaction qualities that bring about such feelings as delightfulness, control, fun, effectiveness, emotional engagement, etc. The same feelings correspond to the basic psychological need satisfactions that cultivate intrinsic motivations in educational settings. Intrinsic motivation is connected to improved learning outcomes, quality of the learning process, and the willingness to self-regulate (Vanasupa, et al., 2010). In other words, immediate need satisfactions and their derived benefits are the experiential outcomes of the interaction with educational technology (Szalma, 2014). For example, the experience of fun and efficiency might reflect the need for competence being satisfied.

To understand what makes m-learning motivating and engaging in a practical sense, common design characteristics affording for such experiences in both instructional design and user interface design were discussed in 2.4.2. Both domains appreciate short-term goals, getting various forms of feedback, interacting with easy-to-use and engaging interfaces, and the ability to be in control or customize one’s physical (or digital) environment.

As demonstrated in the section 2.5, similar characteristics can often be found in full-fledged games or gameful learning applications, which are purpose-built around users' experiential needs. Gameful systems can both directly support end-user activity in knowledge acquisition (by the ease of use) and facilitate this through enjoyment and motivation (van Roy & Zaman, 2017). These systems do this by tapping into the needs of competence, autonomy, relatedness, arousal, attentive focus and curiosity (Deterding, 2015). In the context of gamified learning:

- *Competence* refers to the feeling of one's growing ability to achieve the desired change, resulting from overcoming nontrivial challenges.
- *Autonomy* refers to the experience of acting with volition and willingness, in congruence with one's own goals, needs, values, and identity. Individuals feel autonomous when they have the freedom to choose what to learn, come up with their own solutions and freely express themselves.
- *Relatedness* is the desire to feel connected to others, for example through overcoming challenges collaboratively or through social competition.
- *Curiosity* and *arousal* are stoked by uncertain and unexpected outcomes of interactions and nontrivial challenges. Finding enjoyment in such challenges binds the *attentive focus* and cognition, freeing the player (or learner) from indulging in worries and frustrations of everyday life. (Deterding, 2015)

Similar to the ARCS model, gameful design conveys a sound method for restructuring a learning activity to afford intrinsic motivations. However, gameful design could offer the extra focus for the interface design process, as it examines different parts of the feedback loop between the user and the system through motivational design lenses. Hence, this thesis makes use of the basic psychological need satisfactions described by Deterding, in order to understand KoToToMo+' issues and to derive gameful design strategies. Concepts from Keller's ARCS model are also used to explain some of the identified motivational issues.

The following subsections describe the identified motivational problem categories in KoToToMo+ and how they relate to the need satisfactions. Then, design strategies that could alleviate these problems are discussed.

2.6.1 Category 1: Lack of Short-Term Accomplishment & Satisfaction

Regarding the students' concerns about the adequacy of repetition amounts, it is assumed that the students might be lacking a sense of short-term accomplishment and satisfaction. Although the number of conducted repetitions per task is made visible, it seems that this feature does not provide enough feedback that assesses the performance in a meaningful way. Tracking one's own progress without proper tools or educational feedback can feel discouraging.

This is an issue rooted in the feeling of competence; effectiveness and mastery are associated with empowerment and elevated confidence, which arises from overcoming challenges (Deterding, 2015). The core challenge in KoToToMo+ is mastering the previously studied concepts presented in the Chinese class, by doing repetitions in listening, reading, typing and speaking. The goal is to finish the chapter on time before the next classroom hours and quizzes.

The feedback in KoToToMo+ does little in informing about the current level of proficiency in Chinese. For example, every time the student answers a task correctly, they get

a pop-up message of *"Great work! You are doing a good job".* This type of feedback is severely limited in addressing motivational challenges regarding problems with confidence, perceived relevance, persistence, etc. (Keller, 2010, p. 313)

van Roy and Zaman (2017) suggest integrating feedback mechanisms that positively inform learners about their progress in gaining competencies. Detailed **self-monitoring** of study times and amounts could make repetitions in these activities feel more rewarding, feeding the users' sense of progression and willingness to maintain or alter the learning behavior. Self-monitoring is also a crucial strategy in regulating one's learning (Zimmerman & Campillo, 2003).

Feedback in the form of badges or learning summaries could be beneficial in informing about the progress and how successful the students were, as the language teacher is able to provide only limited amounts of individual feedback in the classroom. Through such rewards, it could be possible to provide competence informing, **actionable feedback** that supports intrinsic motivations (Reeve, 2006, p. 652). The students can then use this feedback to examine their satisfaction with their learning efforts (Zimmerman & Campillo, 2003). Virtual awards could also be used as clear checkpoints as victory conditions (Kipp, et al., 2018), thus providing **interim goals** that break down over-sized tasks and show the path to mastery (Deterding, 2015). It is important to note that expected and task-contingent extrinsic rewards (e.g., if you return your homework, you get a sticker) might undermine intrinsic motivation if they shift the learner's attention away from learning materials towards the awards themselves. (Reeve, 2006, p. 650).

Facilitation of **social interactions** is also recommended, for example in the form of competitive social features, as demonstrated by Baldauf et al. (2017). However, a competitive school environment may form a threat for bonding with peers, with some gamification practitioners stating that competing with others in learning-focused contexts might have negative effects on the learning results (Chou, 2015, p. 295)

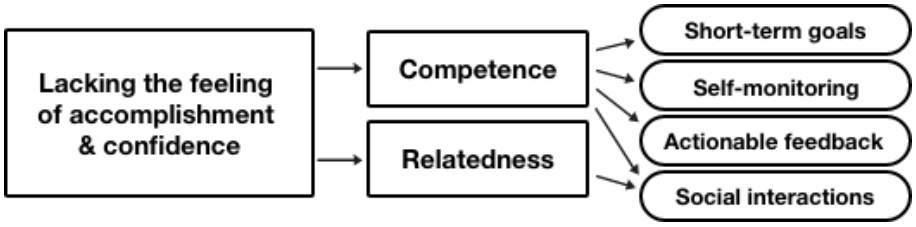

Figure 2.10: Design strategies identified with competence and relatedness

2.6.2 Category 2: Lack of Engagement & Intrinsic Interest

As the students using KoToToMo+ are required to complete the chapter tasks at least once, many of them tend to procrastinate until the day before the bi-weekly quiz. Lacking the engagement and intrinsic interest to start, the students might not have enough internally motivated reasons to voluntarily come back to the application.

Intrinsic interest is characterized as the interest generated from self-motivation while working on a task (Cheng & Poon, 2016). Badges and other means of acknowledgment might work for a while in keeping the interest, but when learning feels intrinsically motivating, students will engage in the activity even without extrinsic rewards. This requires a sense of autonomy; the freedom to choose when and what to study. Although students using KoToToMo+ can choose when to study, students only study the bare minimum the night before the quizzes.

Competence and autonomy can be enhanced by offering a choice in setting goals and procedures to achieve them (Szalma, 2014). Although van Roy and Zaman (2017) suggest avoiding obligatory uses in a gamified system, providing a moderate number of meaningful options that comply with the user's values can be beneficial. As demonstrated in the previous section 2.5, Duolingo gives the users a chance to set a daily goal during onboarding, allowing for customization around one's own learning preferences. A similar approach could be adopted in KoToToMo+ as well, although this should be integrated to the activity contexts, i.e., tailored to fit in how the application is used in the blended learning contexts (Baldauf, et al., 2017; van Roy & Zaman, 2017).

Another way to increase the intrinsic interest is to connect user desire with an e-learning service through showcasing learning benefits (Cheng & Poon, 2016). In motivational design terms, matching interests through role models and success stories builds relevance and thus, an interest to start and maintain learning (Keller, 2010, p. 148). For example, Duolingo claims that 34 hours of learning in the application corresponds to one semester of language studying in a university (Loewen, et al., 2019).

As KoToToMo+ is used as a preparation tool for the bi-weekly quizzes, the students could be given the option for **setting a learning goal** tied to a fixed time, as well as the ability to **customize** this goal later to suit new preferences. Defining one's own standards for success and motive matching (e.g., use of role models) builds relevance to one's studies (Keller, 2010, pp. 66-67). In the self-regulated learning cycle, this could influence the self-motivational beliefs in the planning phase (Zimmerman & Campillo, 2003). Setting goals in the onboarding phase also induces competence by creating a strong want in the user to start (Deterding, 2015).

Figure 2.11: Design strategies identified with autonomy and competence

2.6.3 Category 3: Wishes for New Features

The visuals of KoToToMo+ have received praise, with many students showing delighted reactions to the panda character. The same students also wish for additional features, such as getting reminders to study and seeing the weekly homework. This student feedback suggests hedonic and pragmatic feature needs. Pragmatic features, such as study reminders, would connect to personal development needs in learning, i.e., competence. Hedonic features connect to enjoyable and attractive interface elements that stoke curiosity and capture attention.

The occasional and static appearances of the panda character in the current user interface views of KoToToMo+ could be further enhanced to offer more dynamic visual experiences. Mascots have an affective quality and can create a sense of belonging to the course (Reid, et al., 2016). Such elements can instill curiosity, perceptual arousal, and maintain the focus of the learners (Deterding, 2015). However, these types of embellishments produce only surface-level delight, while more functional, reliable and usable features can deepen the delightfulness (Fessenden, 2017). Getting reminders could potentially fulfill the pragmatic student needs and potentially offload the attention students might spend thinking about course procedures and deadlines. Attention for **aesthetics** and

usability not only makes the interaction experience enjoyable but supports learner competence (Szalma, 2014). Stimulation of both attractiveness of the interface and personal development needs have been demonstrated to have a major impact on motivation to conduct learning (Zaharias & Chatzeparaskevaidou, 2013).

Varying feedback can also foster a sense of competence, but unexpected, juicy feedback could also stoke curiosity (Deterding, 2015). For example, push notifications with interesting and informative feedback about the learning progress could be used to capture students' attention, when they are not using the application. van Roy and Zarman (2017) recommends supporting individual characteristics, e.g., offering enough system flexibility to comply with personal needs and preferences, such as choosing what type of reminders to receive and when. **Customizing** one's own learning environment, i.e., configuring the interface, changing profile picture, receiving notifications could engage the emotional attachment by making the application feel one's own. Exploring and discovering these types of features within the application can evoke curiosity (Zhang, 2008).

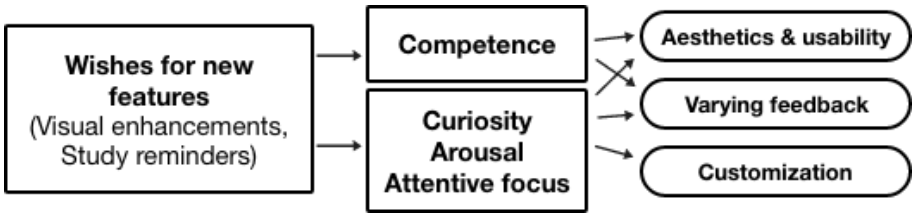

Figure 2.12: Design strategies identified with competence, attentive focus, arousal and curiosity

These charts succinctly describe how identified issues in KoToToMo+ could be investigated through specific design strategies. They provide the blueprint for inferring user requirements and brainstorming potential features. Many of the design strategies can be observed to be connected to competence – this is appropriate since competence should be prioritized in skill-based activities (Deterding, 2015).

It is possible that many of the presented design strategies relate to other problem categories as well. For example, social functions could fit into the category of *"wishes for new features",* but such wishes did not surface from the student questionnaire data or interviews.

3 Methods

This chapter introduces the methodology used in this study and how it was applied in each consecutive phase.

3.1 The Design Science Research Methodology Process

DSRM provides a systematic way for documenting the design of an artifact and new knowledge generated with the artifact. The method also provides a structured framing when creating and developing e-learning artifacts for research investigation (Östlund & Svensson, 2018).

From its roots, the DSRM methodology was mainly concerned with engineer-centered information systems research (Peffers, et al., 2007, p. 47), with little regards to the notion of user involvement (Haj-Bolouri, 2015). Studies have since highlighted usability and user experience to be given explicit consideration when designing any information-intensive system or service. Users should be involved throughout the whole design process, as this makes them more committed to the deployment of the artifact (Eteläaho, et al., 2015). Keeping users in the loop throughout the design process not only positions the user as a priority in the decision-making but can assist in building user acceptance and a sense of ownership with the new system (Wilson, et al., 2018). The feeling of ownership is especially important in the design of m-learning applications; the success of how well the technology integrates to the user's daily activities contributes to this feeling, motivating to continue to use the application (Jones, et al., 2006). Thus, user-centered design methods were applied throughout the nominal DSRM process sequence. However, the user involvement was heavily limited or not possible in every step due to the social distancing regulations.

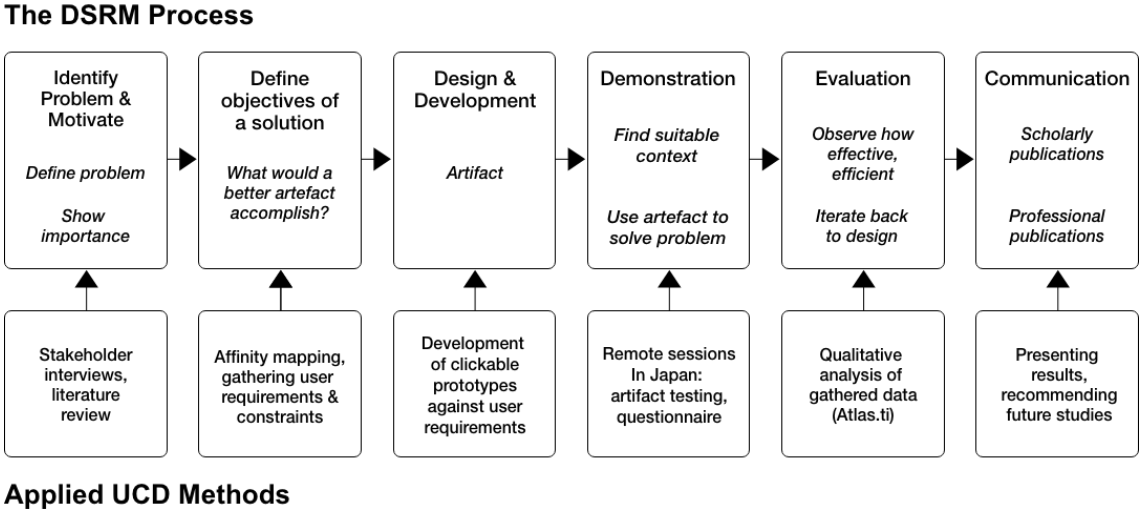

Figure 3.1: Conducted UCD activities in the DSRM process sequence

3.2 Problem Identification and Motivation

Starting from the problem identification and motivation phase, the problem context and importance was introduced in the section 2.1, which presented the motivational issues in conducting sustained, long-term language learning in KoToToMo+.

The section 2.1 is a result of prior questionnaire data investigation, as well as two semi-structured interviews that were conducted with the Chinese language teacher and the project owner of KoToToMo+ project. The focus of the interviews was related to classroom dynamics and technical aspects of the application. The method was chosen as it permits in-depth discussions on selected topics, while also allowing flexibility in additional questions whenever something unexpected or interesting surfaces during the talks (DiCicco-Bloom & Crabtree, 2006).

The interviewees were both Japanese speaking citizens working in Tohoku University. The product owner, Takashi Mitsuishi, was also the thesis advisor. The interviews lasted both 30 minutes, during which notes were taken in a laptop. The interview structures can be seen in the Appendix A and B. The broader problem context, motivational factors in learning and user experience concerns in m-learning, were then studied in the literature review (sections 2.2-2.5).

3.3 Definition of Solution Objectives

Second phase of the DSRM process sequence consists of defining the solution objectives. Findings from the stakeholder interviews and the student survey data from 2018 were analyzed, color-coded in post-it notes and grouped into an affinity map in order to find patterns and identify themes.

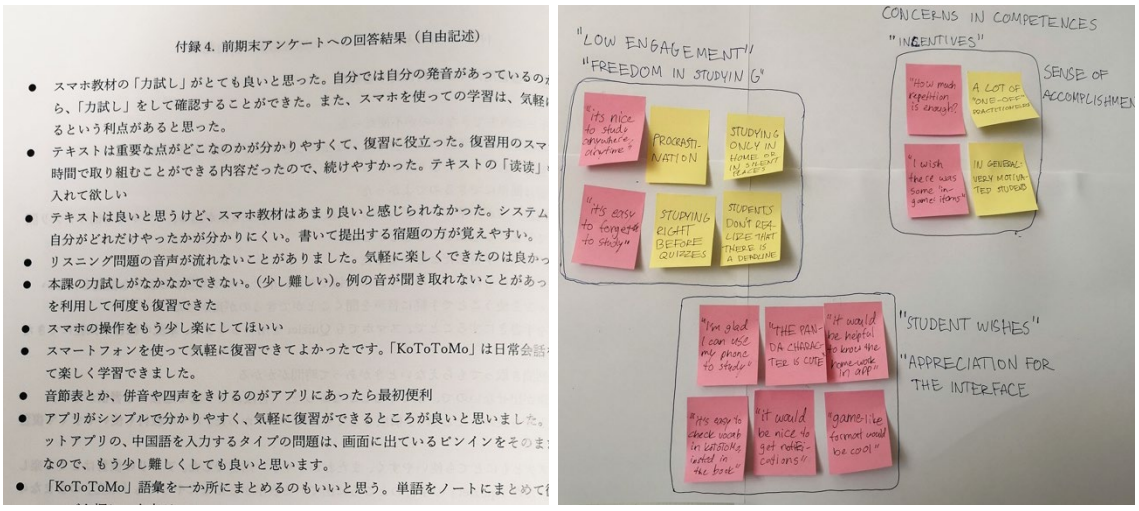

Figure 3.2: Questionnaire data (left image) and interview data findings clustered into groups in the affinity diagram (right image). Pink post-it notes contain student quotes. Yellow post-it notes describe stakeholder interview statements.

From the affinity map, three problem categories were determined and presented in the section 2.6. The literature findings were used to explain the theoretical reasons behind each category. The categories were used to devise initial user requirements, presented in 4.1. The initial user requirements were then used to frame the design decisions, in order to guide the development of the prototypes.

3.4 Design and Development

The third phase, design, and development, consisted of artifact construction in the form of interactive prototypes, as a means of producing design solutions against user requirements.

The presented features have been designed with Adobe XD as a set of interactive, user interface prototypes, which were used to form initial user reactions and opinions about the proposed motivational features. These prototypes were designed to afford enough interactivity to feel familiar to the test participants, in order to enable them to behave naturally during the test. Interactive XD mockups were chosen for numerous reasons; 1) they enable the possibility to pinpoint a specific component to test and allow detailed user feedback 2) they are more presentable to other stakeholders, as they communicate the idea more clearly and can be used to set expectations for developers 3) they enable user testing from multiple devices and browsers.

Due to the social distancing limitations, evaluating preliminary wireframes with the students was not possible. For this reason, semi-functional, clickable mockups were seen as the best option to implement under the compromised circumstances.

The created prototypes are described in detail in the section 4.2. In short, the prototypes consisted of four interface features, where the participants get to experience push notifications, setting a bi-weekly learning goal, tracking the learning progress in "My page" and investigating the achieved rewards and milestones.

3.5 Demonstration

The demonstration phase consists of evaluative activities with the target users. In this study, the interactive prototypes were used for a user testing session with 10 volunteered students. Due to social distancing restrictions, a series of moderated remote testing sessions were conducted. The interaction with the prototypes was paired with a questionnaire, which was used to collect the user reactions and responses. A total of five separate remote testing sessions were held during the week; each day, two students would participate in a Zoom-meeting, where the facilitator (assistant professor Yuichi Ohkawa) would brief them and provide assistance.

3.5.1 User Testing & Questionnaire Setup

The questionnaire items aim to elicit initial reactions and opinions to a specific motivational feature, which can be connected to a specific need satisfaction. The questions need to be understandable from a student perspective; when students are intrinsically motivated, they do not usually say *"I feel autonomous",* but instead *"that was interesting"* or *"I like this"* (Reeve, 2006, p. 651). The experience that is regarded as interesting or delightful is theoretically one of the presented basic psychological need satisfactions (Ryan & Deci, 2000). One issue with such comments is that enjoyable parts of an interaction are not always vocalized, when the interface works as intended. Consequently, it can be difficult to quantify and study what was the factor that made the experience delightful (Fessenden, 2017). For this reason, the prototype features are chunked into different sections, in order to see which student reactions are associated with a particular feature.

Questionnaire structure

The composition of the questionnaire items consists of Likert scale questions, sentence completions, and free comment sections. The questionnaire was implemented with Google Forms, as it allows implementing various forms of question types and easy editing.

The 5-point Likert scale questions have declarative statements, such as *"I did not find the rewards (badges) important"*, provided with an ordered continuum of response categories between *"disagree"* and *"agree"*. The declarative statements clearly express positive or negative opinions, in order to solicit definitive responses. Likert scales are used to conduct needs assessments to gain quantitative data about participants' attitudes and beliefs about a particular topic (Boynton & Greenhalgh, 2004). However, in this study, statistical analysis is not possible, so ratings are used to support the more qualitative participant statements, in a way showing the weight of the written responses.

Thus, open-ended items were also used to give the participants a chance to elaborate on their responses. This allows the possibility to identify new issues that cannot be captured in the Likert scale questions (Boynton & Greenhalgh, 2004).

In the sentence completion, the participants are given a set of sentences, which they fill out according to their personal opinions. The beginnings of the sentences are meant to trigger the participants to think about the experiential aspects of the application use. Sentence completions can be used to assess motivations or attitudes a bit more in-depth, possibly also providing a degree of insight to conditions for long-term, sustained usage (Kujala, et al., 2014).

The Google Forms questionnaire was split up into five different sections, separated by themes: 1) introduction, 2) experience of push notifications 3) experience of setting learning goals 4) experience of the extrinsic rewards 5) general impressions. In the sections dedicated to the motivational features, the participants access the clickable prototypes through a URL, provided at the top of each section page. The users are then provided an instruction screen, after which they interact with the prototype in their desired way. If the participants reach the end of the interaction, they are presented with a message telling them to return to the Google Forms questionnaire.

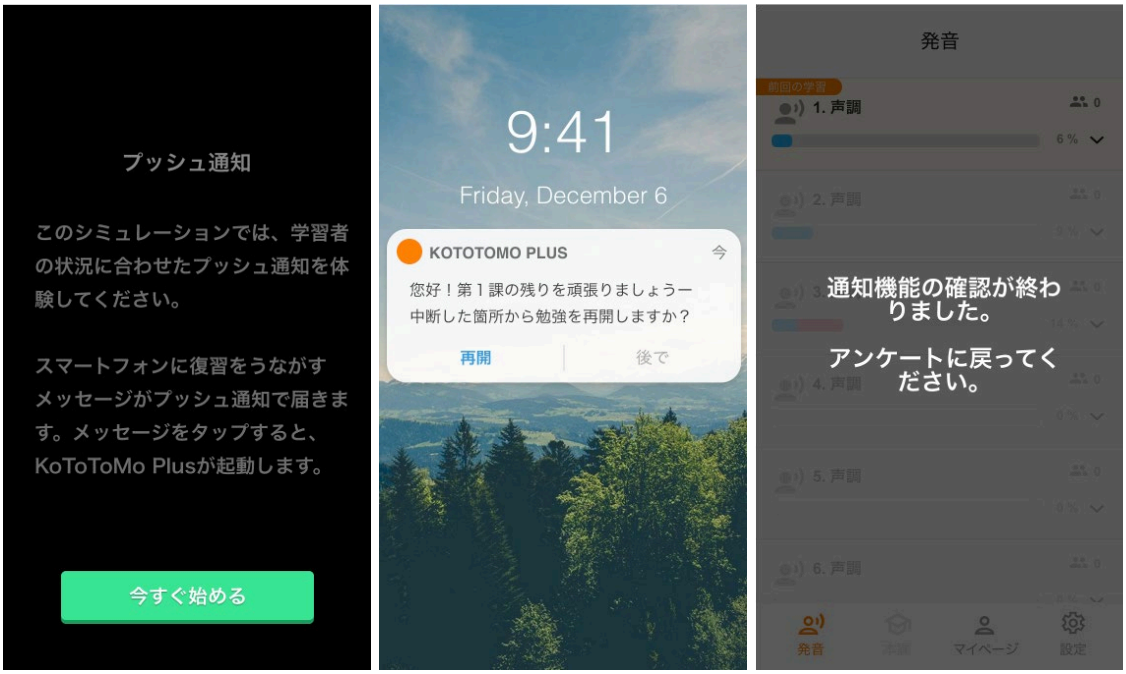

Figure 3.3: Guided interaction: the push notification feature asks the participant to continue studying a chapter. From the notification box, participants are able to choose between "study now" or "study later".

Back in the questionnaire, the participants will then assess their experience with the feature, by rating it according to the provided statement. The participants are able to provide freeform feedback to a proposed motivational feature between each section.

Figure 3.4: Assessing the experience in Google Forms

The sections have the same structure for each motivational feature. The results of the user testing are discussed in the section 4.3.

Sections & questions

In the introduction section, the participants are provided with a set of options, which are descriptions of reasons why they chose to study Chinese, for example, *"I want to use Chinese for travel and work in the future."* These descriptions are based on the OIT motivational spectrum and are used to assess participants' current level of motivation. The main reason for asking the motivation is to later compare the answer with the rest of the answers given in later sections, i.e., whether intrinsically or extrinsically motivated students have specific answer tendencies or feature preferences. It should be noted that this assessment is tentative; determining the student's actual motivational orientation is arguably more complex than merely assessing checkbox items. The participant selects the most appropriate description and then moves to the next section.

The Likert-scale questions in the push notification section weigh the participant opinion on two implementation ideas; would push notifications be appropriate in reminding students to study before the next class, and would they feel accomplished in receiving weekly learning summaries and motivational messages. The participants also have the option to elaborate on how these push notifications could affect their motivation to open the application and start learning.

Similarly, in the next section, the Likert-scale questions in the "My page" section prompt the participant's opinions on how they feel about seeing learning statistics in a visual form, and whether it is important to set a learning goal for the next two weeks or not. The participants then give the option to give free form feedback.

Section with the badges, milestones, and study calendar continues from the last section. The Likert scale on the study calendar feature prompts the participants' opinions on how they feel about visual representations of the consecutive days learned. Questions for

badges and milestones ask whether receiving awards makes the participant feel like they are progressing, or do they matter at all.

The last section is about the general look and feel of the new user interface, asking whether the proposed features deliver significant merit over the old system. Two Likert-scale questions aim to elicit participant opinions on the appeal of social features; whether they would enjoy a possibility for communicating with each other e.g., during a problem situation, or would they enjoy more competitively oriented social features, such as ranking lists. The section ends with two sentence completion tasks: these prompt the participant to think about how the prototype interfaces compare to the original KoToToMo+, and what factors would make them study more with KoToToMo+. The questionnaire items are presented in the Appendix C.

Reliability concerns

There are valid and reliable instruments measuring student motivations and experiential needs in a quantitative manner. Keller's (2010, p. 291) Instructional Materials Motivation Survey (IMMS) can be used to measure reactions to self-directed learning materials. Hassenzahl's (2010) AttrakDiff questionnaire can be used to measure product perceptions and evaluation. However, collecting quantitative data was neither appropriate nor the focus of this study. The objective of the test setup was to elicit initial reactions and opinions from interactions with the prototypes in a qualitative way. The desired data would come from the open and sentence completion items, whereas the ratings gained from the 5-point scale questions would only serve as a positive or negative indicator of the overall impressions. Existing questionnaires were deemed too excessive for this purpose, as well as hard to implement to run parallel with the prototype interaction.

To increase reliability, the test setup was tested with two Japanese students. These students were not studying in the Chinese courses but knew about the KoToToMo+ application. With the help of research partner Yuichi Ohkawa, few alterations were made to the phrasing of the questions. The questionnaire was then accepted by the project owner Takashi Mitsuishi.

3.5.2 Test Subjects & Remote User Testing Procedures

The remote testing was conducted with 10 student participants, who were invited by the language teacher to participate in the test at the end of the semester. As the students would interact with the prototypes and the questionnaire in different browser tabs alone, it was considered that the setup required proper instructions and remote correspondence.

1. *Connecting to Google Meet.* Explanations and instructions are given using Google Meet session, where the participants would connect on a specified time. Participants have the option of leaving the camera or microphone off during the experiment. The URL for the prototypes is sent using the chat function, which the students would access with the computer's browser.
2. *Explanation of the experiment purpose and confirmation of consent to participate* (15 minutes). The background and purpose of the experiment is explained, as well the participant rights. Consent can be withdrawn at any time, even during the experiment.
3. *Confirmation of the test environment, trial run* (10 minutes). In order to get the participants used to the experiment procedures, the web browser is checked to be functioning formally, i.e., prototype and questionnaire pages open without issues.

The participants will conduct a trial run with a test questionnaire that mimics the structure of the real setup.

4. *Experiment* (10-15 minutes) The actual experiment will be conducted using the actual survey system.
5. *End of the experiment.*

In total, the experiment was expected to last 30-45 minutes, depending upon how long the students would spend answering the free form questions.

The 10 participants who volunteered for the test came from various study disciplines: three from engineering, three from social sciences, two from medical sciences, one from natural science and one from economics. Every participant successfully interacted with the prototype and completed the questionnaire. The feedback is presented in the section 4.3 and further analyzed in the section 5.2.

3.6 Evaluation

In the evaluation phase of DSRM, the artifact is observed and measured on how well it supports a solution to the problem. Depending on the nature of the problem and the artifact, evaluation can take many forms, e.g., quantitative performance measures, such as budget or items produced, satisfaction surveys, etc. (Peffers, et al., 2007).

In this thesis, the evaluation of the artifact was conducted through usability testing with representative users. As analyzing usability data is similar to analyzing data from any other types of research (Lazar, et al., 2010, p. 292), this allows opportunities for using various qualitative data analyzing methods. In the context of this study, the analysis was conducted in terms of how well the gathered data matched the user requirements and whether new requirements arose from the data – in other words, how well the design strategies could meet the basic psychological needs. This aligns well within the DSRM paradigm, as the gathered data was analyzed to inform the further design of the application (testing the experiential and usability aspects of the prototype interfaces for later development) and further research (by testing the concept and generating knowledge on the problem context).

A key factor in the proliferation of qualitative research has been the facilitation of many previously difficult and time-consuming operations with the help of computers (Sihvonen, 1999). Among the computer-aided qualitative data analysis (CAQDA) tools, Sihvonen describes Atlas.ti being a versatile tool in coding, categorizing, and visually modeling qualitative data. Thus, Atlas.ti was used to organize the collected student feedback data, categorizing the data respectively under each proposed feature.

The findings were then used to understand what implications it has towards the current issues in KoToToMo+ (RQ1.1), how the basic psychological needs were met (RQ1.2), and how learning in a mobile environment could be enhanced (RQ1.3). These are discussed in the section 5.2.

Answering RQ2 required analysis of how well the used methods produced relevant information in terms of satisfying the basic psychological needs (competence, autonomy, relatedness, curiosity, arousal and attentive focus) – as well as the role of the prototypes contributing to knowledge creation. This is discussed in the section 5.3.

3.7 Iteration & Communication

DSRM and UCD processes both endorse iteration of the design but going through the whole design process again would have required another round of data collection. This was not possible during the timeframe of this study. However, recommendations and future studies are discussed in chapter 5.4.

In the communication phase of DSRM, the problem and its importance, utility, novelty of the artifact, design rigor, and effectiveness are communicated to researchers and other industry practitioners (Peffers, et al., 2007). In the course of writing the thesis, two peer-reviewed research papers were written and presented at international conferences.

The first research paper communicated the problems in application facilitated learning and the rising importance of UX in online course design. The presentation was held in the *EdMedia + Innovate Learning 2020* online conference, organized by the Association for the Advancement of Computing in Education (AACE).

The second research paper elaborated on the previous issues and communicated the utility of the prototypes. The presentation included the results of the user testing, covering implications of the student answers. The second paper presentation was held in the online conference on *Teaching, Assessment, and Learning for Engineering (TALE2020),* organized by the Institute of Electrical and Electronics Engineers (IEEE).

The feedback received in these conferences were used as talking points in answering the RQ2.

4 Results

This chapter presents the results of how user requirements were formed, prototyping design decisions and remote user testing sessions.

4.1 Forming the Initial User Requirements

Initial user requirements were inferred from the design strategies suggested for facilitating KoToToMo+'s issues.

To increase feelings of accomplishment in doing repetitions, it was decided that KoToToMo+ should have a feature for visually monitoring the study times throughout the week and receive informative feedback from the application, like deadline reminders or learning summaries. As an additional visual support, students could benefit from badges, signaling "small victories", week after week. To further increase the engagement, possibilities for comparing own learning efforts with other students could be investigated.

To counter procrastination and increase the will to start learning, it was decided that KoToToMo+ should have a feature for setting an achievable study goal for the next quiz. This would help to control, and pace learning throughout the week and set expectations for success in the quiz. If the quiz goes well with the current study efforts, it will concretely inform the students on how much learning is enough for them in the bi-weekly cycle.

To enhance the interaction experiences and prevent errors, the prototype should use familiar icons, colors, menu hierarchies and afford familiar ways of interaction with a mobile interface. To further provide delightful experiences, the students should be able to set whether to receive notifications at all and receive visually stimulating feedback from their actions. Hence, the initial user requirements were formulated as follows.

- Students should be able set when and how much to study for each new chapter.
- Students should be able to self-monitor their progress throughout the week.
- Students should receive badges from their learning efforts.
- Students should be able to connect and socially interact with each other.
- Students should be able to compare their learning statistics with others.
- Students should receive notifications informing about the learning progress, homework details, or other course-related information.
- Students should be able to use the new features effectively and without errors.
- Students should be able to customize their learning environment or reconfigure prior settings.

These requirements were used to frame the design decisions around the proposed features. Due to the time constraints, features for social interactions were not implemented, but questions about them were presented in the questionnaire.

4.2 Proposed Prototype Features

The following features describe how the features are believed to facilitate students' learning endeavors, potentially creating more engagement.

4.2.1 Adaptive Push Notifications

Adaptive push notifications aim to improve the system usability by giving appropriately timed, actionable feedback, and the ability to customize the frequency of receiving them. The feature focuses on counteracting student procrastination by providing reminders to learn and informative announcements, such as upcoming quizzes and learning summaries.

Irrelevant push notifications are considered disruptive and annoying (Pielot, et al., 2018). This is why the frequency of receiving push notifications should be tailored with the two specific KoToToMo+ user types in mind: students who study only once, and students who practice more than once a week. For the one-time practitioners, KoToToMo+ could send push notification right after the class, informing them about the next week's deadline. If the student has not studied throughout the week, a gentle reminder for the student could be sent a few days before the classroom quiz.

Students who practice more than once a week could be encouraged to keep up the consecutive phase through motivational messages. e.g., notifications that guide the student to study 1-3 times a week. Such notifications could start to appear when the student has studied at least on two separate days.

Through this type of gentle and adaptive feedback, it is assumed that students' cognitive load can be offloaded in dealing with other issues than learning, thus supporting competence. Annoyance related to push notifications can also be alleviated by letting the user know what type of notifications are sent and allowing for customization of notification preferences within the application, i.e., allowing them to be turned off. It is supposed that this ability supports learner autonomy. In figure 4.1, the user receives a suggestion to continue studying the remaining parts of a chapter.

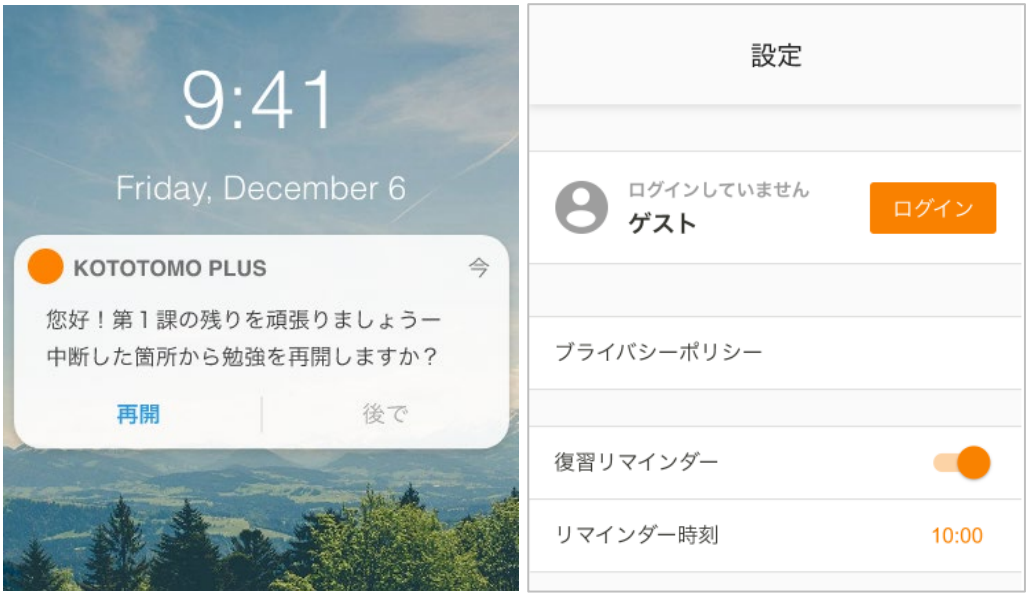

Figure 4.1: Motivational push messages and configuration options. Students are able to configure the time when to receive push messages, or whether to receive them at all.

Although weekly learning summaries were not implemented in the interactive prototypes, one of the questionnaire items presents this additional type of push notification. This form of feedback informs the student how much they have studied during the week and cheers the student to continue.

4.2.2 Bi-weekly Learning Goal & Onboarding

This feature allows setting how much to study until the next classroom quiz. It acts to support students' feeling of autonomy by providing meaningful options that comply with their personal development needs, by creating a short-term goal orientation for a task that is feasible enough to fulfill.

In practice, the students would be presented with an onboarding screen in KoToToMo+ each week, whenever a new chapter has been covered in the classroom. The onboarding prompts the students to input how much they want to study for the next two weeks, and what time they want to be reminded. The learning goal options range from a minimum of 10 minutes to a maximum of 2 hours of bi-weekly studying. Students also have the possibility to skip setting goals and reminders. The onboarding prompts can also be completely switched off from the settings.

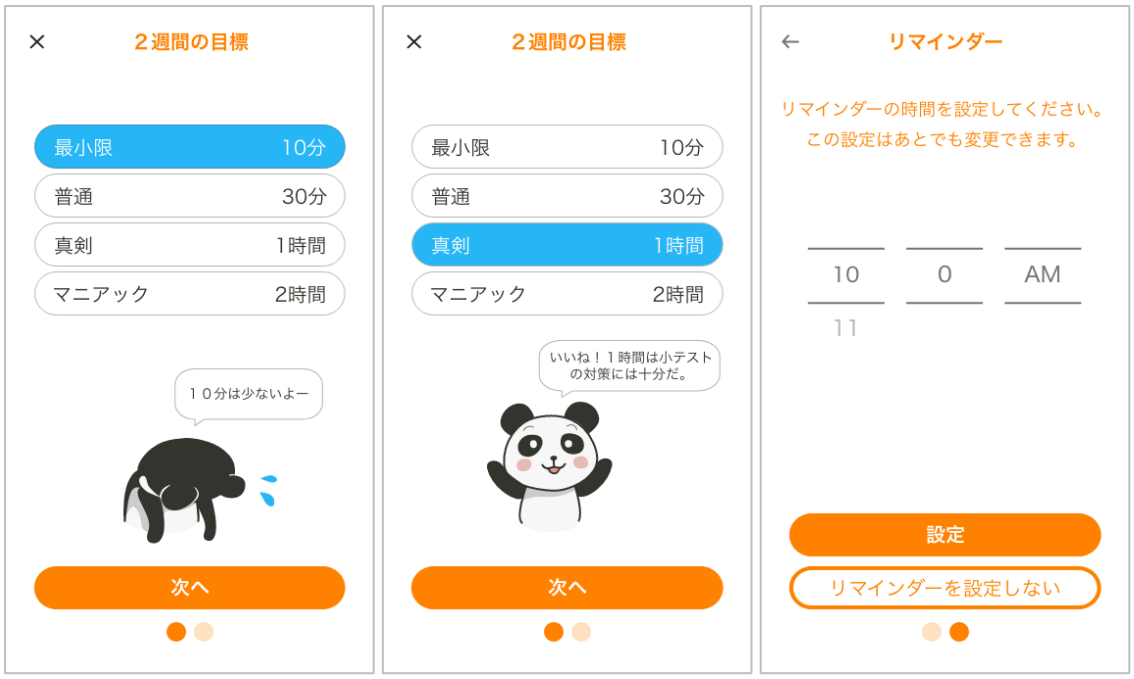

Figure 4.2: Setting a learning goal to 1 hour and a daily reminder at 10 am for the next two weeks.

4.2.3 Badges & Milestones

As many of the students study only once between chapters, it is suspected that the students lack the sense of accomplishment due to the absence of concrete rewards and feedback. Therefore, badges and milestones could provide an additional, varying way of receiving feedback through extrinsic rewards. These rewards also act as a set of visible short-term goals, which the student may choose to pursue.

This could be targeted with badges and milestones that relate to the competences at stake, i.e., indicate the current level of proficiency. For example, practicing 120 minutes of pronunciation tasks could indicate basic level knowledge of Chinese pronunciation. The next level, 1000 minutes, indicates a level of mastery. Additional criteria for the badges were to invite the one-time practitioners to do reviews more than once and earlier than the day before classes. Badges, such as *"Early bird"* or *"Well prepared"* are awarded for certain behaviors, such studying at a certain time of the day (e.g., between 7-8 a.m.) or conducting multiple reviews before the next quiz.

Once badges or milestones are acquired, the color turns gold along with the progress bar, indicating a victory condition. The "juiciness" of this feedback aims to further delight the students.

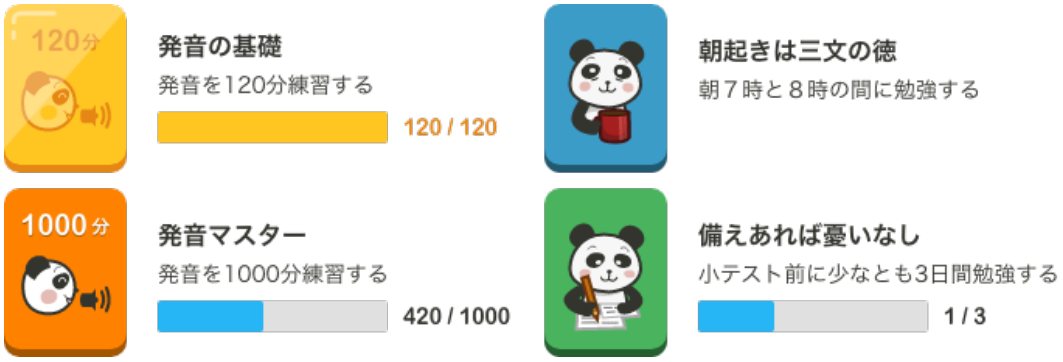

Figure 4.3: Badges and milestones. Used to inform competence and guide towards consistency.

4.2.4 My Page – Study Management Hub

My page offers tools for performance support by enabling self-monitoring, goal setting and short-term goals. The aim is to provide ways for the students to track their studying progress in a more comprehensive way, rather than looking up the review times from individual chapters, as in the current system.

My page acts as a central hub for displaying the student's personal bi-weekly goal for the week, total time used to study, achieved milestones, as well as a calendar visualizing how many days the student has consecutively studied. The calendar also displays when the next quizzes take place.

Figure 4.4: “My page” for tracking learning progress

In the pursuit of fulfilling the need for enjoyment and delight, all of the features aim to integrate into the graphical look and feel of the application. This is done by making use of the current aesthetics, in terms of color scheme, introducing more subtle animations, as well as incorporating the panda mascot more in the interaction experience (e.g., in onboarding and badges). The panda character is also used as a manipulative tactic, as seen in the onboarding interface views; the mascot guilt trips the students to study more by gesturing disappointment when choosing the minimum,10-minute learning goal.

4.3 Results of the User Testing Sessions

This section presents the student answers per each section and feature. The results of the user testing are analyzed and discussed in chapter 5.

4.3.1 Overview

All of the test participants were able to finish the interactions without major hurdles. Nine students shared their opinions in the free form sections, from which three answered every free form question. One student did not write any feedback and only clicked through the mandatory Likert-scale questions.

Eight students chose autonomously motivated reasons for participating in the Chinese classes, either *“I am interested in Chinese culture”* or *“I want to be a person who is able to speak multiple languages”*. One student wrote a personal reason, stating that *“I have a personally close, intimate feeling to the Chinese kanji-characters”*. This can be strong indication of autonomous motivation.

Two students chose the course for extrinsic reasons, i.e., *“I want to get just enough study units”* and *“I want to get good grades”*, which is indicative of controlled motivation. The students with autonomously motivated reasons answered most of the voluntary free

form items, elaborating their concerns and suggesting their own ideas to the proposed features. The two students with externally controlled motivation had clear patterns in their answers. One of them did not have any input for the free form sections, while the other had only quick, superficial remarks of the features, such as *"I think this feature is good"*.

4.3.2 Reactions to Push Notifications

Push notifications functioning as reminders received mixed feedback. One student stated that *"I think reminders are OK, but I don't know if they're enough for me to open up the app."* The Likert-scale ratings were not as positive compared to the other features, as four students rated the reminders either 2 or 3 out of 5. On the other hand, one student said that she was constantly overwhelmed by other school courses and would greatly appreciate a reminder notification.

Informative push notifications, such as receiving digests of classroom activities right after the classes and learning summaries at the end of the week were perceived in a positive light. One student commented that "*I think that displaying detailed summaries of study times or consecutive days studied works great in making students feel accomplished. Even with the English learning app that I used when studying for Tohoku University entrance exams; every time I started the app, a message like 'I'm studying for X days in a row! Great!' encouraged me to continue further."* Few of the students also expressed their wishes for setting the frequency of receiving push notifications or getting reminders of due classroom homework.

4.3.3 Reactions to My Page, Goal Setting & Study Calendar

The goal-setting functionality and study calendar presented in "My Page" received positive feedback, enjoying a high Likert-scale rating of 4.8. By looking at the feedback, eight of the students were seemingly delighted with setting a personal study goal. One student described that seeing learning statistics would make him feel satisfied with his learning efforts. Another student stated that setting a goal would help in "routinizing" learning, while also making the application easier to use. Two students wished to have an option to set more specific learning amounts, or an option to set daily goals instead of the two-week goals. One student had skeptical thoughts on the feature, stating that *"It's nice to be able to set the goal, but deciding when to study depends on the school week, and there are probably a lot of students who leave it up to their current moods, so I think the feature doesn't make much difference."*

Students also appreciated the study calendar function. One student stated that seeing the upcoming quizzes and topics would help to manage their learning better. Another student made a similar remark, elaborating that *"seeing the future quizzes would enable me to 'properly orientate' before studying for the quiz"*. The feature also received improvement ideas, as one of the students expressed a wish for being able to input the quiz scores into the calendar, i.e., having some sort of "scorebook" to track the quiz scores.

4.3.4 Reactions to Badges and Milestones

Badges and milestones received mixed feedback. Half of the students did not answer anything to the free form questions. The Likert-scale question *"By achieving milestones and badges, I feel like I'm getting somewhere."* averaged 3.9 out of 5.

One student expressed a wish for seeing rankings of the classroom attendees attaining specific milestones. Two students who rated the badges 5 out of 5, mentioned that receiving an award would encourage them to study another chapter. Another advocate for badges and milestones stated that the progress bar presented in the milestones would create a sense of incompleteness, thus increasing the motivation to finish them.

4.3.5 Impressions, Thoughts on Competitive Features & Other Wishes

The students had positive responses to the aesthetics and controls of the proposed features. When presented with a question about how the prototype interfaces compare to the current version of KoToToMo+, some students had delighted responses, such as *"These features would make repetitions more fun",* and *"I definitely want to try out the finished version."*

The proposal of social features in the form of student-to-student communications did not receive much support, averaging below 3 on the Likert-scale. Instead, six of the students proposed various ideas for communicating directly with the teacher, such as a chat function or inbox for receiving personal feedback, and information on the current week's learning objectives. One student proposed a mechanism that would allow students to send a question inside the application, which the teacher would then answer in the next class in front of everyone.

Students seemed to be generally acceptive towards competitive social features. However, one student had concerns about anonymity; *"I think it's a nice feature to be able to compare yourself with other students, but if it was anonymous, I would be able to do my best without getting too worked up or anxious"*.

There were a couple of distinct feature ideas, outside of the student-to-teacher communication. On top of the previously mentioned quiz "scorebook" feature, one student shared an idea of a word randomization feature; *"If I could compose my own 'quiz' where the words would appear in random order, it would enable me to casually use the app for studying in my spare time. Choosing words from a self-picked range, for example from chapter X to chapter Y, would be even better."*

5 Discussion & Conclusions

This chapter discusses the implications of the results in accordance with the research questions. Limitations of the study are also discussed in terms of how they affected the results. Lastly, recommendations for KoToToMo+ development are discussed, along with possibilities for future studies. The chapter ends with concluding words that summarize the contents of this thesis.

5.1 Limitations

There are several limitations regarding the testing methods and design instruments, participants, as well as interpretation of the data. Limitations are discussed in terms of generalizability and reliability.

5.1.1 Generalizability

The degree of which the findings of this study can be generalized in other situations, people and test settings, is limited. The user testing participants were all Japanese, first- or second-year students (aged 20 to 22) at Tohoku University, living in Sendai. This makes the user pool relatively homogenic. Additionally, the way learning materials are presented in the classes and in the application is based on how Chinese is exclusively taught to Japanese audience.

With this said, the end result of the tested motivational features might not universally reflect the perspectives and opinions of a mobile language learner studying the basics of a language. Thus, the results might not be transferable to other mobile language learning contexts as such. It is possible that the proposed features might not align well for individuals reaching higher levels of language proficiency. However, the focus was explicitly on creating more engagement in basic level Chinese courses, as was addressed in the thesis scope (see 1.2).

As KoToToMo+ is used as an integral part of a blended learning classroom, the results must be interpreted in this particular context; for example, the bi-weekly goal setting would not make much sense in an independent application that is not used as a part of classroom curriculum.

5.1.2 Reliability

There are several factors that have affected the data reliability, such as the small sample size of participants. Although 10±2 users have been suggested to be an optimal number of participants for usability testing, more recent work suggests that even 10 users are not enough to discover 80% of usability issues in interactive systems (Lazar, et al., 2010, p. 275). A major concern for data reliability is also the lack of in-person testing. Moderated remote testing does not allow the usability facilitator to qualitatively observe the users, e.g., pick up nonverbal and interpersonal cues, or recognize appropriate times for follow-up questions (Lazar, et al., 2010, pp. 280-281).

Conducting the user test on a web browser instead of a mobile device is another reliability concern, as the element of tactile interaction with a mobile device has been removed. However, it would have been more time-consuming and difficult to organize and monitor

a remote session where students would have used their own mobile devices to interact with the prototypes.

Another issue is the overall quality of the gathered student feedback. It is possible that not all of the participants dared to give criticism about the prototypes. Some of the written comments seemed a bit too positive and general, lacking any form of criticism. This can be explained how functional prototypes are less likely to be criticized; if participants are aware that they are evaluating a tool that the user testing facilitator has created, they may be overly favorable in their responses (Lazar, et al., 2010, pp. 203-204).

One of the reliability issues relates to the language and its interpretation. The interviews, user testing and analysis of the data were all in Japanese. Some words in Japanese do not have direct translations to English, and some words can have different meanings depending on the context. This could potentially lead to misinterpretation of the data.

5.2 Design Possibilities in KoToToMo+

This section discusses the implications of the user testing sessions and possibilities of implementing motivational features. The subject will be discussed in accordance with the RQ1 and its sub-questions by answering 1) how the system with the proposed features compared to the original KoToToMo+, 2) how the basic psychological needs were met in educational contexts 3) how mobile affordances may affect the experience and engagement.

5.2.1 Learning in the "New" System & Additional Wishes

The answers elicited from the free form and sentence completion questions confirmed some of the previously identified issues in the original KoToToMo+ but also displayed additional wishes that were not present in the earlier findings.

The prototype system received praise on handy features, such as goal setting and study calendar. Words such as "easier to use", "convenient", "easier study management" were mentioned several times. The praise on enhanced usability could indicate that it is indeed difficult to manage and examine own learning efforts in the original KoToToMo+, which can contribute to the doubts of repetition effectiveness, as well as overall interests to engage in m-learning on a regular basis.

Push notifications as reminders would benefit the students who genuinely forget to learn, but for many others they might not have the same effect. However, receiving digests of course-related activities or individual learning summaries could be beneficial for the majority of the students. In line with the findings of Joyner et al. (2018, pp. 90-91), distributing weekly announcements in an appropriate cadence (e.g., Mondays and Fridays) have been reported to be a significant element in maintaining course dynamics.

The reported ease of use and management abilities not only reflected the importance of control and usability but hinted about the importance of supporting self-regulated learning activities. This was implied in one of the student wishes, which was about being able to input the quiz scores into the system. Looking from the perspective of the self-regulated learning cycle (depicted in figure 2.5.), the reminders and study calendars could support the *performance phase* of learning by helping the student to manage their time and monitor the goal progress. The proposed "score book" feature, in which students would voluntarily input their quiz scores into the system, could enable the students to evaluate the effectiveness of their learning strategies and examine how satisfied they were with their efforts, supporting the *self-reflection phase*. Feedback from this phase will be

then applied to the start of the next cycle, *planning phase*, in which learning goals are again set for the next week.

A handful of test participant comments were positive towards competitive features. Baldauf et al. (2017), who tested a language learning application prototype in a blended learning class, recommend using social interaction and motivating competition (comparison, leaderboards) to engage students. However, the test subjects in Baldauf et al.'s study were aged 13 to 14. The students of KoToToMo+ might have a different academic orientation to their studies and might not benefit from too excessive competition or sending messages to each other. One test participant was also concerned about the ethical aspects of competition, whether it would be anonymous or not.

Still, many of the KoToToMo+ users wished to have some form of a messaging ability with their classroom teacher, whenever they would have a question regarding the materials. Previous studies on software and application use in classroom practice highlight the importance of fitting within the authentic classroom dynamic, instead of the software being something that interferes, prohibits or breaks the rhythm of instruction. This means that the application should be inclusive to all and integrate into the students' learning habits; technology use should become something akin to taking notes and asking questions from the teacher (Kipp, et al., 2018, pp. 46, 241). The messaging feature with the teacher could provide an opportunity to expand this communication dynamic beyond the classrooms, while being inclusive to the students who might hesitate to ask questions during the lecture hours. However, a potential solution should be implemented in a way that does not exhaust the teacher.

5.2.2 Implications to Need Satisfactions

The results suggest that the proposed features could offer opportunities to experience many of the needs satisfactions in educational contexts, given the positive reactions and implications to self-regulate the learning. This means that many of the test participants were on the autonomous scale of the motivational spectrum, i.e., the students already have a high motivation to learn Chinese.

The delight and contentment in observing the learning efforts demonstrated how especially the pragmatic system qualities affected the perceived confidence. Visual representations of learning efforts would seem to encourage keeping consistent with the studies. High system usability and support for skill development positively affect competence, thus the motivation to use the system (Szalma, 2014).

When setting a learning goal, some students expressed the wish for setting a more specific goal than displayed in the onboarding screens. Additionally, some students wished to set a daily goal instead of a bi-weekly goal. Similar wishes for configurability surfaced in push notifications feature as well, as one student wished to alter the frequency of receiving them. These explicit wishes indicate that students would voluntarily dedicate time and energy to plan their studies, while also highlighting the importance of being able to configure the learning environment to one's own liking. This demonstrates how the experience of choice can positively affect autonomy (Szalma, 2014).

Social features were not part of the prototype testing, which limits the extent of how the need for relatedness can be discussed. Relatedness in educational contexts is deeply associated with how the teacher conveys support and respect to the students (Niemiec & Ryan, 2009). The need for relatedness seems to be present while using KoToToMo+ as well, considering how six participants made explicit wishes for being able to communicate with the classroom teacher. This could also be an indication of hesitance to ask questions during the classroom hours.

Although no explicit remarks regarding hedonic features (e.g., graphics, panda mascot, animations) were to be found, comments such as *"learning would be more fun"* and *"I want to change push notification frequency"* reflects the delight in trying out the new features, as well as the curiosity of experimenting with the configurations. The mixed reactions to badges and milestones is difficult to assess with the current data, but one student comment demonstrated how curiosity can also be unpleasantly experienced: having a sense of incompleteness when looking at the half-completed milestones and badges. This could be explained by how curiosity not only reflects pleasurable anticipation of acquiring information (e.g., watching a TV drama episode) but can also involve a feeling of deprivation by not having access to new information (the episode ends in a cliffhanger). (Litman & Jimerson, 2004).

Even though the impact of virtual badges has been previously studied in educational contexts, their efficiency remains inconclusive. Some studies have reported favorable student receptions to badges as a motivational tool in blended learning contexts (Kipp, et al., 2018, p. 243). Simultaneously, other studies have observed students to be performing worse in situations with badges, points and leaderboards compared to peers who were not exposed to these game elements (van Roy & Zaman, 2017). One reason could be that extrinsic rewards in learning settings can switch the focus to just getting a reward, thwarting the learner autonomy (Reeve, 2006, p. 650). In educational settings, any type of extrinsic reward (e.g., badge, milestone, quest), should focus more heavily on developing the skills of the student. von Roy et al. (2017) highlight that the learner should not possess all of the information about what activities to conduct to achieve the rewards, so by no means they could be perceived as controlling. In a similar vein, study reminders that nag the students to do reviews can also feel controlling. This highlights the importance of being able to turn off the push notifications or change the frequency of receiving them.

The mixed feedback of extrinsic rewards may reflect the different motivational types of the test participants. For example, one of the autonomous motivations, *identified regulation*, is characterized by behavior that is not linked to particular rewards; the person values the activity as a means to attaining a personally important goal (Szalma, 2014), such as reading a push notification to get personal feedback about the learning progress. Considering the seemingly autonomous motivation among the user testing participants, this could explain the mixed reactions to the reminders, badges and milestones.

5.2.3 Thoughts on Mobile Affordances Affecting Retention

This section discusses the student feedback related to the mobile affordances (e.g., push notifications, instant availability) and how they might affect the interaction experience and retention. The unauthentic test settings and elicited results limit the possibility to preemptively describe how the students interacted with the prototypes, including swiping, gestures, mishaps, dismissal of notifications, etc. However, there were still interesting comments related to particular interaction habits associated with smartphones.

Although learning summaries delivered through push notifications seemed useful to the students, study reminders did not receive an equal number of positive receptions. This reaction could be explained by how mobile push notifications are generally experienced: when the user receives a notification, thoughts and attention are drawn to the device, as there might be a reward in the form of basic psychological need satisfaction. Dismissing this message would mean accepting the probability of missing out on something (Pielot, et al., 2018). In the moment of reading a notification of e.g. *"You should finish chapter 3 tasks.",* the user decides whether capturing the attention was worth it. This moment of

reflection is known as "Habit-Goal Interface" – a short period of time of time when subconscious habits and consciously executed goal-oriented behaviors intersect. During this moment, the users evaluate whether the habit and their goals are aligned (Wood & Neal, 2007). Push notifications are appreciated if the users endorse a habit of picking up a smartphone to read the message – this makes them feel autonomous. If the users feel controlled, users take offense at the message, even if they think there is an activity that should be done. In short, reminders might be perceived as controlling, whereas learning summaries deliver competence informing useful feedback.

Another interactional mobile element that could affect student engagement and retention related to the feeling of deprivation, described by one of the test participants browsing the incomplete milestones. In contemporary interaction and game design, this feeling has been tried to explain through the "Zeigarnik effect", according to which people are more likely to remember an uncompleted task, than one they have finished. In other words, people have a hard time abandoning a goal – even in the case of an artificial video game goal that serves no other purpose than just attaining it. This effect is especially visible in massive multiplayer online games (MMOs), as discussed by Rigby and Ryan (2011, p. 108): it is hard to log off from the game, because the player is always in the middle of something and usually in the middle of several goals, simultaneously. However, smartphones afford opening up a game just to quickly complete a goal and then log off a system. In mobile games, Zeigarnik effect typically manifests in the form of quest logs, or challenges that are time-restricted or location-based. For example, if a quest in the game is to find 12 jewels, it is difficult to stop at 11. Or if the quests can only be undertaken in a certain time during the day, this scarcity and fear of loss might build the urgency to do them (Chou, 2015, p. 423). Or if a game item can only be acquired in a certain location by moving close to it, this motivates the user to physically move in the real world, such as in Pokémon Go (Colley, et al., 2017). But as discussed in the previous section; exploitation of user behavior should be for a good cause. In education settings, the quests need to be tied to the learning objectives.

Mobile users direct their attention and interact with their smartphones for brief moments, logging in and out of applications in search of a need satisfaction. Therefore, gameful features should consider this casual way of interaction. One of the students explicitly mentioned how learning words in a random order from a self-picked range of chapters would allow him to conduct repetitions in a "lean-back" and casual fashion. This finding was similar to what Ushioda (2013) has previously documented, that is, the level of interactional engagement in mobile language learning being broadly superficial. This can be true for KoToToMo+, as the users dip in and out of learning only for short periods of time. However, in terms of motivation, students' own intuitive perceptions and feelings about m-learning benefits for them seemingly plays a critical role, regardless of the level of cognitive engagement. Basic psychological needs can still be met if they can be facilitated through a personally meaningful, casual way. In other words, facilitating frequent (instead of deep) engagement. In the case of this student, choosing the range of study chapters from where words would appear in a random order would probably increase the frequency of learning. As a method for improving retention in m-learning solutions, Haag and Berking (2014) suggest providing spaced learning methods and supporting them with other mobile affordances. In KoToToMo+, the word randomization feature could be implemented as a flashcard-based spaced repetition system, supported by gentle, encouraging push notifications about the study amounts, or perhaps weekly quests that are based on the goals of the individual course textbook chapters.

5.3 Did the Methods Support the Design?

Based on the related work of end-user considerations in educational systems, UX design was thought to generate knowledge and provide insight to the student issues and needs in KoToToMo+. User-centered design methods in educational technologies have been noted be of use in informing online course design (Reid et al, 2016). Using the methods throughout the design process has the potential of not only enhancing system usability, but increasing the likelihood of implementation, utilization, and sustainment of the system (Wilson, et al., 2018). From the literature review, it was found that qualitative methods, such as contextual inquiry and activity theory, can help designers invent enjoyable services and fun-filled applications (Shneiderman, 2004). m-learning strategies in particular would benefit from these types of user-centered design methods, considering the difficulty in deliberately designing for motivational experiences. Mobile behavior and device affordances need a thorough inspection in the design process (Haag & Berking, 2014). Questionnaires, interviews and iterative prototyping of a design artifact have been demonstrated to be beneficial in finding out the student requirements, engagement and acceptance of a gamified m-learning application (Baldauf, et al., 2017).

In this thesis, design science was chosen as a research approach to design and test a gameful prototype artifact, while gaining knowledge of the students' experiential needs affecting retention rates. The methods did support the design, as the prototypes allowed finding out information about the factors and phenomena that contribute to elevated student engagement and motivation in gameful m-learning contexts. Practically, this meant evaluating how the user requirements were met. The positive reactions to the prototypes are an encouraging factor. The findings can inform future developers about the student wishes and needs that are prevalent in KoToToMo+.

Due to the social distancing regulations and compromises in the schedules, many critical UX design methods could not be executed, such as low-fidelity prototype testing, in-person interviews and iteration of the design. This meant that early student feedback could not be included in the artifact design. Still, given an environment restricted by time and global pandemic, user interface prototyping and remote testing seem to work well in finding out student opinions and needs. Early creation of the high-fidelity prototypes proved also to be valuable in terms of problem communication. Different groups of stakeholders have different perspectives on requirements, necessary functionality, and usability (Lazar, et al., 2010, p. 197). By demonstrating the prototype functionalities to the product owner and the language teacher, they could better understand how the student needs could be concretely satisfied.

The use of the chosen methods has further implications, as they illustrate how UX design can be used to inform instructional design solutions. The lack of awareness between the two fields might show in semantics and methodologies used to describe and evaluate solutions. Instructional designers and teachers at EdMedia and TALE2020 conferences were curious on how the field of UX design relates to the concepts in the ARCS model and how UX methods, such as high-fidelity prototyping, benefits the design process. Instructional design frameworks inform the way content is delivered and presented, but UX design ensures that the student voice is integrated within the design, by sharing the development and iteration process with those who the system is designed for. If no high-fidelity prototypes would have been created, eliciting user reactions and responses would have not been possible to discuss in-depth. The results of this thesis agree with the statement that instructional design would benefit from more iterative and structured approaches to framing and solving problems (Wilson, 2020).

5.4 Recommendations & Future studies

Based on the results, it seems that the students would benefit from the proposed features. The students who participated the user testing sessions also seemed to be quite motivated to learn Chinese from the beginning. The features that will eventually be developed should consider this delicate motivation, as it can be thwarted by the feeling of being controlled – this might come from nagging feedback (e.g., messages such as "You have work to do!") and external rewards that draw attention away from learning. The findings also suggest that the dynamic between student and teacher should be somehow maintained outside the classroom. The next section describes tweaks to the current feature proposals and additional enhancements for future development.

5.4.1 Recommendations for KoToToMo+ Development

Support the self-regulated learning cycle

KoToToMo+ should have features that support students in planning, monitoring performance and self-reflecting their studies. However, iteration should be done on how the proposed features could be tweaked to best fit into individual needs. For example, investigating whether the students should be able set an even more detailed learning goal – setting daily goals instead of weekly goals, or setting a custom learning time instead of choosing between the options given in the onboarding screens. The students would then control and observe their progress in the "My page", making adjustments to their goals if needed. Finally, students should be able to self-reflect and evaluate the effectiveness of their learning strategies. Self-reflection could be made possible by implementing the aforementioned "score-book" feature; seeing the correlation between the learning efforts and the quiz results could affect students planning phase beliefs, strengthening the will to keep the same learning pace or make adjustments.

Consider possibilities for a (non-exhaustive) student-to-teacher communication

To support the performance phase of the self-regulated learning cycle, KoToToMo+ users would most likely benefit from a communication channel with the teacher. However, implementing a direct chat would not be efficient, as there is only one language teacher for the eight basic level Chinese classes; receiving an answer to one's question would take time and add to the teacher workload. A possible alternative would be to implement a "post box" like feature for the student questions. During the next class, the teacher would then collectively answer the student questions. This feature connects the application more to the blended learning dynamic and could reduce the student hesitance to ask questions in the classroom.

Tying badges and competition to the learning objectives

Some students (especially the one-time practitioners) could benefit from some type of stimulus that informs about incomplete tasks. Milestones could be redefined as "quests", with a quest log listing the possible tasks that can be completed. One option would be to provide a set of weekly quests that operate based on the textbook chapter progress. Completing these weekly quests could be then awarded with badges – the Zeigarnik effect created by the limited availability could instill urgency on getting them. Additionally, the

effect could be used to create a sense of unfinished business through a quest that highlights the presence of incorrect answers in particular chapters, e.g., "*Get all exercises correct in chapter 1 (16 / 17)*". The existence of the incorrect answers and seeing how there is only one left to be corrected, could act as a source of reengagement motivation. Completing the quests should not affect the overall course grade, but rather inform the students about the benefits of doing frequent repetitions.

Competitive features could also have potential in engaging the students. Such features were also a talking point during the TALE2020 conference, in terms of how they could be meaningfully implemented in the blended-learning contexts, given the concerns in anonymity. One option would be to present graphs or percentages of the different activity statistics conducted by the class students (e.g., average study times, percentages of students having completed a specific quest). The student could then compare, whether one ranks below or above average. This would eliminate the concerns of anonymity, but still provide a subtle way to compare one's own efforts to the classmates – similar to the current feature of seeing the number of students undertaking a particular chapter.

Enhance "casual" ways of learning

KoToToMo+ should have features that can increase the frequency of brief learning moments without high levels of cognitive effort. One option could be to implement a spaced repetition feature (discussed in 2.2.3) around individual word acquisition. In addition to reviewing the chapter contents in a streamlined format, randomizing and spacing the word appearance order would concretely show the student their strengths and weaknesses, as difficult flashcards are shown more frequently, while older and less difficult flashcards are shown less frequently. Frequently practicing the chapter contents in a randomized order and knowing that the vocabulary is transferring into long-term knowledge through this spacing method could ease the mental effort and feeling of ambiguity in the students.

5.4.2 Instrumentalization & Future Studies

The use of gameful methods in education reportedly have positive effects, but empirical, mixed-method research reporting statistical analysis and effect sizes are scarce. Comparative studies with controls are also needed to make sure what effects gameful design has beyond other approaches (Tondello, 2016).

Implementing the motivational features described in this thesis would offer opportunities for a comparative case study, where the new system performance is compared to the old system. A practical way to implement such comparison would be to release a closed beta system containing the proposed features and have two student groups using both versions of the application during one study semester: one group using the KoToToMo+ with motivational features and the other using the old system. This would enable the evaluation of increased learning frequencies and long-term system usage. The potential variations in student learning behaviors could be measured through the existing web analytics service, Visualizer. Additionally, implementing Keller's IMMS survey at the end of the semester for both of these groups could provide a deeper, quantitative perspective on (potentially increased) students' motivational attitudes.

Future studies could also investigate what type of motivational features can sustain learning when moving towards intermediate and advanced levels of language proficiency. In the intermediate Chinese classes in Tohoku University, there are currently no applications used to supplement learning; could KoToToMo+ be used in situations, when the focus starts to shift away from just rehearsing grammar rules and vocabulary?

5.5 Conclusions

In learning contexts, intrinsic motivation has been shown to play a significant role in promoting a learner's engagement. Theoretically, more engagement would lead to more frequent learning, a greater appreciation for learning, as well as inclination for adaptive expertise. Intrinsic motivation is key in developing the will power and skills for lifelong learning. This is especially important in effective language learning, which many language teachers are trying to cultivate inside and outside their classes. In the attempt to increase the learner engagement outside of the formal classrooms, prior studies have tried to harness the motivational pull of mobile devices as a part of the course curriculum. But the more technology is introduced to the educational dynamics, the more instructional designers need to tackle UX-related concerns. A bad digital experience leads to disengagement – this is a common challenge in designing any engaging mobile application.

Inspiration has been searched from games, as they are directly related to basic psychological needs and human behavioral patterns. Consequently, game-like mechanics have been used to increase engagement in non-entertainment contexts. The reviewed literature implies that gameful design in m-learning can improve the overall learning experience by permitting learners to set and understand their own goals, experience success through reaching interim goals, receive various forms of feedback, customizing the interface and monitoring the learning progress. Immediate need satisfaction of autonomy, competence, relatedness and curiosity lead to experiential outcomes, such as fun, effectiveness, control and emotional engagement – all of which cultivate intrinsic motivations.

This thesis aimed to explore the ways of elevating students' motivations to conduct more frequent language learning in a mobile application, KoToToMo+, and to see how the design science research method (DSRM) supported the venture. DSRM was chosen as a research method, as it provides a structured framing when creating and developing e-learning artifacts (Östlund & Svensson, 2018). Interactive, user interface prototypes consisting of many of the aforementioned game-like elements were created. The prototypes were then used in a user testing session with 10 volunteered students to form initial user reactions and opinions about the features. The proposed features generated responses that could be connected to engagement and motivation. The results could be interpreted in terms of how the prototype system compared to the original KoToToMo+, how the results related to the basic psychological needs, and how the mobile affordances could have affected the interaction experience. The results also display the importance of incorporating student voice in all of the design process steps; use of user-centered design methods increase student acceptance of the system.

The vast majority of the participants appreciated the managerial functions, such as goal setting, seeing past learning efforts, and getting learning summaries. Some students liked competitive features and getting extrinsic rewards (badges), while other students had more mixed feelings about such features. This could be an indication of different motivational types; extrinsically motivated students are more drawn to badges, whereas purely intrinsically motivated students are motivated by the act of learning itself. Reactions to push notifications as study reminders were also met with mixed feelings, as they might generate a feeling of being controlled. The overall reaction to the prototypes was positive, but the participants were also curious on the possibilities for direct teacher communication, casual flashcard based learning and highlighted issues with anonymity if competitive features were to be implemented.

This study provides limited insight into the perspectives of modern mobile language learners and their experiential needs. The study is limited in terms of generalizability (e.g., homogenous user group) and reliability (e.g., small sample size, unauthentic test environment). Despite the limitations, the applied methods were found to support the design,

because it allowed finding out information on the factors contributing to student motivation in m-learning related to goal setting, interim goals, various feedback, aesthetics, usability, customization, and social interaction.

The results of this study form the basis for evidence-based development, as it informs future developers about the experiential student needs and grounds them on current knowledge of human motivation and engaging m-learning experiences. The main theoretical contribution of this thesis is demonstrating how UX design can be used in educational applications.

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Appendix 1. Structure for Product Owner Interview (translated)

22.11.2019, Tohoku University, Sendai, Japan

- How does KoToToMo materials relate to the classroom materials?
- Can the users enter any course chapter, at any time?
- Where do the students use the app?
- How many times can the materials be reviewed?
- Are there any restrictions, such as deadlines in the application?
- What type of learning patterns KoToToMo has?
- What do you think are the biggest problems currently in KoToToMo+ (UI / learning content)?
- Free comment about existing tabs / new functionalities

Appendix 2. Structure for Language Teacher Interview (translated)

27.11.2019, Tohoku University, Sendai, Japan

- How many students are taking Chinese classes?
- What is the instruction order, in terms of self-study and classroom learning?
- How many courses and levels are there in Chinese classes?
- How is KoToToMo+ typically used to study?
- Is KoToToMo+ used in every course or level?
- What are students' feelings or attitudes towards using the app?
- In general, are there differences in motivation between students?
- Positive / Negative feedback from the students; what did the students enjoy the most, and what are their worries?
- In your opinion, what kind things would engage the students more in KoToToMo+?

Appendix 3. Questionnaire items (translated)

Choose an option that best describes your reason for studying Chinese

- To get just enough study units
- I want to get better grades
- I want to use Chinese for travel and work in the future
- I was given advice or encouragement (from teachers, seniors, parents, etc.) to study Chinese
- Studying Chinese itself is fun and worthwhile
- I want to be a person who can speak multiple languages
- It's embarrassing to know only one foreign language
- I'm interested in Chinese society and culture
- [own reason]

(1 / 4) Push notifications tailored for the learner

1. If I would get reminders like this, I think I would soon feel like studying.
2. I feel accomplished when receiving motivational messages and viewing learning summaries.

(2 / 4) My page: goal setting & learning progress

3. Viewing and confirming how much I have learned gives me a sense of accomplishment.
4. I think it's important to decide my own learning goals and when to study.

(3 / 4) Days learned, rewards, milestones (interim goals)

5. It's convenient to check the days learned, and upcoming quizzes.
6. By achieving milestones and badges, I feel like I’m getting somewhere.
7. Getting badges does not mean that much to me.

(4 / 4) Overall impression, requests (usability & attractiveness, etc.)

8. The new user interface looked convenient and useful.
9. The new user interface has an appealing and entertaining look.
10. I wish KoToToMo+ had a function that allows me to compare my study progress with other learners.
11. I wish KoToToMo+ had a function that allows you to interact with other learners, e.g. in case of not understanding something
12. Compared to the previous version, this version of KoToToMo+ makes me feel [student answer]
13. I would likely study more with KoToToMo+ if [student answer]