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How to design a motivating e-learning concept for students for a social (informal) exchange of information in the digital age?

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Abstract

In recent decades e-learning is becoming increasingly important in higher education due to the rapid development of digitalisation. E-learning not only offers opportunities to reinvent and support learning but could also provide an answer to how to cope with the rapidly changing information in 21st century society. However, the focus of higher education was on face-to-face courses until March 2020, when the COVID-19 pandemic required a rapid shift to e-learning. E-learning enabled students around the world to continue their studies, but also brought many new challenges for them. While formal study communication with lectures could be converted to an e-learning format, informal communication among students, which is also an essential part of the study and learning experience, suffered. This lack of communication was accompanied by a decline in student motivation and well-being. This master's thesis investigates these e-learning problems, analyses modern e-learning approaches and technologies, and creates a concept that supports the mostly informal information exchange between students. The concept is based on the pedagogical ideas of Constructivism, Connectivism, and Adult Learning Theory. This leads to the choice of using the collective learning approaches Community of Practice, Artistic Pedagogical Technologies, Microlearning and Microtraining combined and to integrate them in the open-source platform Humhub. The concept and platform are evaluated in a small qualitative study. The results provide a starting point to create a better e-learning experience for students - not only during the COVID-19 pandemic, but also in the future as the digitalisation of higher education will continue to grow.

Kurzfassung

In den letzten Jahrzehnten hat E-Learning in der Hochschulbildung aufgrund der Entwicklung der Digitalisierung an Bedeutung gewonnen. E-Learning bietet die Möglichkeit, das Lernen neu zu erfinden und zu unterstützen, und könnte eine Lösung für die sich schnell verändernde Relevanz von Informationen im 21. Jahrhundert bieten. Bis März 2020 lag der Schwerpunkt der Hochschulbildung auf Präsenzkursen, bis die COVID-19-Pandemie eine rasche Umstellung auf E-Learning erforderte. E-Learning ermöglichte es Studierenden, ihr Studium fortzusetzen, brachte aber auch viele neue Herausforderungen. Gerade die informelle Kommunikation unter den Studierenden, die wichtig für die Studien- und Lernerfahrung ist, litt. Dies bewirkte einen Rückgang der Motivation und des Wohlbefindens der Studierenden. In dieser Masterarbeit werden diese E-Learning-Probleme untersucht, moderne E-Learning-Ansätze und -Technologien analysiert und ein Konzept erstellt, um den informellen Informationsaustausch zwischen Studierenden zu unterstützen. Das Konzept basiert auf den pädagogischen Ideen des Konstruktivismus, des Konnektivismus und der Erwachsenenbildungs-Theorie. Dies führte dazu, dass die kollektiven Lernansätze Community of Practice, Artistic Pedagogical Technologies, Microlearning und Microtraining gewählt und kombiniert wurden sowie in die Open-Source-Plattform Humhub integriert wurden. Das Konzept und die Plattform werden in einer qualitativen Studie evaluiert. Die Ergebnisse bieten einen Ansatzpunkt, um eine bessere E-Learning-Erfahrung für Studierende nicht nur während der COVID-19-Pandemie, sondern auch für die Zukunft zu schaffen, da die Digitalisierung der Hochschulbildung weiter zunehmen wird.

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List of abbreviation

App ..... Application
APT..... Artistic Pedagogical Technologies
CBT..... Computer-Based Training
CET..... Cognitive Evaluation Theory
CMC ..... Computer-mediated Communication
CoP..... Community of Practice
CPU ..... Computer Processing Unit
CSCL..... Computer Supported Collaborative/ Cooperative Learning
DC ..... Distributed Cognition
HCI ..... Human Computer Interaction
LMS..... Learning Management Systems
LPP ..... Legitimate Peripheral Participation
OIT ..... Organismic Integration Theory
SCT..... Social Cognitive Theory
SDT..... Self-Determination Theory
VCL..... Virtual Cooperative Learning Space
WBT ..... Web-Based Training

1 Introduction

1.1 Introduction

Supporting the human learning process is not a new idea but with the rise of computers and the development of digitalization the field of e-learning grew over the last decade. According to Kerres (2018), e-learning refers to the use of digital media for teaching and learning purposes. These can be offered via data carriers or the internet and enable the transfer of knowledge, joint work on artefacts, and interpersonal communication. E-learning offers great potential for different challenges of the 21st century like flexible learning, individualization, as well as update possibilities to keep up with the fast-changing relevance of information. In the context of digitisation Moore's Law states that every two years the number of transistors in the corresponding components such as the Computer Processing Unit (CPU) will double. This increases the performance of the technologies that contain components with transistors. The higher performance in turn leads to new technologies and new knowledge (Mollick, 2006). As this development grows exponentially traditional learning methods have difficulties to keep up and react quickly to the change.

In order to keep up with the e-learning progress, German universities have received several hundred million euros in funding for e-learning projects in recent decades (Bremer et al., 2010). Nevertheless, the full potential that e-learning can offer has not always been exploited by the institutions, and the focus has remained on traditional and more formal face-to-face teaching (Kerres, 2020). According to Scheer (2017), higher education institutions show a slow pace of transformation due to a tradition-oriented understanding, a slow generational change of teachers and researchers, the adherence to idealised role concepts, little competition in comparison to private universities, and a financial security through state funding. E-learning activities are often seen as individual initiatives and IT systems are often used to manage courses, that have been developed in-house and are therefore, slow to evolve. E-learning courses are often perceived as very costly to create and with a lack of supportive pedagogical approaches. There are also many prejudices against digital possibilities (Scheer, 2017).

With the start of the COVID-19 pandemic in March 2020, universities had to face new challenges in the field of e-learning. Universities, colleges, and many other institutions, that have previously only offered face-to-face or digitally accompanied face-to-face teaching, were now confronted with the challenge of rapidly digitising their traditional offerings which often didn’t consider digital possibilities (Kerres, 2020). Due to the rapid conversion and integration of e-learning concepts at universities, solutions have often been introduced slowly and not yet been optimised. This affected the learning experience of the students (Lörz et al., 2021). I decided to write this thesis due to my experience as a student who began her online study program in March 2020 with the start of the COVID-19 pandemic and finished her study program online due to the development of the pandemic. While studying online for two years and encountering other students from the study program, I recognize a shared understanding about the good and bad of online studying and e-learning. Also, it was appreciated to be able to attend the lectures and exams and profit from the e-learning benefits, as well as to have support and understanding by

lectures, there is a shared feeling among students that something is missing while studying online. This something, causes isolation, loneliness, motivational problems, and a reduction of the well-being for a lot of students. As this is a subjective perspective, I decided to do a literature research for this thesis and found studies that confirmed, that many students in Germany feel the same way. Negative aspects are identified in studies from 2020 and 2021 (Berghoff et al., 2021; Mulders & Krah, 2021; Stammen & Ebert, 2021; Winde et al., 2020). In the context of this thesis, three challenges from these studies regarding the field of e-learning are examined more closely: Communication, motivation, and well-being and contextual factors. Contextual factors are only discussed shortly due to their influence on the possibilities to participate in e-learning (Mulders & Krah, 2021). These problems are common e-learning challenges (Schümmer & Haake, 2012; Urhahne et al., 2012) which were enhanced during COVID-19 pandemic and are therefore, important to be improved, not only for the study during the pandemic but also for the growing e-learning offers at universities that are here to stay after the pandemic. This is because of the fast-evolving digitalisation and the many positive aspects of e-learning. While studies offer proof that there are challenges, they didn't offer solutions to improve them. In order to create a better study experience for students, this thesis is dedicated to provide a first step to fill this research gap with answering the following research question.

1.2 Research question and aim of the thesis

The research question of this thesis is focusing on the three e-learning challenges communication, motivation, and well-being of students. However, this work is not intended to be a proposal for the digitisation of teaching in higher education. Studies show that formal lectures and communication worked during COVID-19 pandemic, while informal communication between students is perceived as problematic (Berghoff et al., 2021; Mulders & Krah, 2021; Stammen & Ebert, 2021). This is why the focus regarding the topic communication is on informal exchange but it does not disregard formal exchange, since informal and formal exchange are not opposites, but rather lie on a spectrum (Cross, 2007). The research question of this thesis therefore is: How to design a motivating e-learning concept for students for a social (informal) exchange of information in the digital age?

- How to support (informal) learning in a fast-changing information environment?
- How to reduce the feeling of isolation and therefore, improve the communication and well-being in an e-learning environment?
- How to keep students motivated to participate in social online learning activities?

The aim for this thesis is to answer the research question with a concept. This concept offers a new interactive, and social way for students to share current and rapidly changing information, to learn together in an "informal" way, to foster motivation and well-being during the COVID-19 pandemic and to improve future e-learning offerings at universities.

2 Related work

For the purpose of answering the research question, it is first presented why the thesis is written in the subject area of Human Computer Interaction (HCI), as well as the connection to the topic of e-learning. The main challenges of e-learning are presented and discussed with the focus on the extreme case and current e-learning development stand during the COVID-19 pandemic. It is elaborated how learning works with a focus on e-learning. Approaches for a concept solution are selected, based on current learning and knowledge theories, and technological possibilities. The collected information serves as a foundation for designing first concept ideas that are evaluated in the pre-study. The knowledge of the Related Work chapter literature review and the pre-study build the concept. The concept exploits the potential of digital possibilities and modern approaches to provide a learning experience for the 21st century.

2.1 The role of e-learning in HCI

2.1.1 Human Computer Interaction

The field of Human Computer Interaction has its beginnings in the field of "Human Factors", today referred to as Industrial Design, which emerged during the Industrial Revolution. During this time, the focus of businesses was on maximising productivity. Frederick W. Taylor, founding father of Taylorism, attempted to increase productivity through scientific labour management with the separation of the conception and execution of work, resulting in the exploitation and devaluation of human workers, who became expendable. In the 1970s and 1980s, the field of "Human Factor Engineering" emerged in North America, which focused on better machine interface designs to improve physical and mental workload – stress, to maintain production and avoid human breakdowns (Bannon, 1991, 2011; Hewett et al., 1992). In Europe, a similar development took place under the term ergonomics (Bannon, 1991). Human Factor Engineering combines interdisciplinary fields of knowledge such as behavioural science, psychology, industrial design, and physiology (Bannon, 1991; Hewett et al., 1992).

The development of the first computers ushered in the digital age and the transformation from the field of Human Factor Engineering to "Human Computer Interaction" (HCI). Computer technology can be divided into four development phases, that shaped the field of HCI. In the early 1940s, the first computers were developed in the "Mainframe" development phase. The computers filled entire rooms, were programmed, and operated by several highly qualified experts, and took over the calculation of specific tasks, such as in the military. HCI, though not yet defined, was then shaped by engineering, and exact science from the core informatics field. As computers and technologies evolved, a disconnection between developers and users emerged. HCI emerged partly from this problem and has its beginnings in 1968 with Sutherland's Sketchpad PH.D. Thesis, which later led to several HCI interaction techniques. HCI established itself as a permanent field in the early 1980s (Hewett et al., 1992; Pinatti, 2020b). From around 1977, computers became smaller and cheaper, and the "Personal Computer" phase began. Computers were sold as mass products. Users used the devices as multi-functional tools for their work and private use at home, with new interaction possibilities such as sound and new input mechanisms

such as the mouse. The focus of the HCI research at that time was based on applied computer science and software ergonomics, to improve the relationship between the user and the computer with topics such as usability and influences from psychology and cognitive science. From around 1988 onwards, the third development phase began called "Networked Computers". Computers increasingly found their way into companies and private use continued to grow. Topics such as computer-mediated communication (CMC) and cooperation between people were focused. HCI was very close to the field of business informatics and focuses on the usability of collaborative tasks, and communication science, and social sciences (Harper et al., 2008). From around 1996, the fourth and currently still ongoing phase of "Ubiquitous Computing" begins, in which a single person operates many devices simultaneously. The focus here is on the relationship between technology, user and application ecologies. HCI looks at topics such as user experience, Infrastructuring and is shaped by areas of knowledge such as praxeology/cultural science and could be seen as socio-informatic focused (Pinatti, 2020b).

> *„Human-computer interaction is a discipline concerned with the design, evaluation and implementation of interactive computing systems for human use and with the study of major phenomena surrounding them." (Hewett et al., 1992, p. 5)*

Human Computer Interaction (HCI) today, defined by Hewett et al., (1992) refers to a field focusing on computer-heavy and interactive machines and systems and the interaction with people. The term *people* includes individuals, groups, and organisations. According to Harper et al., (2008) HCI refers to both designing and understanding different relationships between people and computers. Both definitions show that HCI is a very large and interdisciplinary field consisting of design, engineering, and sciences such as computer science, psychology, sociology, anthropology, and industrial design. Each field contributes important knowledge to HCI research. Computer science brings knowledge about designing applications and human interfaces, psychology leads to the consideration of cognitive processes, as well as empirical behavioural analysis, sociology and anthropology allow to consider interactions between technologies, work, organisations and people, and industrial design brings knowledge about interactive products (Hewett et al., 1992). The development of HCI and computers has changed the field to what it is today. In the context of digitalisation, HCI is constantly asking how a field of interest can be supported to be improved. This question is also asked regarding the field of learning/e-learning.

2.1.2 E-learning

E-learning is a field that developed from the idea of supporting the learning process and transformed over decades to the diverse and digital field, that is researched in the field of HCI today. According to Dittler (2017) this happened in four phases. Supporting and automating the teaching and learning process by a machine is not a new idea. At the beginning of the 16th century, a learning machine was created to automate the teaching and learning process. Agostino Ramelli created an automation concept for a book wheel that was mechanically movable and allowed the reader to switch between 12 books, so that the books remained positioned as before (Ramelli, 1620 as cited in Dittler, 2017). The first attempts to mechanically support teaching and learning processes were developed during the peak of Behaviourism at the beginning of the 20th century. Behaviourism in short, is the view of the learning

process as a link between stimulus and response. Reward in the case of a desired response can increase its occurrence and punishment can decrease it. In 1926, Edward Thorndike presented a learning machine that asked learners single and multiple-choice questions, which were evaluated. This invention did not succeed to spread. At the same time, Sidney L. Pressey developed a mechanical machine that displays questions and various alternative answers as text. Thorndike's approaches were adopted by Frederic Skinner after the Second World War, who, based on Behaviourism, carried out experiments on learning for both animals and humans. Skinner and James G. Holland developed a learning machine based on the linear programmed instruction approach, consisting of a learning goal, a planning of the learning path and a control of success, as well as stimulus reinforcements. Norman Crowder further developed programmed instructions based on Skinner and established a branched learning structure with short learning units followed by questions with a choice of answers instead of one linear one. The correct answer leads to the next learning unit, the wrong one leads to a learning aid and then to the incorrectly answered question. Based on Crowder, various further developments emerged over the next few years, such as the cybernetic-oriented approach. In this approach, learning machines evolved from mechanical to electronic machines (Dittler, 2017b).

E-learning development phase 1 - Monolithic Computer-Based Training

The first computer-based training in the early days of computer-supported learning in the 60s/70s was still based on Behaviourism. During the development, this changed to Cognitivism, which focused on the cognitive thinking process in learning. Deriving from Behaviourism and Cognitivism, Constructivism dominates the development of electronic and interactive learning media since the 1990s until today. It understands learning as a construction of knowledge, based on individual prior knowledge. After attempts to mechanically support the teaching and learning process, the first computer-supported learning programmes based on cybernetic learning approaches were developed in the 1960s. In the course of time, other media formats were added to text, audio and film, and several people could learn individually in parallel. An example is Robbimat, developed in 1964, it enabled 24 learners to first learn information through a slide projector with a tape recorder and after that, users could answer questions in certain sequences by pressing a yes or no button. Feedback was given with a red or green light. In the 60s and 70s, learning machines were further developed with film and sound. Computer-assisted teaching reduced learning time, but the organisational effort and costs were 10-45% higher than with book-based teaching. The hardware of learning computers had to be specifically built until the 1970s when this was changed by the Personal Computer era. Media-assisted learning and computer-assisted learning were more widely studied. From 1978, LaserDisks were available and better picture and video quality became possible, as well as additional interaction with learning content. At the end of the 1990s, with some intermediate developments, the LaserDisk was replaced by the storage medium CD-ROM. Learning applications could now be developed more easily and cheaply and became widespread. Companies now also used multimedia learning applications, also known as Computer-Based Training (CBT), which imparted factual knowledge and later also soft skills (Dittler, 2017b).

E-learning development phase 2 – Web-Based-Trainings

From 1995 to around 2005, the second e-learning development took place. The increase in internet access in the workplaces, universities and private households created the basis for Web-Based Trainings (WBT), learning platforms and Learning Management Systems (LMS). Through these, learners have access to learning material and their learning behaviour can be evaluated. Web-Based Training requires only a URL and access rights for distribution and enables cooperation between learners, as well as support by teletutors. Learning content can be updated more easily, and the distribution is cheaper. Learning psychology and didactic considerations were neglected during this time and the focus was on maximising the use of technical possibilities. Due to increased training costs and the growing need for training and further education, more and more companies started to get involved with e-learning and at the end of the 1990s a hype began to develop. At the turn of the millennium, e-learning experienced a crisis. The production of CBT/WBTs took a long time and was more expensive than a simple workshop (Dittler, 2017b). The exaggerated expectations of the hype were disappointed. According to Gartner Inc.'s (2022) E-learning Hype Cycle, the hype phase and the great disappointment phase are followed by the plateau of productivity. In this phase, it was recognised that instead of increasing productivity, e-learning should be used to improve teaching and learning processes. Topics such as blended learning, motivational strategies and social learning were started to be explored (Dittler, 2017b).

E-learning development phase 3 – User Generated Content Web 2.0

The third wave took place between 2005 and 2012 and is also called e-learning 2.0. During this time, weblogs, wikis, and podcasts, which are based on the principle of user-generated content, became increasingly important. These collaborative and internet-based forms of communication, according to O'Reilly's (2005) Web 2.0, were taken up by the field of e-learning. Multimedia teaching and learning methods were supplemented by communicative computer-based possibilities (Dittler, 2017b).

E-learning development phase 4 – Postmediality

Since 2005, parallel to the Web 2.0 development, another change has been taking place through the emergence of smart devices. The so-called postmediality describes a 21st century society, in which technical information and communication media are ubiquitous, networked and are connected closely to the user at will. Worldwide existing information is available at any time through representation, transmission, and information exchange media. The quality of the resulting data in particular demands new skills from people, since the social and individual interpretation of the collected information is changing faster. Collecting knowledge from all people and making it available leads to a rapid increase in information and knowledge. Because of the amount of new shared information, it is more often consumed informal, e.g. reading as short post, than formal, e.g. visiting a workshop. Learning is no longer focused on acquiring this knowledge but on the competence to deal with it. Knowledge also increasingly is gained in collaborative processes through strong networking (Cross, 2007; Dittler, 2017b). A scientific field that deals precisely with this topic is "Computer Supported Collaborative/ Cooperative Learning" (CSCL).

2.1.3 Computer Supported Collaborative/ Cooperative Learning

The development of Human Computer Interaction, as well as the development of the field of e-learning, shows that computer-supported learning today is not an isolated activity of an individual, but has changed into a collaborative, constantly evolving practice. The field of "Computer Supported Collaborative/Cooperative Learning" (CSCL) overlaps with the field of HCI and deals precisely with this topic and was first defined in a workshop with the same name in 1989. The definition and meaning of the term are not clear regarding the second “C” which could stand for collaborative learning or cooperative learning (Koschmann, 1996). Collaborative is often used when there is a common goal shared by all those involved in the learning process. The focus here is on the joint negotiation of the processes, goals, and outcomes. Cooperative often refers to structuring the learning process through roles and cooperation methods (Haake et al., 2012). According to Haake et al., (2012), cooperative learning is learning together in a group or community supported by information technology systems. CSCL is a very interdisciplinary field of research, with influences from the fields of psychology, education, sociology, communication sciences, artificial intelligence, and computer science. From psychology, the question of how people learn is answered; from pedagogy, which teaching/learning methods are suitable for CSCL; sociology and communication science try to find out how group dynamics, cooperation, and communication function; and computer science contains knowledge of how CSCL can be supported technically (Haake et al., 2012). The research area serves as a foundation for selecting approaches to answer the research questions in this thesis and to design an e-learning concept.

2.2 How is e-learning different from face-to-face learning – study during COVID-19 pandemic

The focus of German universities remained on traditional and more formal face-to-face teaching over the last decades due to a more traditional orientation, prejudice, perceived costs, and lack of pedagogical approaches etc. (Kerres, 2020; Scheer, 2017). With the start of the COVID-19 pandemic in March 2020, universities had to face new challenges in the field of e-learning, when rapidly digitising their face-to-face or digitally accompanied face-to-face teaching, which often didn’t consider digital possibilities (Kerres, 2020). Through the rapid conversion and integration of e-learning concepts at universities, solutions have often been introduced slowly and not yet been optimised and therefore, affected the students learning experience (Lörz et al., 2021). In a study exploring students' perspectives on the 2020 digital semester, Mulders & Krah (2021) found, that students had both positive and negative views towards the digital study. They found that 53% of respondents welcomed the integration of digital elements in their study program (Mulders & Krah, 2021). For example the individual determination of learning times was liked and supported by 58% of the respondents (Mulders & Krah, 2021). Different negative aspects were identified in studies from 2020 and 2021 (Alawamleh et al., 2020; Mulders & Krah, 2021; Stammen & Ebert, 2021). In the context of this work, three e-learning challenges from these studies are examined more closely: Communication, motivation, well-being. In addition contextual factors are shortly discussed due to their influence on the possibilities to participate on e-learning offers (Mulders & Krah, 2021). These problems are common e-learning challenges (Schümmer & Haake, 2012; Urhahne et al., 2012) which increased during COVID-19 pandemic and therefore, must be overcome.

This is important not only for the study during the pandemic, but also for the growing e-learning offers at universities, that are here to stay after the pandemic, due to the fast-evolving digitalisation and the many positive aspects of e-learning. To overcome the challenges, their cause must be understood and analysed.

2.2.1 E-Learning communication challenge and explanation

Negative effects of the computer-mediated communication on the students

With the change from face-to-face lectures to online lectures at universities, a study by Mulders & Krah (2021) found in a survey, that most students felt the changeover challenging. Due to the struggles of the university to switch their program, many complained about a lack of exchange and communication. In their study, 26% of the respondents found the communication to be partially working, 37% hardly working and 16% not working at all (Mulders & Krah, 2021). Contact restrictions were the greatest challenge in the pandemic (Winde et al., 2020) and made the communication challenges in the topic of e-learning more observable. In a study by Stammen & Ebert (2021) in Germany, 26.3% of 7012 respondents stated that the exchange with students during the online semester is partially successful and 24% that it isn't successful. Especially the contact with other students was often missed, particularly among first-year students. According to a study by Berghoff et al., (2021), first-year students would have wished for more support from the university to establish contact to other students. A social network is very important for academic success, because educational content is often exchanged informal (Marczuk et al., 2021) and as a result, new and important knowledge is generated. The contact with teachers on the other hand, was rated as being better (Alawamleh et al., 2020; Mulders & Krah, 2021). Boling et al., (2012) found that many students viewed their online study as individual learning and felt isolated from teachers and other students as often, assignments were distributed, or lectures were held with little space and time for discussion and exchange.

Informal learning is gaining recognition and importance at institutions like universities and the digitization enables informal learning everywhere. Formal learning like learning in schools, courses, workshops etc. is often top-down and means that learners are assessed and graded for learning material, that is considered important by others. Often there are awards for this, e.g. certificates or diplomas. Informal learning can happen consciously or unconsciously and does not require a grade or class. It is an ongoing process that lasts a lifetime and examples for informal learning are learning by observation, trial and error, conversations, and information exchange with others, etc. A lot of those things weren't possible during COVID-19 pandemic. Formal and informal are not opposites, but ranges along a continuum of learning. Informal learning therefore, does not replace formal learning but supports and enriches it (Cross, 2007). Due to the lack of informal interpersonal conversation and discussion, online studying was often perceived as impersonal, demotivational, and also prevented students from learning more. The studies show that online communication was possible with the provided technology but didn't work in order to support social connection especially between students and was limited in supporting the collective learning study experience. To find an answer on how to create an e-learning concept that supports students' communication, it is first analysed how communication works with the focus on computer-mediated communication (CMC).

Explanation – difference between digital communication in e-learning and face-to-face communication

The term communication is not consistently defined (Blanz, 2014). It derives from the Latin term communicatio (Beck, 2013, p. 155). Blanz et al., (2014) explains the term as communicating informationally, making socially common and allowing to participate in communication and therefore, concludes that communication is something between two parties. Shannon & Weaver's (1972) communication model defines communication as something that happens between a “transmitter” and “receiver”. A message from the “communication source” is “encoded” into a “signal” by a transmitter and sent via a “channel” to a receiver. Here the signal is “decoded” and arrives at the “communication destination” as a received message. Two types of interference can occur during this process. The first one is “noise”, which refers to signals registered by the receiver but not sent by the transmitter and the second is “equivocation”, which refers to signals sent by the transmitter but not received. Communication, according to Shannon & Weaver (1972), only needs to exist but not be understood. The communication model of Shannon & Weaver (1972) is still used today to define communication, but it is highly simplified and Kienle & Herrmann (2012) state that human interaction, even computer-mediated, is more than a simple transfer of a message through a channel from A to B. In today's digital and network connected world, especially in e-learning and CSCL, there are many participants communicating and constructing knowledge together. The German “Model of Electronic Mediatised Community Communication” (transl. Model der elektronisch mediatisierten Gemeinschaftskommunikation) is translated in English for this thesis. The model is chosen to see, what information exchange looks like in an electronic mediatised communication space like web-based services e.g. social networks etc.

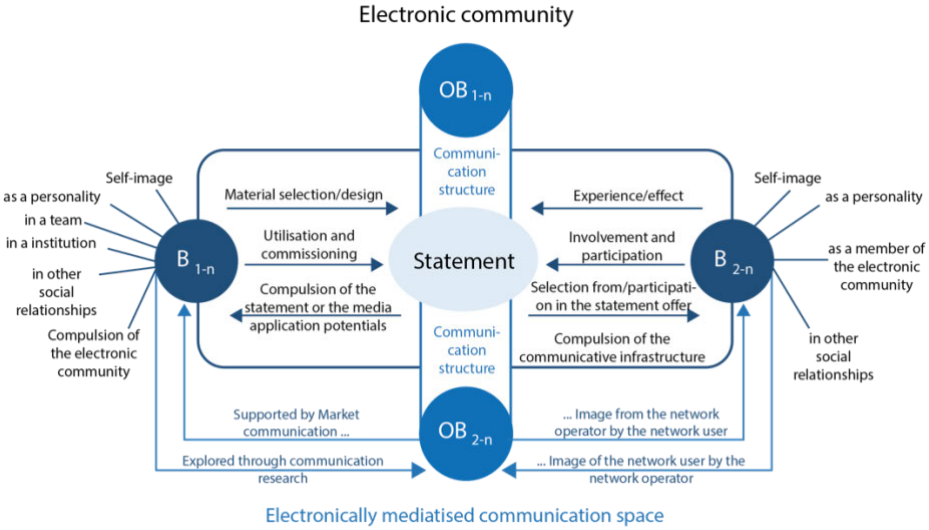

Figure 1: Model of Electronic Mediatised Community Communication based on Maletzke (1963) adopted by Hömberg & Burkart (1998) adopted by Dittler (2017b)

The Model of Electronic Mediatised Community Communication (see Figure 1) based on Maletzke, (1963) was adapted by Hömberg & Burkart (1998) which were both adopted by Dittler (2017b) and formed into a model. The model shows that the communication of participants "B1-n, B2-n" are influenced by individual subjective characteristics and psychological dispositions e.g. self-image and characteristics, job and tasks, social dispositions e.g. the position in the team and the joined institution,

other social relationships, as well as the online community itself. All elements influence each other. The online community observes the communication and influences the communication content, as well as the statements of participants. The chosen communication medium which builds an electronical mediatised communication space e.g. social media platform and its communication structure like chat functions, stories etc. also influence the communication. The communication medium determines the utilisation and commissioning of the social network by participants, e.g. who can use the social network. The medium also influences the involvement and participation of participants, e.g. who can actively experience or just passively look at the content. The communication medium influences also the communication content selection of material/design e.g. photos or videos, as well as the experience/effect e.g. how content is presented. The use of the communication space is constraint by the compulsion of the communicative infrastructure e.g. functionalities but also the organisation "organising participants OB 1-n, OB 2-n" such as moderators with administration rights. These can determine roles and rights. They influence three points: The rules of etiquette, editing individual contributions, removing them, etc., and the knowledge of this role leads to a change in the behaviour of the participants. Computer-mediated communication in the group is consequently influenced by individual conditions and social roles and structures similar to the real world. However, most aspects of group communication are influenced by the choice of the technical medium building the electronically mediatised communication space (Dittler, 2017a). This also applies to the choice of a medium for the channel in Shannon & Weaver's (1972) communication model. Thus, there is always a difference between CMC and face-to-face communication caused by the used medium.

In order to analyse computer-mediated communication (CMC), it is useful to identify how the medium influences the communication with the so-called media richness. Media richness refers to the limitations of a medium on a communicator's ability to reduce ambiguity in messages and interpersonal uncertainty. Communication consists of verbal communication such as text and of non-verbal communication such as facial expressions. Both together make for rich communication, but can also take place separately, as in the case of e-mail or telephone. A very rich medium supports communication with personal information, immediate feedback, social cues, and ease of language use (Sherblom, 2010). Face-to-face communication is the richest medium with personal meaningful information obtained of the situation such as visible emotions, synchronous feedback, multiple verbal and non-verbal social cues, and a variety of language possibilities (Trevino et al., 1990). Kiesler et al., (1985) notes that in many CMCs, non-verbal communication is diminished, e.g. e-mails with only text. Here CMC is a leaner medium, which can transmit less information, keys, etc., and communication and thus lacks auditory and visual social information. Some information can be partly provided by telephone calls and video conferencing tools. Medium richness influences decision making, problem solving, and communication (Kiesler et al., 1985; Trevino et al., 1990). Kiesler et al., (1985) also states that CMC often feels impersonal because important key factors of our personality also called social presence including our emotions, body language and way of interaction (Yamada, 2009; Ying Tang & Khe Foon Hew, 2018) are lost. Yamada, (2009) describes social presence as meaning psychological closeness, immediacy, intimacy and familiarity with the other person, communication, and relationship. It’s absence strengthens the sense of anonymity, reduces appreciation and empathy towards others, communication partners are

evaluated less positively, it takes longer to develop relationships and inappropriate behaviour, such as swearing, occurs more frequently (Kiesler et al., 1985). The identity of deindividuation effects (SIDE) model argues that the reduced social cues and visual anonymity leads to attention being paid to the limited data available, such as communication style, word choice, etc. The cues are over-emphasised and stereotypical impressions about social status, class, gender, ethnicity, etc. are reinforced (Garcia et al., 2009; Postmes et al., 1998). Visual anonymity also leads to deindividuation, greater identification with the group, and can lead to increased outgroup and intergroup dynamics, as well as prejudice (Lee, 2004). Another effect of CMC is the hyperpersonal perspective (Walther, 1996) which shows that people strive to be liked and to receive recognition (Ramirez et al., 2004, p.424; Toma et al., 2008) and in CMC this is expressed through the strategic manipulation of messages for better self-presentation. It is the asynchronous and near-synchronous communication that gives time to revise the message and reconsider responses (Duthler, 2006; Toma et al., 2008; Walther, 1996). This creates a feeling of distance in communication. It is important in CMC design to be aware of this and to create a comfortable place, where participants feel they can be themselves in order to connect, belong and experience well-being. Electronic profiles can be created to balance non-verbal and social cues and provide information for a richer communication and better group communication (Sherblom, 2010). The evolution of digitalisation has also opened new non-verbal ways and strategies to enrich communication, such as sending emojis to give messages more emotional meaning for a better interpretation. Positive emojis can also strengthen the perceived intimacy and relationship (Ying Tang & Khe Foon Hew, 2018). Despite the challenges that CMC brings, Kiesler et al., (1985) states that it can, if used correctly, support long-distance work and strengthen relationships. Especially when there is a common goal or interest, people like to use CMC (Kiesler et al., 1985).

In summary regarding the field of e-learning, computer-mediated communication brings many challenges which, when not acknowledged, can diminish the communication and social and emotional well-being of students during their online study. The reason for that is the lack of a good digital infrastructure, the knowledge of the digital possibilities and the lack of pedagogical approaches. Universities during COVID-19 pandemic were often unable to provide a good digital solution with rich communication possibilities. Often different digital tools were chosen by lecturers that offered little overlap with other courses and whose only task was the distribution and discussion of course material. Informal learning exchange between students, a social presence and a sense of community were not well supported. In order to design a concept for a better learning experience and communication for students, the challenges of CMC are considered.

2.2.2 E-Learning motivation and well-being challenge and explanation

Negative effects of e-learning on students' motivation to study and well-being

Many students' motivation has also been negatively affected by the COVID-19 pandemic through the solely online teaching programme (Winde et al., 2020). In a survey by Winde et al., (2020) 59% of the students surveyed reported motivation and concentration problems during their online semester. In a study by Stammen & Ebert (2021), 41.2% of 7012 respondents reported a loss of motivation during online study. The satisfaction also dropped from 85% in the previous semester without the COVID-19

pandemic to 51%, according to Winde et al., (2020), as academic study life was negatively affected by the pandemic. E-learning or remote learning, according to E. Knowles & Kerkman (2007), requires self-directed learning without other students to support the process. Therefore, academic success in learning is strongly linked to self-motivation and therefore, intrinsic motivation (Ryan & Deci, 2000a). Motivation and especially intrinsic motivation, which is important for learning, were negatively affected during the COVID-19 pandemic, particularly by the feeling of isolation, but also by the lack of technological support (Hara & Kling, 2003; Winde et al., 2020). To find an answer on how to create an e-learning concept that supports students' motivation and well-being, it is analysed how the challenges emerge and how motivation works.

Explanation – difference between face-to-face and e-learning regarding the student's motivation

The motivation of learners in computer-supported learning environments is often given little consideration, even though motivation influences the individual learning success, the attitude towards learning tasks, the avoidance or seeking out of learning situations, and the experience of frustration or satisfaction (Schoor & Bannert, 2011; Urhahne et al., 2012). Urhahne et al., (2012) refers to two learning motivation theories, in the still little researched field of motivation in CSCL (Schoor & Bannert, 2011), that she considers particularly important for the field: Rheinberg (2008) and Rheinberger & Vollmeyer (2019) Cognitive-Rational Model of Motivation and Ryan & Deci's (2000b) Self-Determination Theory. Both theories are examined in more detail below. Since Richard M. Ryan and Edward L. Deci have done a lot of research on the topic of motivation, extensions of the Self-Determination Theory are also considered to deepen the topic in relation to e-learning (Ryan & Deci, 1985, 2000b, 2000a).

The Cognitive-Rational Model of Motivation defines motivation as a function consisting of the component's situation, action, result, and the resulting consequences (Rheinberg, 2008; Rheinberger & Vollmeyer, 2019). For this purpose, an individual chooses an action depending on a situation to achieve a result with un/expected consequences. An action can be intrinsically motivated to act, motivated by expected consequences or motivated by incentives to act. An extension of the Cognitive-Rational Model of Motivation includes a so-called expectation level. This describes results and consequences that individuals expect due to certain situations and actions. Depending on these estimated expectations, the corresponding motivation changes. There are different expectations in the expectation level that are related to each other. The "situation-result expectation" describes the result of a given situation if no action is taken. If the situation-result expectation is high, the willingness for the activity is low and the motivation decreases, e.g. when receiving a certificate of achievement only for attendance without contribution. The "action-result expectation" is based on the individual's subjective assessment of how one's own action could lead to a possible result. If one's own action is assessed as having a low or negative impact on the result, the willingness to carry out this action decreases, e.g. a comment helps little or not to answer a question. The "result-consequence expectation" is the assumption regarding the connection between result of an action and consequences. A separation between the result of an action and consequences makes sense, since results are directly influenced by the action, but consequences are a reaction of the environment and can only be estimated. Results of an action can therefore, have several unexpected consequences that can be assessed differently. If the result-

consequence expectation is low, the motivation for an action is lower, e.g. if a contribution of a group work subsequently contributes little to the individual examination. In addition to the expectation level regarding one's own actions, there is also an incentive level which shows where the motives for the action reside. These include incentives based on the consequences, which look at the consequences of action results e.g. whether internal and environmental states are evaluated as desirable. Incentives of the consequences of an action are often extrinsically motivated, e.g. grades and external evaluation. The incentive level also includes activity incentives that lie in the action itself and are therefore, intrinsically motivated (Rheinberg, 2008; Rheinberger & Vollmeyer, 2019; Urhahne et al., 2012). According to Rheinberg, (2008) and Rheinberger & Vollmeyer, (2019), the intrinsic and extrinsic motivational components often depend on the interest in the learning task. The model shows that it is important to be aware of the expectations of students especially regarding the results and consequences to improve intrinsic motivated participation and well-being in a modern e-learning concept, but also make use of extrinsic motivators for important but less interesting topics.

Students are often motivated to succeed in their studies by their intrinsic motivation e.g. the joy of learning, and extrinsic motivation e.g. getting a good job. To develop a deeper understanding what these motivations are and how they work the research of Ryan & Deci (1985, 2000a, 2000b) is analysed. According to Ryan & Deci (2000a), intrinsic motivation is defined as acting out of joy of an activity, while extrinsic motivation refers to an action intended to bring a specific goal. Intrinsic motivation is particularly important in education because it helps people to learn better and to be more creative. Intrinsic motivation, according to Ryan & Deci (2000b), is based on the Self-Determination Theory (SDT). SDT focuses on three psychological needs of humans: Competence, autonomy, and relatedness. Autonomy is the ability to do an activity independently. Relatedness is the feeling of being respected and cared for, and competence is being able to do things. It also includes environmental factors that positively or negatively influence intrinsic motivation (Ryan & Deci, 2000b). Cognitive Evaluation Theory (CET) is a sub-theory of STD and complements it with interpersonal events and context which can also influence the three factors. CET also argues that competence, autonomy, and relatedness are interdependent. The fulfilment of the three needs promotes growth, constructive social development, well-being, interest, excitement, and self-confidence, which in turn improve a person's performance and creativity. Communication is an important factor for intrinsic motivation, as positive performance feedback increases the need of competence. Autonomy can also be promoted through social interactions and communication (Ryan & Deci, 2000b). According to Ryan & Deci, (1985) autonomy does not stand for separation and rejection of communities, but for the ability to fulfil an activity independently of the community. Relatedness is also very important, as a supportive community can provide security to discover new things. Studies prove that especially in online learning intrinsic motivation is more important than in traditional face-to-face teaching (Wighting et al., 2008; Yukselturk & Bulut, 2007). Therefore, it is important to consider need fulfilment when designing an e-learning concept. However, students are not only intrinsically motivated but also extrinsically motivated. Extrinsic motivation is important because it ensures that study tasks that are less enjoyable are also completed (Ryan & Deci, 2000a). Contrary to what is often assumed, extrinsic motivation does not always mean that people cannot fulfil the needs of competence, autonomy, and relatedness and thus

cannot achieve well-being. The Organismic Integration Theory (OIT) argues that extrinsic motivation is not the opposite of intrinsic motivation, but can also include aspects of intrinsic motivation, which makes it important for consideration in the design of e-learning concepts (Ryan & Deci, 1985).

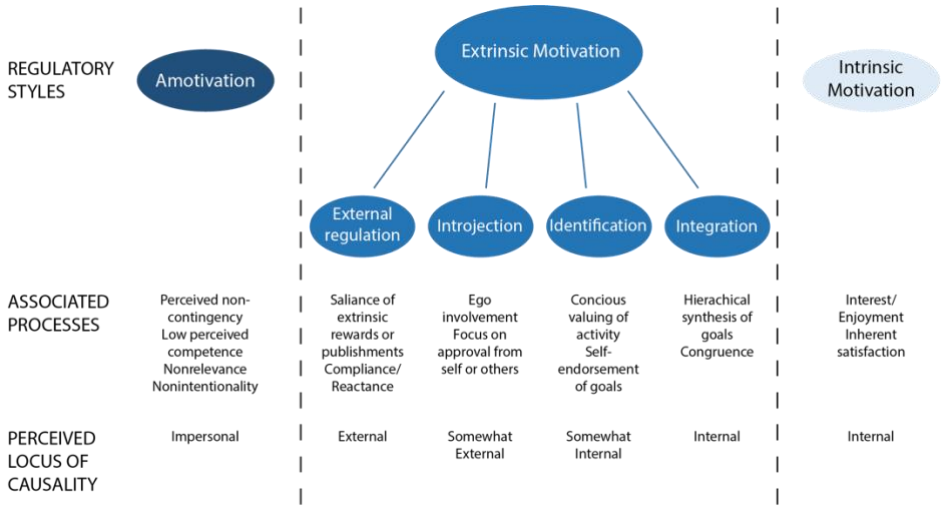

Figure 2: Based on Ryan & Deci (1985) Organismic Integration Theory (OIT)

The OIT (see Figure 2) explains that extrinsic motivation is divided into four levels. Since intrinsic motivation is crucial for learning success in e-learning, this paper focuses on the two extrinsic motivation stages that are similar to the intrinsic motivation. The first level is called “Identification” and describes that a person acts autonomously and self-determined but is extrinsically motivated. This means that a person identifies with a behaviour or activity that is important to them personally and is willing to do things that are not intrinsically motivated e.g. learning vocabulary to be able to speak a language. The second level is called “Integration” or “Integrated Regulation” and is the most autonomous extrinsic motivation and therefore, very similar to intrinsic motivation. Here, a person appropriates extrinsic regulations in such a way, that they correspond to their own values and needs. The more closely the regulations match one’s values and goals, the more self-regulated one’s motivation for action becomes (Ryan & Deci, 1985, 2000a). Relating this to learning, the more students can identify with the knowledge imparted and the demands associated with it, the more they are motivated to engage, perform better, and learn more. In particular, the need for relatedness can promote extrinsically motivated behaviour through social connection and a sense of belonging to a group. However, this should not result in negative peer pressure, but feel more like a positive responsibility to participate in the group towards a common goal. The more these three needs are fostered by an extrinsic motivated activity, the more intrinsically motivated benefits the person receives.

In the study by Pelikan et al., (2021), the relationship between the three needs, intrinsic motivation and procrastination was investigated in 17 countries. The study found that especially during COVID-19 pandemic, the factors competence, autonomy, and relatedness were affected which had a negative impact on students’ intrinsic motivation and led to more procrastination (Pelikan et al., 2021). Due to the pandemic, students were isolated, and especially first-year students in a new country had difficulties establishing a social network at the beginning. Additionally, many colleges and universities had problems

establishing communication networks at the beginning due to the rapid change. According to a study by Pelikan et al., (2021), this caused a lack in the need relatedness and had a negative impact on the intrinsic motivation to learn and on the sense of belonging. A lack of perceived autonomy by the students increased procrastination, worsened the perseverance to work, and diminished the intrinsic motivation a lot. The reason given was that students could not choose whether to study online or face-to-face which was perceived as limiting their autonomy. The perceived competence influenced the persistence with which students worked on the tasks. The lack of it could also lead to an increased procrastination. The reason given was the assumption that explicit and implicit feedback from students and teachers also exclusively took place online. Implicit feedback can be difficult due to the lack of informal discussion and social feedback that one would get in a face-to-face conversation (Pelikan et al., 2021). However, Pelikan et al., (2021) notes that the results were influenced by the different ways countries dealt with the COVID-19 pandemic. The studies and motivational models demonstrate that to develop a successful e-learning concept to support the motivation and well-being of students, it is necessary to consider the three needs, as well as the expectations especially regarding the results and consequences of participating students. A possibility to improve the motivation can be building a community of students, with voting's as well as communication support to be aware of the expectations of the students and to provide them with influence on the learning goal.

2.2.3 Contextual factors influencing participation in e-learning

The successful use of an e-learning concept depends not only on the satisfaction of the three needs competence, autonomy, and relatedness, as well as a good communication and social interaction but also on the contextual factors of the students. E-learning has not only changed the learning form but also the place of learning and learning times. The place of learning used to be institutionalized e.g. in the university and the time of learning depended mostly on a timetable. E-Learning shifts the place of learning from the institution too everywhere with access to the learning courses and material (Dittler, 2017a). During COVID-19 pandemic the place was mostly at home and strengthened the impact of socio-economic factors on learning. Stammen & Ebert (2021) found in their study on the acceptance of e-learning programmes that all statements were influenced by socio-economic factors such as full- and part-time studies, parenthood, studies in the mother tongue or a foreign language, stable internet access etc. It also became apparent that not all students had the necessary technical devices such as a laptop, tablet or smartphone for an online semester (Lojewski & Schäfer, 2017; Stammen & Ebert, 2021). The technical requirements that were important to be able to use the e-learning offer included not only access to the internet but also the quality and speed of the connection. In the survey by Stammen & Ebert (2021), it was found that of 7012 students surveyed in Germany, 91.6% had access to an internet connection (mobile or WLAN/LAN connection), but 23% had permanent connection problems and 39.7% had problems at least once a week, which limited their performance. The place of internet access can be at home but also in public institutions (Lojewski & Schäfer, 2017). In the survey by Stammen & Ebert (2021) in Germany, 6.1% of the students had difficulties obtaining the devices they needed for online study, 10.6% had to buy new devices, and 18.9% planned to buy more devices. A total of 28.4% said they wanted to buy new equipment but did not have the financial means at the time. The figures were due to students from low-income backgrounds and students who owned inadequate

hardware e.g. too old for the software they needed. The housing situation is particularly difficult for parents who are studying, as they didn't always have a quiet retreat due to childcare (Marczuk et al., 2021; Stammen & Ebert, 2021). International students can have problems due to the time difference because of their place of residence. Interestingly, the technical competence of the respondents was not an issue and very high as 97.3% stated that they were proficient in the use of different media and 75.1% would have trusted themselves to help others with technical problems (Stammen & Ebert, 2021). Not only the learning place changed but the learning times have also become more flexible despite lectures, as no commute was necessary and some study formats also allowed for a free division of learning through e.g. uploaded lectures, thus enabled individual adaptation. However, the associated constant accessibility through digital communication media and permanent access to learning material, blurred the line between free time and learning time. This could led to an expectation among students that there must be a permanent willingness to learn and could caused more stress during online study, which should be acknowledged when designing an e-learning concept (Dittler, 2017a). Context plays an important role in the access of e-learning and should therefore, be considered in the design. It is not possible to take all criteria into account as, for example, living conditions cannot be influenced by the design. In chapter 2.4.3 (p. 25), a reference is made to the topic of Infrastructuring, which helps to take contextual factors into account in the design process.

2.3 How does (collaborative) learning work

In order to develop a modern e-learning concept and improve the three discussed problems, first a basic pedagogical perspective of how collaborative learning works must be acquired. This chapter looks at the development of the understanding of learning, followed by a consideration of the currently dominant learning approach of Constructivism, as well as approaches that support it from the field of CSCL. These approaches are presented in relation to the topic of e-learning and then combined to form a foundation for the development of a modern e-learning concept to answer the research question of this thesis.

2.3.1 Paradigm shift in teaching and learning

As can be seen in the history of the field of e-learning in chapter 2.1.2 (p. 4), there is not one learning theory but many. First learning theories were based on general behavioural theories, which stated that the environment influences people, who adapt their behaviour due to effects on their learning process (Bandura & Walters, 1970; Janneck, 2012). The S-R "stimulus-responses" theory later reinforced this idea and understood learning as an observable change in behaviour that occurred in response to an external stimulus. This basic idea was also a part in Behaviourism, a learning theory that became widely accepted. It stated that by manipulating these stimuli and the experienced consequences, the behaviour shown can be changed and thus learning can be controlled. These approaches were developed in the beginning of the 20th century and were very popular in the 1940/50s for developing behavioural technologies as well as teaching and learning technologies. Today, learning approaches such as Behaviourism are strongly criticised because mental, motivational, and emotional aspects are described as a so-called "black box" and neglected in the studies as humans are seen as creatures responding to stimuli. Nevertheless, the first CSCL concepts were designed according to Behaviourism. In the 1950s, a

paradigm shift took place in psychology, also called the "cognitive turn" (Janneck, 2012). Cognitive models of learning and Cognitivism came to the foreground and dealt with human information processing, perception, memory processes, thinking and problem-solving strategies, speaking and language comprehension. Learning according to cognitive models was seen as based on an individual's accumulated experiences, and influencing not only their view on what they have already learned and experienced, but also the individuals current perception of the environment and how they find their way in it (Gentner & Stevens, 1983; Janneck, 2012). The learning processes in the cognitive sense aimed to build knowledge and to store it in long-term memory. However, Cognitivism plays a subordinate role in CSCL today because social, emotional and motivational processes are neglected, which are important due to their strong influence on human behaviour and thinking (Janneck, 2012). According to Janneck (2012) social-constructive theories are most important for the field of CSCL today, as they understand learning as a social process that takes place in the interaction between people. They form a basic assumption for how cooperative learning works. Constructivism today, which gained more importance since the 90s in CSCL and therefore, in the development of e-learning, relies strongly on the ideas of social-constructive theories and forms the foundation for many modern e-learning tools and concepts.

2.3.2 Teaching and learning according to Constructivism

Early constructivist learning theories are based on the radical Constructivism of von Glasersfeld (1997). He defined radical Constructivism as knowledge that existed only in people's minds, which consists of a subjective construction of conceptual entities based on their experience. Knowledge thus does not correspond to reality. Knowledge is a collection of concepts, relationships, and actions that have proven to be viable in the pursuit of goals. Truth or reality is not important in his definition (von Glasersfeld, 1997). Grune & de Witt (2012) concluded from radical Constructivism that learning cannot be planned and that people were seen as closed systems, since there is no objective, equal environment and thus learning makes no sense. Vygotskij (1978) described in a summary of his writing called "Mind in Society" first thoughts which today are related to Constructivism and social Constructivism. These writings are influenced by the Social Cognitive Theory (SCT) by Bandura & Walters (1970). The SCT states that behavioural, cognitive, and environmental factors influence human behaviour. The theory shows that people learn by observing others and associate certain behaviour with a desired outcome. This behaviour is then in turn adapted by the observer. Vygotskij (1978) writings emphasised the significance of social interaction in the construction of knowledge, as well as the important role of tutors in the learning process and provided a foundation, from which many different constructivist approaches emerged (Couros & Hildebrandt, 2016; Lave & Wenger, 2002; Stahl, 2012; Vygotskij, 1978). The writings also influenced many pedagogical and didactic approaches of today. One modern constructivist approach is the one of Papert (1986). Paperts (1986) definition of Constructivism, is used as a foundation in this thesis on how learning works.

> *„The word constructionism is a mnemonic for two aspects of the theory of science education underlying this proposal. From constructivist theories of psychology we take a view of learning as a reconstruction rather than as a transmission of knowledge. From a rich body of educational experience we take the view that learning is particularly effective when it is embedded in an activity the learner experiences as*

> *constructing a meaningful product (for example, a work of art, a functioning machine, a research report or a computer program.)" (Papert, 1986, para. 1)*

This Constructivism is based on epistemology and states that knowledge is constructed and interpreted according to the learner's mental model in an active process to understand the world. There are also multiple realities, that are constructed locally by social actors. The reality of the individual thus changes through interaction with others and learning is embedded in a social process. This view considers that learners already have prior knowledge and are surrounded by context and situations, which are the base to build new knowledge. Learning is a self-controlled process, therefore, the amount of influence of the prior knowledge used in the process of generating new knowledge can be controlled (Anderson, 2016; Dittler, 2017a; Gräsel & Mandl, 1999; Grune & de Witt, 2012; Rohde, 2020). Learning according to the constructivist approach is often project-based and experimental with the aim of learning new things based on the motivation, beliefs, and interests of the learners. Tutors act as a support in the learning process and help to connect thoughts and ideas also by helping to construct artefacts in the form of learning aids (Anderson, 2016; Dittler, 2017a; Papert, 1986; Vygotskij, 1978). Papert (1986) proposed the constructivist approach as a solution to the already and still existing challenge that information changes faster due to digitalization. This requires a learning strategy that supports learners to learn more flexibly and to use the new digital possibilities. A core thesis is therefore, that computers offer different possibilities for free and self-determined constructivist-based learning and have a high potential for application and creativity (Papert, 1986). However, it was noted that for the learning experience on the computer, knowledge of how to use it is necessary, and physical and sensory experience and social skills are not taught. Papert (1986), not only defined Constructivism but also conducted a study that was later used as a reference by many researchers. Papert's (1986) project was called "Lego-Logo" and its aim was to enable children in primary school to acquire programming skills for their own ideas according to a constructivist approach. The focus of the project was therefore, not on imparting knowledge but on enabling the children to learn autonomously. For the project, the children first received Lego bricks with which they were allowed to build whatever they wanted. Step by step, the children's artefacts were equipped with electronics that could be controlled with the Logo software. Teachers were tutors in this process and helped the children to realise their ideas. Social interaction thus also played a role. The children had influence and freedom of choice in the project design, as well as the process. The project motivated the children intrinsically because they could pursue their own interests trough creative self-determination. What was learned was also seen as meaningful. Papert (1986) drew four key points from the project that should be asked when designing learning materials and tools according to the constructivist approach: Level 1- Can the material be used to achieve something, Level 2 – Can what is learned be used for other things, Level 3 – Consider the user individually and Level 4 – Analyse the integration of the material in different learning environments. The project proved that learning based on the constructivist approach supports intrinsic motivation to learn (Papert, 1986). Similar to Papert's (1986) four key points Dittler (2017a) defined a good learning environment based on the constructivist approach as:

- Learning is designed as an active and constructive process
- The acquisition of knowledge can be self-directed

- Knowledge can be acquired in the active confrontation with problems
- Authentic problem situations are provided
- The acquired knowledge can be applied in different problem situations
- Newly acquired knowledge is evaluated in a social group (Dittler, 2017b)

2.3.3 Pedagogical concepts to support the constructivist approach

The basic idea for answering the research questions lies in Constructivism. However, the approach for designing e-learning concepts, which has dominated since the 1990s, only provides a rough framework according to which a concept can be designed (Anderson, 2016; Couros & Hildebrandt, 2016). To consider the target group of students, as well as the digital change that has happened since the 90s, two other approaches are used and briefly introduced. Since most of the target group are students and adults, the constructivist approach has to be applied to adult learning and therefore, the Adult Learning Theory is presented. To focus more on the progress of digitalisation, Connectivism is considered, which is often seen as an extension of Constructivism (Dittler, 2017a; Siemens, 2006).

Adult Learning Theory

Adult Learning Theory states that adults learn differently from children and that the differences should be considered. M. S. Knowles (1978), who also worked on the Adult Learning Theory, argues that adults have a different motivation to learn and already have more experiential knowledge. He also states that adults should be involved in the planning and evaluation of the learning process, the experience gained should be considered, topics with direct relevance to the job and everyday life should be preferred, and learning should be problem based (M. S. Knowles, 1978).

Connectivism

Connectivism has its origins in psychological models, such as that of Donald O. Hebb and is based on the idea that in the brain, clusters of cells organize themselves neuronally and thus enable a learning process. This idea of learning based on the psychological models can be transferred to the internet where information is linked to each other with a e.g. link and communicated with e.g. comments. In this way, people and increasingly also technology form a knowledge network and collective knowledge is created on the internet. Learning in the sense of Connectivism on the Internet, is a process that consists of activities of humans and machines. Humans and machines through their algorithms, simultaneously create, edit, share, evaluate and delete information. Both activities create a network that is constantly changing and which contains the knowledge of today's digital knowledge society (Kerres, 2018). Connectivism shows the importance of digital applications, software, hardware, and network connections in learning. The approach recognises that new technologies are changing human cognition and how people create, store and exchange information. The approach states that learning and knowledge are based on dynamic learning, which is an important process connecting people, groups, ideas, information, and digital interfaces. Fostering and maintaining connections in the network is fundamental to a knowledge society. The Connectivism approach is very interesting for the field of e-learning development as it looks at different aspects of human learning in today's digital fast evolving

and internationally connected world (Couros & Hildebrandt, 2016). There are eight principles that define the Connectivism of Siemens (2006) that is considered in this thesis:

- Learning and knowledge rests in diversity of opinions to present the whole, as well as to offer the selection of the best approach
- Learning is a process of connecting specialized nodes or information sources
- The knowledge rests in networks. Nurturing and maintaining connections are needed to facilitate continual learning
- Learning may reside in non-human appliances and is enabled and facilitated by technology
- Capacity to know more is more critical than what is currently known
- Ability to see connections between fields, ideas, and concepts is a core skill
- Currency (accurate up-to-date knowledge) is the intent of all Connectivism learning activities
- Decision-making is itself a learning process. Choosing what to learn and the meaning of incoming information is seen through the lens of a shifting reality. While there is a right answer now, it may be wrong tomorrow due to alterations in the information climate affecting the decision (Siemens, 2006)

Some see Connectivism as an extension of Constructivism, with the difference that it also considers the rapidly changing amounts of information and the constantly evolving living environment. In constructivist learning theories, knowledge is always linked to persons or institutions. Connectivism, on the other hand, also considers digital knowledge storage. In this theory, the individual represents a networked being that has access to several sources of information, which can be technical or human, and can generate knowledge through these connections. Selecting and evaluating the information received is an important part of the learning process, as is maintaining the connection to the sources. Similar to Constructivism, in Connectivism the intrinsic motivation to learn, and a willingness to explore topics, and evaluate, and question what is learned is central (Dittler, 2017a; Siemens, 2006).

2.3.4 Foundation for building an e-learning concept based on the Constructivism, Connectivism and Adult Learning Theory approach

The development of a modern learning concept that offers the possibility to improve the communication, motivation, and well-being of students is built in this thesis based on the Constructivism of Papert (1986), Connectivism by Siemens (2006) and the Adult Learning Theory by M. S. Knowles (1978). In summary, these approaches view learning as a social construction of knowledge that emerges from the connection between human and technical knowledge carriers. The focus is no longer on learning all knowledge, as this changes and grows fast, but on learning how to evaluate, assess and link new information with other and already gained knowledge. It is important to consider the interest of adult learners to create an intrinsically motivated learning experience. Direct or practical knowledge application and relevance to the learners' present or future is also important. Learning with problems that are important for the learners is suitable for imparting knowledge with a strong practical and everyday relevance. Learners should actively participate in the learning process, to be able to act self-determined and be supported by tutors. The acquired knowledge should be discussed and reflected on in a group, as well as by the individual during the learning process.

2.4 Building an e-learning concept focusing on communication, motivation, and well-being

After defining the basis for how learning in the developed e-learning concept works (chapter 2.3, p. 16), as supplements, modern learning approaches are presented that focus on improving the three challenges communication, motivation, and well-being (chapter 2.2, p. 7) more specifically. One approach to consider the context while designing the concept is also shortly introduced. In the last part the technical realisation of the collected approaches is discussed.

2.4.1 Approaches to improve the communication in a modern e-learning concept

The e-learning concept that is developed in the context of answering the research question intends to improve mainly the informal exchange of information between students. The digital learning space differs in the richness of the communication and the medium. Low richness leads to increase of the feeling of anonymity, reduces empathy for others, it takes longer to build relationships, inappropriate behaviour occurs more often, etc. (chapter 2.2.1, p. 8). The aim of the following approaches is to create a social presence and a sense of community to improve the informal communication online. This is to be achieved through the approaches Artistic Pedagogical Technologies (APT) and Community of Practice (CoP). The APT approach is focusing more on stimulating a creative exchange and the CoP approach on establishing a collaborative practice, which is why they can complement each other.

Artistic Pedagogical Technologies (APT) approach

One of the biggest communication problems is the often-perceived lack of community, social presence in computer-mediated communication and e-learning. This lack has a negative impact on the feelings towards other communication partners. As discussed in chapter 2.2.1 (p. 8) their absence, could lead to a feeling of isolation, alienation and deindividualization, as well as a hyper-personal perspective which can lead to misinterpretation of messages. To improve the communication, the Artistic Pedagogical Technologies (APT) approach by Perry & Edwards (2016) is chosen. Perry & Edwards (2016) conducted research on how learning designers and teachers can create a sense of community and a social presence in an online course, to create meaningful interactions and a good social experience while learning. Social presence refers to the ability of learners and teachers to project their personal characteristics into the online e-learning space and thus present themselves as a real person (Garrison et al., 1999). Social presence has many benefits in e-learning such as a sense of belonging which creates a good environment where participation and collaboration are encouraged (Zhao et al., 2014). Perry & Edwards (2010, 2016) sense of community is defined as a “community as a culture”, which is a shared culture in an online classroom with shared values, norms and beliefs and which is influenced by the background and context of the involved individuals (Zhu, 2012). Learning in a community significantly enables learning experiences with other members and improves learning through informal discussions (Ziegler et al., 2014). Holmes (2013) confirms this when he examined the European Commission’s e-twinning project which is a sub-programme of the Live Long Learning programme. In this programme, an online community for teachers was initiated to collaborate and informally learn with other teachers. The aim was to try out Web 2.0 e-learning tools and share the experience with the community. The e-twinning project offered therefore, learning events where an expert or tutor from the community worked on

topics with small groups of teachers. Many teachers were able to learn about new ways of teaching and gain great added value, which encouraged their participation and collaboration in the community. Teachers who could not apply the knowledge reported that they still felt inspired by the discussion and exchange and developed new ideas. Many participants reported that the discussion helped them to stimulate critical and reflective thinking (Holmes, 2013). Feelings of isolation and loneliness can also be reduced through the proper establishment of an online learning community (Phelan, 2012) and social presence.

In Perry & Edwards (2012) view, many pedagogical strategies that focus on fostering community have an art-based approach. Art-based approaches include literary, visual, musical or drama elements. APTs differ from traditional online technologies in that they focus on aesthetics and creativity. APTs can have different applications (Perry & Edwards, 2012), the approach considered here is suitable for new technologies and the integration of pedagogical foundation of Constructivism, Connectivism, and Adult Learning Theory to create a community, where members have a social presence. One of the APT's approaches proposed by Perry and Edwards is called Photovoice. Photovoice was developed by Wang & Burris (1997) and adapted for online instructional technology by Perry & Edwards (2012). It involves posting a digital image with a reflective question by the teacher. Perry & Edwards (2010) studies show that APT's can improve interaction between teachers and students, as well as among students, and improve the social presence in virtual classes or communities. The extent to which images can contribute to discussion and creative exchange can be seen on social media platforms such as Instagram. APT's also recommend that learners should be able to share a photo, story or poem about personal interests, as this often relates to the person's values, and beliefs and thus promotes a social presence (Perry & Edwards, 2010).

Community of Practice

In order to establish a learning community in e-learning, the concept of Community of Practice (CoP) by Wenger (2008) is used as a supplement to the more general APT approach by Perry & Edwards (2016), as it forms the basis for many CSCL processes. The CoP is more focused on establishing a shared practice e.g. learning while the APT approach is more focused on establishing the community feeling with a shared feeling and believes. The CoP approach, like Constructivism, assumes that individual learning always takes place in a social context, in this case a community. A community in CoPs is seen as a group of interacting individuals who share a common interest and practice and thus have a sense of belonging with a loose and often voluntary cohesion. According to Lave & Wenger (2002) and Wenger (2008) a CoP is a group of people, who share an interest in a topic and continuously try to solve problems. The "Negotiation of Meaning" is the shared understanding of the practices, knowledge, activities, and norms within the CoP, such as software developers having a shared understanding of what a bug is. The "Participation and Reification" process is important for the Negotiation of Meaning (Wenger, 2008). The Reification is the creation of objects, artefacts or symbols that carry meaning e.g. in a software company this would be software manuals, a database, a wiki etc. in which software bugs and terms that emerge over time are documented. The Reification happens due to the Participation of members through a joint process of negotiation with conversations, discussions and problem-solving (Ley et al., 2012; Wenger,

2008). This could be achieved for example with posting topics and tasks based on the APT approach. According to Lave & Wenger (2002) and Wenger (2008) "Participation and Reification" build a central mechanism of collective learning. Individual learning within the collective learning process is described as "Legitimate Peripheral Participation" (LPP). LPP is an interactive process through which new community members are introduced step by step to the social practices and thus adopt the knowledge and norms of the community. This social and situated learning in CoPs is considered constructivist, as a new experience is linked to prior knowledge within a context of action, e.g. apprentices learning from experts and growing into tasks. CoPs focus on the "Distributed Cognition" (DC) approach, which refers to the exchange of different perspectives of multiple people and the artefacts used for this purpose, e.g. images and text. According to Lave & Wenger (2002), artefacts are a representation of the mental model and thus a knowledge representation of individuals who confront others with it, e.g. a wiki entry of one employee influences the thoughts of another employee. A rich design of communication media provides different possibilities for artefacts and establishes individual connections between the mental models of the members (Ley et al., 2012; Wenger, 2008), so they can learn from each other.

The CoP and an adapted APT approach integrated in an e-learning concept have the potential to improve the communication through creating a social presence, as well as to diminish the feeling of isolation through community-based learning practices and therefore, are used to create a concept to answer the research question. The APT approach needs to be adapted as creative elements can only be integrated to an extend depending on the learning topic. Therefore, the main idea of using creative elements, as well as reflective questions to support discussions and exchange, are used for the concept.

2.4.2 Approach to improve the motivation and well-being in a modern e-learning concept

In order to improve motivation and well-being in e-learning based on the motivation theories presented in chapter 2.2.2 (p. 11) and the basis of learning theories consisting of Constructivism, Adult Learning Theory, and Connectivism in chapter 2.3.4 (p. 20), it was determined that it is important to recognize and consider the expectations of the learners. The learner should therefore, be involved in the design of the learning process, relevant problems, and learning content should be presented. The learning process should also fulfil the human needs of competence, autonomy, and relatedness. Autonomy and competence can be achieved through active contribution, constructive feedback, and influence on the learning process and content. Relatedness can be achieved through using a CoP and APT approach mentioned in chapter 2.4.1 (p. 21). To offer a framework for learning content that can be adapted to the interests of the learner and that does not take too much of the students' time to avoid a high stress load, the Microlearning and Microtraining approach is chosen. Both offer short structured informal information content that can be adapted to various purposes regarding the topic of e-learning.

Microlearning and Microtraining

Robes (2009) defines Microlearning as short online activities. These activities can be users, answering self-organized questions or an education expert who guides the user in dealing with a specific topic. It is an everyday approach where a goal is set and to achieve it, small informal learning processes are repeatedly conducted. Microlearning is similar to modularised learning material a closed unit, that can be learned independently of other units. It often includes links to additional information to learn

independently more, if interested. While Macrolearning refers to formal learning, such as lectures, that take several days to years to complete and impart comprehensive knowledge, Microlearning is a short learning process of a few minutes (5-15 minutes). It imparts short-term problem-solving strategies and focuses more on informal learning. Informal learning has little structure in terms of learning goals and learning times and often no formal recognition for an acquired competence in the form of a certificate. Microlearning is a flexible concept and depends on the perspective of the observer (Robes, 2009). According to Robes (2009), there are two perspectives. Learners see Microlearning as self-organised information search, evaluation, and selection to achieve a self-imposed goal. They therefore, consume Microcontent and make contributions to it through comments and links. Lecturers regard Microlearning as (Micro)content that is didactically prepared. Microlearning consists of Microcontent which, according to Robes (2009), is defined by the following characteristics:

- Microcontent has a focus and is always about a concrete and definable content, idea, or thing
- Microcontent has a structure with at least one title, one author, one date etc.
- Microcontent is a self-contained unit and to be understood independently of other content
- Microcontent is indivisible and forms the smallest unit of meaning that cannot be shortened further without loss of meaning
- Microcontent is addressable and has its own URL through which it can be accessed (vgl. Leene, 2006; Robes, 2009)

Microcontent and therefore, Microlearning are integrated into Web 2.0 social applications and services such as social networking services, wikis, weblogs, and microblogs (Robes, 2009). Microlearning supports social and collaborative learning, especially through the networking possibilities (Mohammed et al., 2018). It focuses on demanding few material resources and intangible resources such as time and attention. It is deeply integrated in the modern information society. For example, a person briefly reads a newsfeed in an app in the morning, maybe clicks on an article to read it, and saves it, and forwards it in a message, and learns not only through this but also exchanges it's knowledge with another person. This approach is suitable for a modern e-learning concept. Increasingly, Microlearning is demanded by the economy, as it enables work-integrated, flexible, and efficient learning. In everyday life due to social and digital change, users have become accustomed to consuming many small information modules, means Microcontent, at any time (Robes, 2009). A study by Mohammed et. Al., (2018) compared traditional teaching with Microlearning sessions in two groups of students who were studying the same topic and had to take several unannounced tests. The study proved, that Microlearning in comparison to traditional learning led to better test scores. This was attributed to a higher motivation of the students, which was supported by the shorter but also more creative and actively co-designed Microlearning units (Mohammed et al., 2018). Thus, despite the shorter learning units, Microlearning is not inferior to traditional more formal teaching in terms of learning success and information transfer, when applied correctly.

According to Robes (2009), Microlearning in terms of qualification is called Microtraining. Microtraining is a short and guided format that can be integrated into training programmes. The format is capable of different objectives. It can be focused only on e-learning or enabling a mixture between traditional and e-learning, e.g. offline tasks for 10 minutes that are sent by e-mail. Microtraining can promote interest

and content or can be a part of a qualification offer. A Microtraining session lasts 15-20 minutes and has a fixed structure consisting of: Active start phase of 3 minutes, demonstration and exercise phase of six minutes, reflection and discussion phase of four minutes and a what is next, and anchoring phase of three minutes. Several Microtraining sessions can form a series of learning units consisting of an introduction, several Microtraining sessions and a conclusion. Microtraining is more suitable for inexperienced learners as they need more instructions, while Microlearning is for experienced learners who can learn more independently. As experience grows, learning requirements often become more informal and individualised (Robes, 2009). For the developed learning concept, Microtraining and Microlearning are considered due to knowledge differences of the students depending on their semester.

2.4.3 Approach to consider the students context in a modern e-learning environment

The context can only be considered to a certain extent by the designer, when creating an e-learning concept, because of the lack of influence on for example socio-economic factors. Due to the time limitation of this work, the context is only briefly illuminated with the Infrastructuring approach. However, the Infrastructuring perspective, requires a long-term study, in order to be able to fully understand and consider the wider context of the concept, developed in this thesis. The approach is therefore, used superficially. Infrastucturing is a theoretical framework that has been developed to support designers and developers to engage in social technological systems and create in a sensible way technology and interactive systems that are useful and usable for people in their everyday life. This is why it is also usable for the area of CSCL. Infrastructuring is an umbrella term appropriated for practices and an approach to consider all facilities and environmental, physical, digital, cultural, cognitive etc. elements around people, the relationship between them, and how they relate to the system that is designed. The approach goes beyond user and practices. It focuses on relationship of different elements to support the designed system (Pipek, 2017; Star & Bowker, 2002). The eight characteristics based on Star & Ruhleder (1996) and Star & Bowker (2002) can be used to design a e-learning concept, considering the wider context in which it is placed in:

1. *"Embeddedness"* (Star & Bowker, 2002, p. 152) of infrastructure in other social and technological structures (Pipek, 2017). The e-learning concept and the digital tools used for it are embedded in the context of students but also, regarding the wider context, in the university structure. Community-based learning approaches, like CoP, support formal learning concepts like lectures in universities or build an independent informal learning unit (Ley et al., 2012). Because this concept is for the target group of students, the university setting is important. The model of knowledge maturation from A. Schmidt et. Al., (2009) shows how CoPs are embedded in these larger organisations and institutions and how they influence each other. The model shows both the temporal influence on knowledge representation development externally and internally in the CoP. The CoP can be a self-organised knowledge development and influence the organisation (bottom-up) or be influenced by the organisation (top-down). In the model, knowledge is transferred from the individual to the community to the organisational level through a variety of social learning processes. In the process, knowledge matures through constant sharing and contextual distancing, supported by different digital tools. This is why the technology landscape

of the university is important and how the concept, which must be implemented in a technological tool, fits into it (A. Schmidt et al., 2009). How the e-learning concept will affect the university and how the university will affect the concept can only be analysed after the concept implementation. Regarding the direct learning context for students, it is important to provide internet access, as well as devices to be able to use the e-learning concept. To include students that have problems there, the concept can be designed to be partly used offline on different devices. Providing a quiet and calm setting for concentration is challenging outside of the university and a problem that is not solved easily. The university and the policy can create offers to enable people in difficult circumstances, such as with low income or parents with children, to study at home. Due to the limited possibilities to consider these challenges in the design of an e-learning concept, they are neglected in this work.

2. *"Transparency"* (Star & Bowker, 2002, p. 152) in invisibly supporting tasks (Star & Bowker, 2002). The e-learning concept could be a support for lectures in providing additional knowledge for students and also offer the possibility to learn from each other. The appropriation of the concept by students to support other tasks is something, that only can be researched when distributing the concept for a long time and observing the users and effects on the university.
3. *"Reach or scope"* (Star & Bowker, 2002, p. 152) which is spatial or temporal (Star & Bowker, 2002). The e-learning concept and the digital tools used for it are designed for students at the University of Siegen of faculty three. This was decided due to the time limitations of the work. While the concept is constructed and tested for one faculty with similar programs it can be used for several similar faculties or a whole university. Since this is a learning, communication, and information exchange concept, a common interest and goal are important to support discussion and to integrate a sense of community. How wide the e-learning concept usage spreads and how long it is used can only be analysed in a long-term study.
4. Comprises taken-for-granted artifacts and organizational arrangements *"Learned as part of membership"* (Star & Bowker, 2002, p. 152). People aren't always aware of infrastructure, sometimes they take it for granted, especially when behaviour is surrounded by dependency (Pipek, 2017; Star & Bowker, 2002). The concept and the digital tools used for it will be embedded in the technological, social, and organizational structure of the University of Siegen which is important for the design and is discussed shortly in the first characteristic. To be able to consider these structures they must be analysed in detail in a separate study.
5. *"Links with conventions of practice"* (Star & Bowker, 2002, p. 152). Infrastructures shape and are shaped by conventions of practice, which means it is what it is because of how people use it (Pipek, 2017; Star & Bowker, 2002). The e-learning concept and the digital tools used for it are shaped by the students using and appropriating them. How the users will use the concept can only be fully analysed in a long-term study.
6. *"Embodiment of standards"* (Star & Bowker, 2002, p. 152) infrastructures *"are plugged into other infrastructures and tools in a standardized fashion, though they are also modified by scope and conflicting (local) conventions"* (Pipek, 2017, p. 95). Like for example standards that mediate communication between different infrastructures. The e-learning concept and therefore, used digital tools are plugged into the technology landscape of the University of Siegen. In order to

provide as much access for all students as possible and to create a e-learning concept which can be adapted to different learning scenarios, the digital tool for the concept implementation should be independent from university software tools like Moodle etc. but with interface points.

7. *"Build on an installed base. Infrastructures do not grow de novo, they wrestle with the inertia of the installed based and inherit strengths and limits from that base"* (Star & Bowker, 2002, p. 152). Also, the concept that is developed in this thesis may be new, it isn't possible to develop everything that can be imagined. The social environment and stage of technology development shape how the concept can be implemented into the technology. It does not matter how innovative technology is, it is always based on patterns from before (Pipek, 2017; Star & Bowker, 2002). Thus, for the concept used, digital tools are based on today's technological possibilities.
8. *"Becomes visible upon breakdown"* (Star & Bowker, 2002, p. 152). The Infrastructure becomes visible when it isn't working anymore (Star & Bowker, 2002). The e-learning concept and the digital tools used for it are dependent on the internet access of the students, which means, when the internet access is breaking down or the right devices aren't provided, the e-learning concept can't be used. For the concept an existing digital tool is adapted. This causes a strong dependency from the digital tool provider in topics like tool breakdown or update problems.

In order to create a better learning, experience, the infrastructure characteristics are considered to a possible extent for the design.

2.4.4 Technical implementation based on the motivation, communication, and context approach requirements

Web 2.0. technologies and functionalities

To choose the right technical tools and functionalities to implement the discussed approaches, their requirements must be fulfilled. The learning foundation consisting of Constructivism, Connectivism, and the Adult Learning Theory needs the possibility to exchange information collaboratively, regarding different learning content. Also, the current knowledge must always be stored up to date and be accessible for all learners to construct a knowledge network. To improve the communication, motivation, and well-being the APT, CoP, Microlearning and Microtraining approach require a group-like functionality, in which short multi-media artefacts can be shared and discussed. The contextual dependencies are acknowledged but can only be considered to a limited extent e.g. providing downloadable information. To set a technical framework for the approaches first a *Virtual Cooperative Learning Space* (VCL) must be established. The *Virtual Cooperative Learning Space* (VCL) is a concept allowing coordinated e-learning through the systematic and purposeful use of technologies with the three functionalities coordination, communication, and cooperation, which can be established through various digital and analogue functionalities and tools. Communication in VCLs is the exchange of information between users through functions like chat, comments, etc. Coordination functions regulate the communication, and the distribution of tasks, and access rights e.g. assignment of roles. Coordination does not have to be computer-assisted and can also be established through rules in advance. Collaboration technologies enable users to work together like collaborative text writing in a wiki (Dawabi, 2012). VCLs can be set up for one learning purpose or are adaptable. An example for a set up VCL is the Virtual Teaching and Learning VCL (VITAL) (Pfister et al., 1998) which enables the joint

reading and editing of materials in the form of hypermedia documents with communication tools such as chat and audio, as well as awareness functions, that help to visualise the presence and activities of participants. Generic VCLs such as the CSILE platform developed by Apple in 1995 for cooperative learning in schools, can be flexibly configured for different learning scenarios and content (Scardamalia & Bereiter, 1996). Due to the selected approaches a generic VCL is more interesting for the e-learning concept.

The digital tools used to establish a VCL are often based on Web 2.0 technology (O'Reilly, 2007) also named social software (Koch & Richter, 2009). Web 2.0 was defined by O'Reilly and MediaLive International (Ebner, 2012; O'Reilly, 2007) and refers to the paradigm shift in the use of the Internet towards user-generated content, user networks, and the provision of services. Web 2.0 technology consist of three basic functions. The first is identity and network management e.g. user profiles and the construction of a contact network. Second is information management in which user-generated content is related, found, evaluated, and managed. The last function is the interaction and communication with other people (Koch & Richter, 2009). Also, Web 2.0 technologies have these three functions in common, they differ in the following dimensions:

- Dimension: The communication can be synchronous, asynchronous, or mixed. Asynchronous communication channels store messages while synchronous communication connects participants to the communication channel simultaneously. Mixed forms offer both options.
- Number of partners: Bilateral communication between two or multilateral communication.
- Media: There is written or textual communication, images, references to artefacts, transmission of audio and video etc.
- Persistence (permanence): Volatile messages with a time frame or permanently retrievable messages.
- Information flow: Push media message inform users without active intervention, pull media recipient means that message must explicitly be retrieved.
- Symmetry: Symmetrical communication means all participants have the same rights and opportunities while asymmetrical communication means they have different rights.
- Openness: Open user groups have a publicly accessible medium and closed user groups have a medium with access control e.g. invitation (Schümmer & Haake, 2012).

Depending on which dimensions are important technical tools are chosen to establish a VCL, as well as the different learning, communication, motivation, and well-being approaches. This is done through aligning the dimensions of Schümmer & Haake (2012) with the dimensions and therefore, proposed digital tools of Ley et al., (2012). Ley et al., (2012) based the digital tool proposals on Wenger et al., (2009) and adapted them to support CoPs with digital tools (see Table 1). As the CoP is an important focus of the concept and also contains ideas of the constructivist approach the table can be used to identify the right technical tools. The proposed tools can then be used in a way, that also fits the functionalities needed to establish a VCL.

CoP Polarities	Technological Dimensions	Examples for Tools
Temporal-spatial rhythms: Being together vs. separated	Synchronous	**Microblogging**, **Instant Messaging**, Whiteboards
	Asynchronous	Email, Social Tagging, **Wikis**, **Weblogs**, Discussion boards
Identity: Individual vs. collective identity	Individual	**Weblogs**, **individual Profiles**, Email, Friend lists
	Group	**Community sites**, **Wikis**, Newsletter
Interactions: Participation vs. reification	Participation	Email, Videoconference, **Chats**
	Reification	Document management, Collaborative Tagging, Bookmarking, **Wikis**

Table 1: Technological dimensions & tools by Wenger et. Al., (2009) adapted by Ley et. Al., (2012)

The following dimensions of Ley et al., (2012) and Schümmer & Haake (2012) should be fulfilled, and support the decision of which of the technical tools and functionalities should be used for the technical realisation of the concept. An asynchronous dimension e.g. wikis and weblogs (see Table 1 bold words) could make learning time more flexible for students and easier to integrate into the stressful university day but also an almost synchronous communication e.g. chats and instant messaging (see Table 1 bold words) should be given to stimulate more active discussions. The e-learning concept and used digital tool should be an exchange platform for a student group, and therefore, it should be a multilateral usable tool e.g. community sites, wikis (see Table 1 bold words). However, students should also have the opportunity to present their own thoughts individually with e.g. individual profiles, weblogs (see Table 1 bold words). Persistence should be based on permanently available messages and the flow of information could be based on pull media, as this prevents students from feeling that they always should be online in order to not miss out. An asymmetric communication structure allows a few responsible people to establish important rules that enable structured learning. Since tutors are supposed to provide help and support and stay longer in the community as students finish their study, it would be useful if they have more rights. The tools should have a broad access control. For example, all members of a degree programme or a faculty in the university context could have access, since they deal with thematically similar areas of interest and thus bring a good foundation for an exchange of information and building a Community of Practice (Ley et al., 2012; Schümmer & Haake, 2012). Based on the dimensions and the three characteristics of a VCL a social networking tool will be used to implement the approaches. Social networking tools offer identity and network management e.g. user profiles, information management of user generated content and interaction and communication functionalities with chats, comments, wikis, weblogs, microblogs, community sites etc. but also fulfil with these the discussed dimensions and proposed digital functionalities (Table 1 bold words) (Ebner, 2012; Ley et al., 2012).

Social Networks

Social networks, also called user networks or social network services, are explained by Koch & Richter (2009) as networks created through user participation and a service that focuses on identity and network management. Social networks have five basic functions:

- Identity management through user profiles, where users can present themselves, connect with contacts and communicate through chats etc. (Ebner, 2012; Schümmer & Haake, 2012)
- Contact/expert search enables people to be suggested through matches in profiles and search for profiles with keywords. Acquaintances can be made in the system and together they form a social network (Back & Gronau, 2009; Ebner, 2012)
- Network awareness informs people of what is happening (Ebner, 2012). This can include different awareness types: Social Awareness defines, that users are informed about other members and receive information about them like e.g. interests, preferences, and current situations. Activity Awareness means users are informed about the actions of other users in the group like e.g. which object is being worked on etc. Task Awareness describes knowledge of group members about tasks distribution and the current state of the process like which tasks are defined or how should they be processed (Gutwin et al., 1995; Schümmer & Haake, 2012)
- Context awareness enables the creation of a common context by highlighting similar interests
- Contact management helps to manage contact connections (Ebner, 2012)

In addition, a social network consists of functionalities like chats or instant messaging, user profiles, community sites, sharing content in weblog-like posts, notifications, etc. Social networks can be used stand-alone or extended by integrated services such as wikis. Sharing information and interacting with content through liking etc. enable both asynchronous and synchronous communication (Ebner, 2012). Social networks can be used to establish CoPs through a CSCL orientation and support collaborative formal and informal learning. A study by Greenhow (2011) demonstrated that Facebook contacts enabled students to get help for creative learning tasks and can be used for collaborative e-learning. E-learning can be systematically established by setting up a VCL with using coordination, communication, and cooperation functionalities of the social network (Cross, 2007; Dawabi, 2012; Ebner, 2012; Ley et al., 2012; Schümmer & Haake, 2012). If the social network is perceived as a network where learners can actively participate, this can have a motivating effect and create a good learning environment (Schümmer & Haake, 2012).

Weblogs and Microblogs

Walker (2003) defines a weblog as a website that regularly receives new contributions like posts that are presented in chronologically reversed order from new to old. Weblogs enable people to present their own experiences, thoughts, and ideas on topics to the public or to a closed group (Ley et al., 2012; Schümmer & Haake, 2012). They can be part of a social network, weblog software or a simple HTML website (Schümmer & Haake, 2012). Weblogs and microblogs are often used in universities to discuss course material or to develop a common understanding and learning on topics and to record one's own learning success. Own weblog contributions can contribute to the exchange of ideas and promote the establishment of a CoP on a specific topic through communication functions such as comments in which discussions can take place (Ebner, 2012; Ley et al., 2012). Users who network on weblogs form a network of relationships that motivates them to participate more strongly in the resulting CoP (Ley et al., 2012). More rarely, weblogs are jointly authored as group weblogs (Schümmer & Haake, 2012). References are often visible and can thus be tracked (Herring et al., 2005). Weblogs have a structure and contain multimedia elements like text, videos etc. They often contain a weblog title or headline,

which is the identifying feature of each weblog post. Posts can be tagged to make joint annotation. Tagging takes place with freely selected keywords called tags that are linked to objects and build a network consisting of users, tags, and objects. A rough structuring can be achieved with categories and the visualization with tag clouds with colours, font size, etc., to see active areas of interest of participants (Ley et al., 2012). Weblogs also often consist of a sidebar with navigation elements and a search field. Each weblog entry contains a Permalink to the post (Ebner, 2012). Microblogs differ from weblogs, in that posts have a text length limit, such as Twitter's 140 words. The aim is to exchange news, messages, and communication between users (Borau et al., 2009). Posts are often publicly accessible, and users can subscribe to them by following other users. The posts form an information stream (Ebner, 2012) and are connected by hashtags to form a news stream on a topic. This makes posts navigable and filterable. Messages from one hashtag can be displayed on a board. Microblogs additionally have the following features: With re-tweets, posts can be posted repeatedly. The username with an @ is a mention or a direct address of another user who is informed about it and can reply. URL shorteners shorten long URLs to create a short link. Metadata such as the time of transmission etc. is automatically recorded (Borau et al., 2009; Ebner, 2012). Microblogs are also very suitable for consolidating a CoP and support learning communication (Ley et al., 2012; C. Müller et al., 2012; J. Müller & Stocker, 2011). Especially in social networks weblogs and microblogs share the same functionalities and only differ in the amount of used words. The weblog structure and format are similar to those of Microcontent and therefore, Microlearning and Microtraining structure and can be easily adapted to this approach.

Wikis

Wikis are content management systems with the aim of enabling collaborative knowledge construction through interaction between individual contributions (Bruns & Humphreys, 2005; Ebner et al., 2013; Ley et al., 2012). Wikis enable web or intranet based collaborative text creation and editing (Raitman et al., 2005). Wikis often include version control and link consistency. The authoring group can be a community or open to anybody. Authors have equal rights to edit text, but when one area is edited, it is often locked to others (Koch & Richter, 2009). Wikis focus on collaborative information management rather than on individual participants. Discussion and communication support are not the focus and often serve to correct errors in contributions. Wikis often have the following functionalities:

- The text is edited section by section with a WYSIWYG "What you see is what you get" editor, that displays already formatted text
- Full text and title search to find documents which form a main navigation element in many wikis (Back & Gronau, 2009; Koch & Richter, 2009)
- A version control tracks changes and restores old versions in case of problems (J. Schmidt, 2006)
- Discussion pages or comments help to discuss and resolve errors
- Links between wiki pages are provided by non-directional hyperlinks. Setting hyperlinks to non-existent pages can indicate a need for new information (Back & Gronau, 2009)

With open wikis, quality control of the information is difficult. Only when the number of users is very large errors can be quickly noticed and corrected through discussions (Ebner, 2012). With small wikis, the responsibility can be on the participants, wiki entry creator or a control authority. When a wiki is used with the Connectivism approach, the information presented is understood in such a way that

readers have to actively reflect and question it rather than passively consume it. Therefore, the entry provides a first step to learn about a topic, but it is known, that other sources should be used additionally to build knowledge and reflect on the provided information. Wikis are often used in CoPs because they offer different perspectives, existing and new ideas visible in written form. In this way, a shared sense of meaning can become apparent, as well as the current stand of knowledge. Knowledge exchange succeeds through the joint editing of texts and supports the process of understanding in CoPs (Ley et al., 2012; Raitman et al., 2005; Zhu, 2012). As a wiki contains different perspectives in the form of different entries, it offers positive conflict potential for discussion and promotes the participation of members in discussions. If the individual perspective contrasts with others, an accommodation process takes place, in which the knowledge representation of people expands (Cress & Kimmerle, 2008; Ley et al., 2012). This is also where the Constructivism, Connectivism, and CoP approach can be found, which describe a collaborative knowledge construction. The difference between wikis and weblogs is that wikis focus on collaborative content creation, while weblogs present mostly individual contributions (Avci & Askar, 2012). Wikis can be independent or integrated into a social network.

Technical implementation with the open-source social network tool Humhub

To establish a social network with VCL functionalities, the considered dimensions and therefore proposed technologies and functionalities, the open-source platform Humhub is chosen for the technical implementation. Humhub contains not only the functionalities of a social network but also offers weblog and wiki functionalities. The platform is a social networking software that can be designed flexibly and individually through numerous plug-ins. Humhub provides some standard features for asynchronous almost synchronous communication with comment, follow and like functions that can be used multilateral or individually. The coordination is possible by creating roles e.g. having admin rights, access control and collaboration functions are provided with the wiki. In Humhub community sites can be build and are named “spaces”. Spaces contain an activity stream which displays all activities and contributions that space members share within it. According to the pull media principle, a notification function can inform users about news, when they are logged in. The notification function is providing different awareness types as it informs about different activities of the community and community members. Contributions can be microblog- or weblog-like posts, documents, and other digital multi-media elements. Individual profiles give members the opportunity to introduce themselves and to connect with others. As the platform is a self-hosted solution, the network creator retains control over the users' data. As Humhub has already been deployed in other projects of the University of Siegen, it is made available and adapted for this project. The security of the students’ data is the responsibility of the university, which already owns and securely stores data on students independently of the platform. In the following chapter, it is explained how the research question “How to design a motivating e-learning concept for students for a social (informal) exchange of information in the digital age?” is answered in the thesis, with the collected knowledge of literature research in the Related work chapter.

3 Methodology

To answer the research question, not only the literature review, which is in chapter 2 (p. 3) but also a qualitative study is conducted. In the literature review, a search for research papers and literature is conducted to analyse the existing knowledge on the topic of e-learning challenges, the current situation during COVID-19 pandemic, collaborative learning, communication, motivation, and well-being approaches. The findings build the foundation for the creation of a concept (chapter 5, p. 39) to answer the research question. A qualitative study is used, because the research topic focuses on the socially interactive aspects of e-learning, as well as communication, motivation, and feelings e.g. well-being. The qualitative and exploratory research approach allows a deep insight into the user's feelings and thoughts regarding a relatively new topic (Baxter et al., 2015; Flick, 2009; Schoor & Bannert, 2011; Urhahne et al., 2012). With the nonprobability-based sampling method "purposive sampling" specific recruitment criterions are set in order to identify and recruit students of the target group that are relevant to the study (Baxter et al., 2015; Flick, 2009). The qualitive study contains two parts with the pre-study and the main-study. For both parts one criterion is set: Students had to start their studies during the COVID-19 pandemic or one semester before it started, without having been enrolled at the university before. Students that fulfil this criterion are able to reflect on their online study experience as they studied mostly online. For the main-study two additional sampling criterion are chosen: The students shouldn't know each other well and belong to the same or very similar degree program of one faculty of the University of Siegen. Both criteria enable to test the building of social presence and getting to know others and building a CoP around a common learning topic. In the pre-study three semi-structured interviews are conducted and in the main-study the concept is implemented into Humhub and tested and evaluated with semi-structured interviews with six participants. Semi-structured interviews are chosen to be able to compare answers of participants and to deepen interesting aspects during the interview when needed (Baxter et al., 2015). The results are used to discuss the opportunities the concept offers as well as the limitations. In the final step, the improved concept aspects are visualized in a high-fidelity prototype. This offers a first impression of how an e-learning concept within Humhub could look like and answers the research question. Additionally, it offers the opportunity to include functions and ideas that could be integrated in Humhub in the future, as the current state of the software in the University of Siegen is very simple.

For the pre-study three participants are interviewed to get to know the target group of students and their needs and challenges during their study in the COVID-19 pandemic, in order to reflect the findings of the Related work chapter 2 (p. 3) and evaluate first concept ideas. According to Guest et al., (2006), in the context of a small qualitative study with interviews, six participants are necessary to get a first impression of the target group in relation to a topic, but in the context of this thesis it was decided to work with only three participants due to time constraints and a second main-study with six interviews. For the semi-structured interviews an interview guide is prepared (Appendix A, p. 85). The interviews are transcribed into an edited transcript (Appendix B, p. 87) without word crutches and misstatements and analysed using the qualitative content analysis method with the software MAXQDA to gain important insights. A code list is created based on the interview guide to analyse the transcripts

regarding the interview questions in MAXQDA. The MAXQDA file can be found on the CD enclosed with this thesis (file path: /MasterThesis/02_Pre-Study/03_Analysis of Interviews/Analysis_PreStudy_Masterthesis_LisaClausen_WiSe22.mx22). The results and the analysis are documented in and Excel document which can be found on the CD enclosed with this thesis (file path:/MasterThesis/02_PreStudy/03_AnalysisofInterviews/AnalysisResults_PreStudy_Masterthesis_LisaClausen_WiSe22.xlsx) (Baxter et al., 2015; Kuckartz & Rädiker, 2022). The results of the pre-study and the chapter Related work form the foundation for the e-learning concept (chapter 5, p. 39).

In the main-study, the e-learning concept is integrated in the open-source platform Humhub and then evaluated. The platform is used because it offers the possibility to create an individualized platform for social information exchange. This makes it possible to test a concept that includes the informal exchange of information and the successful integration of a CoP that supports e-learning, reduces the feeling of isolation, and focuses on intrinsic motivated participation. According to Guest et al., (2006), in the context of a small qualitative study, six participants are necessary to get a first impression of the target group in relation to a topic. Therefore, the test will involve six students as participants and myself as tutor. Due to the time constraints of this work, the concept is tested for a period of two weeks. After the test, the participants evaluate their experiences in semi-structured interviews (Baxter et al., 2015). Even if the main goal of the concept is to test if a community and social presence could be established in a group, semi-structured interviews enable to evaluate how individuals really feel about the group dynamics and learning experience and therefore, gain a better understanding on how to integrate individuals in the e-learning concept. The interviews discuss the topics of communication, motivation, and well-being, how they perceive the setting of Humhub as well as if the participants could learn something valuable and new in addition to their study program. For this purpose, an interview guide is created (Appendix F, p. 106). Then, the interviews are transcribed into an edited transcript (Appendix G, p. 108) without word crutches and misstatements and analysed using the qualitative content analysis method with the software MAXQDA to gain important insights into improving the concept and to discuss the limitations. For this purpose a code list is created, based on the interview guide to analyse the transcripts regarding the interview questions in MAXQDA. The MAXQDA file can be found on the CD enclosed with this thesis (file path: /MasterThesis/03_Main-Study/05_Analysis of Interviews/AnaylseResultsMain-StudyMasterthesisLisaClausenWiSe22.mx22). The results and the analysis are documented in an excel document which can be found on the CD enclosed with this thesis (file path: /MasterThesis/03_Main-Study/05_Analysis of Interviews/AnalysisResults_MainStudy_Masterthesis_LisaClausen_WiSe22.xlsx) (Baxter et al., 2015; Kuckartz & Rädiker, 2022).

4 Pre-study

To get to know the target group of students and to understand their needs and motivation regarding their e-learning study program experience during the COVID-19 pandemic, a small pre-study is conducted. This offers the possibility to get the opinions and thoughts on the main findings of the literature review in the Related work chapter 2 (p. 3) and to evaluate first concept ideas to create a better and more useful e-learning concept.

4.1 Semi-structured interviews

For the pre-study, semi-structured interviews are conducted in order to have comparable answers from the participants and also to elaborate on interesting topics if needed (Baxter et al., 2015). Instead of the six participants recommended by Guest et al., (2006) only three were interviewed for this qualitative pre-study due to the time constraints of the thesis and the following main-study. The three students (see Table 2) were chosen as participants according to the non-probability sampling method purposive sampling (Baxter et al., 2015; Flick, 2009). The sampling criterion is that the students had to start their studies during the COVID-19 pandemic or one semester before, without having been enrolled at the university before, so they didn't start studying with a fully established social network. This way participants could provide answers to questions regarding their start and challenges in a new e-learning study program and reflect on first e-learning concept ideas.

	Participant 1D	Participant 2L	Participant 3C
Age	26	24	25
Gender	Female	Male	Female
Country	Germany	Germany	Germany
City	Siegen	Siegen	Siegen
Moved to Siegen for study	Yes	Yes	Yes
Study program	Human Computer Interaction (HCI)	HCI	HCI
Study start	March 2020	March 2020	October 2019
Study end	September 2022	April 2022	September 2022
Current semester	5th	finished	6th
Living Situation	Own flat with partner (own room)	Shared flat (own room)	Shared flat (own room)

Table 2: Pre-study – participants demographic overview

The interview guide was designed based on the elaborated findings of the Related work chapter 2 (p. 3) and can be found in Appendix A (p. 85). The interviews were conducted online with the software zoom and audio and video recorded. The recordings were then transcribed into three edited transcripts (Appendix B, p. 87) without word crutches and misstatements and analysed qualitatively with the qualitative content analysis method in the software MAXQDA. The MAXQDA file can be found on the CD enclosed with this thesis (file path: /MasterThesis/02_Pre-Study/03_Analysis of Interviews/Analysis_PreStudy_Masterthesis_LisaClausen_WiSe22.mx22). For this purpose, codes were created based on the interview guide, with which the transcripts were coded in the software. The codes

were then analysed and evaluated in an Excel spreadsheet. The analysis process is documented in an Excel document which can be found on the CD enclosed with this thesis (file path: /MasterThesis/02_PreStudy/03_Analysis of Interviews/AnalysisResults_PreStudy_Masterthesis_ LisaClausen_WiSe22.xlsx) (Baxter et al., 2015; Kuckartz & Rädiker, 2022).

4.2 Results and comparison with the findings of the Related work chapter

Reflection online study during COVID-19 pandemic and the findings of the Related work chapter

The participants all studied Human Computer Interaction at the University of Siegen. Two of the participants (participant 1D and 2L) started their studies directly before the COVID-19 pandemic and have thus spent almost their entire studies online. Participant 3C started one semester before the pandemic, and has an insight into offline, as well as the transformation to online study. All three participants were not working or studying in Siegen before their studies and moved to Siegen for this purpose. Therefore, all participants were confronted with reorienting themselves and building a social network at the beginning of their studies. The online study during the COVID-19 pandemic is evaluated by all participants as both positive and negative in the interviews. As advantages, the participants mentioned high productivity and flexible time management, which contributed to good grades.

> *„It's hard to answer for me. If you measured it in the productivity kind of way, it's very positive cause it helped me a lot within time management but in an emotional way I would say negatively because I am lacking the human connection and also the probability of opportunity for me to grow my skills was negative because I lose access to certain labs or facilities at the university." (Participant 1D, 2022, Appendix B p. 87)*

The lack of commuting to the university, the participation in several parallel lectures through video recordings, the possibility to attend more lectures, and write more exams were also mentioned as positive aspects. On the negative side, the participants rated the lack of the university experience, the lack of soft skill development due to the absence of university buildings such as laboratories, as well as a lack of social contacts, informal conversations, and interactions. This caused participants to feel lonely. Motivational problems occurred in two out of three participants and were triggered by recorded lectures which according to them led to procrastination. It is also mentioned that bad team members in group work decreased the motivation.

> *„I had more motivational problems when it went all online because in summer you got to be outside in the sun and you think it's recorded so I spent my time with friends and in the wintertime, I was feeling more tired. I think because everything it is just online you don't have to be motivated in the moment you can just do it later – procrastination. When lectures are at a set time, and it's not recorded that's kind of what is motivating you. I don't want to miss this because it won't be repeated. And if you don't know anybody you can't ask if they remembered something if you missed. It's hard because if you are not at the university and you are somewhere else you enjoy yourself somewhere else, which leads to losing the motivation to participate in the university." (Participant 3C, 2022, Appendix B p. 99)*

These interview results confirm the studies by Winde et al., (2020), Stammen & Ebert, (2021), and Pelikan et al., (2021) which are presented in Related work chapter 2 (p. 3) and show the emotional and motivational problems of students in their online study during the COVID-19 pandemic. The participants mention that they used laptops, tablets, and smartphones as devices to participate in their online study program. Two out of three participants bought small new accessories for this purpose. Internet access was perceived as good by all participants. These findings don't confirm the study of Stammen & Ebert (2021) that a small number of students had bought or planned to buy new devices for their online study program and had smaller internet problems. However, as this is only a small study, more interviews would have to be conducted to validate the findings.

Regarding the contact between students during the online study program out of three participants, two found it difficult to approach other students. Participant 3L stated that it was possible to get to know new students, but it took longer than in a physical setting. The reasons given were shyness, lack of physical meeting, lack of emotion and body language which made communication difficult and limited especially in text form. Communication between students was often perceived as very task-oriented and less informal and it was also conducted over too many channels which was considered as distracting by the participants.

> *„[...] But as any other text-based messaging I think there was not that much conversation. You want to know something you get that information, but this had not that much informal communication and also at one point it was hard to maintain because there were so many applications we should install, and I think even in the course channels they were not truly many discussions going on regarding the topic. I think if we are in a classroom or like in person, group discussions could have happened better." (Participant 1D, 2022, Appendix B p. 87)*

Communication with many strangers in big groups was perceived as unpleasant by the participants. The constant accessibility and the possibility to ignore messages were also mentioned in connection with communication between students. Participants felt that the university tried to support the communication between students. Overall, therefore, communication was perceived as possible but in need of improvement. The communication difficulties are also found in the studies by Mulders & Krah (2021), Berghoff et al. (2021), and Stammen & Ebert (2021) from the Related work chapter 2.2.1 (p. 8). The findings therefore, confirm the relevance of improving communication. Participants had both positive and negative feelings during their online study program. For example, online group work with good team members was associated with positive feelings. However, the lectures were often perceived as one-sided and more stressful than physical lectures. This and group work with poor team members led to feelings of isolation and loneliness.

First concept ideas

In order to find out the participants' opinion on first elaborated ideas from the literature research for the e-learning concept that is developed in this thesis, these were presented to the participants in a short scenario which is placed in the interview guide (Appendix A, p. 85). After that, participants were questioned about the scenario. Participants stated that for profiles of students in an e-learning tool,

they would like to have information about the educational and professional background, interests and hobbies, activities at the university such as Fab lab projects or working student jobs at chairs, as well as course of study, and courses attended to get a first impression of the person. Also they would like to know the country of origin, current place of residence (country and city), as well as travel experiences. Current status or mood and age were also indicated by the participants. All participants found both the possibility to create profiles and to have instructions or tips on how to do it good. However, they expressed data protection concerns.

> *"Not exactly no, I'm kind of a private person, so I like to choose what I show on my profile. It's about privacy issues so I like to choose what people can see." (Participant 3C, 2022, Appendix B p. 99)*

Concerns were expressed that posting courses could lead to students being stalked or harassed. All participants felt that creating a community in a social media tool was a good idea to share information and learn together. Problems were seen mainly in the adoption of another tool and in finding a common topic in very interdisciplinary groups. Weekly by the community voted on topics which are discussed together, were rated as good by the participants. However, it was emphasized that the participation of many other members in discussions was necessary, to feel motivated to join it. All participants found the idea of weekly tasks in the community a good idea to learn something but also to get to know other members from whom they could learn through exchange.

> *„I would really like it because from my experience sometimes the professor or lecturers they focus more on the theoretical perspective. Like a top-down approach and they don't want to really teach you how to use the software in general. […] But I mean it will be good to provide this platform, so everyone gets a chance to know what others know and exchange their skills because now I have a feeling that if a good friend knows the software then no problem I don't need any platforms or any kind of supporter because I just learn from him but if I don't know this guy knows it all, then I'm lost. Especially if this is part of a project and I need to build something with this tool I would feel really worried about the lecture. So having this platform would be really helpful." (Participant 2L, 2022, Appendix B p. 92)*

The interviews confirm the findings of the studies discussed in the Related work chapter 2 (p. 3) and the relevance of the research question. The first ideas of the developed e-learning concept were positively evaluated by the participants regarding the potential for an improvement of their study experience during their online semester. The participants also provided interesting ideas to improve the concept. Data protection concerns should be considered in the development. As the participants wished for a strong online offer of the university and a mixture of online and offline lectures for the future in the interviews, this implies the relevance and the future orientation of the e-learning concept developed in this thesis. The improvements and positive evaluated ideas of the pre-study are integrated in the concept which is introduced in chapter 5 (p. 39).

5 Concept for modern e-learning with digital tools

Based on the learning approach foundation consisting of Constructivism, Connectivism, and Adult Learning Theory from chapter 2.3.4 (p. 20) and the approaches and technologies elaborated in chapter 2.4 (p. 21) to improve students' communication, well-being, and motivation in collaborative learning in online study, the final concept, integrated in Humhub, is now presented. The responses of the participants from the pre-study (chapter 4, p. 35) and the positive evaluated concept ideas have also been incorporated into the concept. With Humhub, the social network "Sharing my Learning" was already created at the University of Siegen in order to host different projects. It is important to note that the platform is in German, but the concept ideas are integrated and tested in English as the platform will be available in different languages soon and the concept is intended to include students of different nationalities. In the social network a so-called space is set-up with the name "Learning Community" (see Figure 3). A space is similar to a social network group.

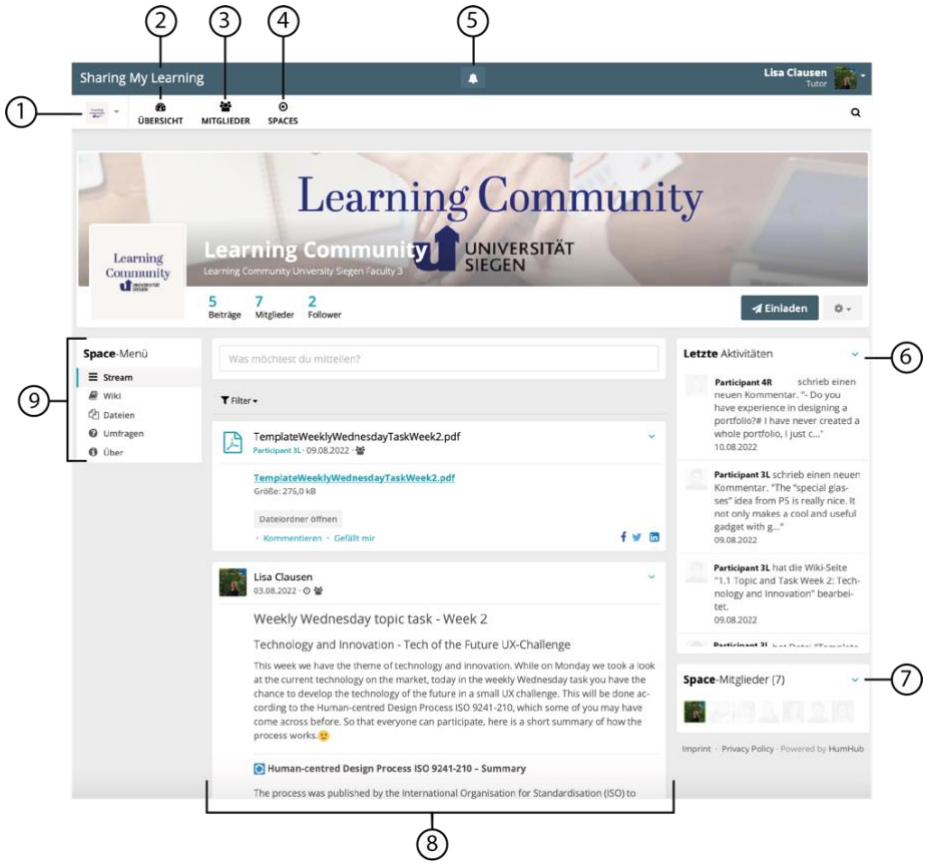

Figure 3: Learning Community space in Humhub

Sharing my Learning menu (see Figure 3) contains:

(1) Joined spaces, that exist in the social network Sharing my Learning

(2) Overview (transl. Übersicht) with all activities in the social network Sharing my Learning

(3) Members (transl. Mitglieder) of the social network Sharing my Learning

(4) All spaces that exist in the social network Sharing my Learning

(5) Notification function with all activities in joined spaces (e.g. Learning Community) and of contacts

The Learning Community space (see Figure 3) contains:

(6) Activity stream (transl. Letzte Aktivitäten) keeps the community updated about who worked on what when and where

(7) Space members (transl. Space-Mitglieder) are members of the Learning Community

(8) Learning content (Microlearning & Microtraining), documents, voting's etc. can be shared with the community

(9) Space menu (transl. Space-Menü) offers different space functionalities:

- Stream shows all activities and shared content of the Learning Community
- Wiki summarizes the weekly topics and task results of the Learning Community
- Documents (transl. Dateien) are shared documents for the Learning Community
- Surveys (transl. Umfrage) contains all votes of the Learning Community
- About me (transl. Über mich) describes the purpose of the Learning Community space

The space is used to create Virtual Cooperative Learning Space and to establish a Community of Practice (CoP) focused on the practice of shared learning. In order to set up a Virtual Cooperative Learning Space coordination, communication, and collaboration must be established. The coordination is integrated through behavioural rules which are written down in a wiki entry and established through two roles. The tutor role consists of admin rights in order to support the community member role, which is only able to make contributions but can't change space functionalities. One or more tutors manage the space. Only the tutor has admin rights, otherwise it would be difficult to coordinate settings with many voluntary and often changing student community members e.g. disenrollment. In the sense of Constructivism and Connectivism, the tutor accompanies and supports the learning exchange of the CoP. The rules include that the purpose of the Learning Community is learning and the informal knowledge exchange, outsiders are only allowed to join the community under consolidation of tutors and a thematically relevant contribution to the community, e.g., a subject expert. Also, the treatment of community members is respectful and polite, and insults, discrimination, harassment, and bullying are not tolerated. If insults, discrimination, harassment, or bullying occur, this can be reported immediately to tutors, who can take the necessary measures to protect those concerned. The last rule is that personal data about individuals is not to be shared outside the community. Only thematic content can be shared outside the community. The communication in the space is possible with comments and posts. The collaboration is enabled through the wiki function where knowledge can be collected collaboratively. The Virtual Cooperative Learning Space has the goal to enable coordinated collaborative informal learning and exchange in a Community of Practice of students.

In order to support the informal learning exchange between community members, the tutor provides a be-weekly voting (see Figure 4) in which they can choose anonymously a topic they are interested. The current state of the voting is shown, so that it is visible which topic is likely to be discussed in the next weeks. Participants can suggest topics to the tutor, or the tutor can propose topics. The topics shouldn't be discussed in lectures but offer interesting additional knowledge that is relevant for current projects or the future e.g. job entrance of the students. The relevance of the topic for students is based in Constructivism, Connectivism, and the Adult Learning Theory to intrinsically motivate community members to participate, start informal discussions, be curious and to learn more self-determined.

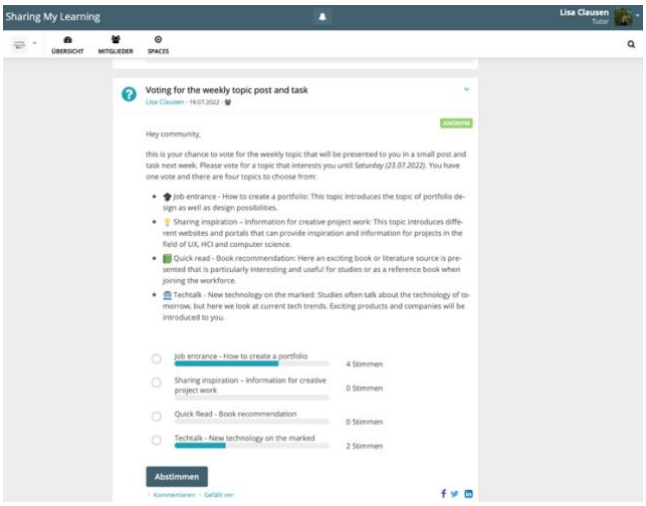

Figure 4: Voting in Learning Community space in Humhub

To establish a learning practice and informal exchange and foster the establishment of a Community of Practice with the focus on that, the tutor, or in consultation with the tutor a community member, provides learning artefacts in the form of *Microlearning post* introducing a topic and *Microtraining task posts* that offers to gain additional practical knowledge regarding a voted-on topic, on two fixed days a week. When planning their week, the fixed days help participants to know when to check-out the platform for new tasks and topics, as well as discussions. The participation isn't mandatory. Posting a *Microlearning post* or *Microtraining task post* is similar to posting a short weblog entry. Like a Weblog they are regularly posted on fixed days and contain important information regarding a topic, they contain multi-media content e.g. text, pictures, videos, have an author, date, title, and discussion opportunities through comments. In order to fit into the Microcontent format the *Microlearning* and *Microtraining task posts* additionally are self-contained knowledge units that can't be shortened without losing meaning, are focusing on one topic, contain URLs for further information regarding the topic and have a Permalink under which they can be found and shared.

The *Microlearning post* is therefore, a short post with an author, date and title that introduces the topic. The topic is shortly presented with text, pictures, quotes or videos, and links to learn more. To not only informally learn while reading the post but to informally exchange the knowledge, the post also contains aspects of the Artistic Pedagogical Technologies (APT) Photovoice approach. The topic is not only presented with multi-media possibilities like photos, quotes, or videos to be more interesting but is always followed by a reflective question, that challenges the community members to reflect the gained knowledge in comparison to their own experience and to discuss that with the community, using the comments under the post. Differently to the APT approach the question concerns the topic and therefore, the whole post and not only one specific element like a picture. In order to read the post and answer the question, community members should take 5–15 minutes. The content of the post can be downloaded so participants don't always need internet access to read the information. Only for commenting, internet access is required. Participants have two days before the additional *Microtraining task post* is posted. The *Microtraining task post* is the practical part of the *Microlearning post* and helps, especially beginners, to create a deeper understanding for a topic. It contains an exercise that takes 15–

20 minutes. Learners should need approx. 3-4 minutes to read through the problem and 16 minutes for solving the task. The time can change depending on the speed of the learner to complete it and the size of the task. Robes (2009) Microtraining structure is adapted as the tasks used for the concept can be bigger. The Microtraining is designed in such a way, that it can be worked on asynchronously by participants within four days. After the four days the next week begins with a new topic. Students can decide voluntary and spontaneous whether they want to take part in the training and integrate it flexibly into their lecture schedule. The task can consist of small research or design exercises. The *Microtraining task post* consist of a title, author, data, a Permalink, and the post as PDF for download. When bigger tasks are presented, a template is provided to help participants finishing the task in the time frame of a Microtraining. The post presents the task with text, pictures etc. and also contains information to be able to do the task, links for more information, and a link to a wiki entry. The wiki entry summarises the information from the *Microlearning post* and *Microtraining task post* and offers space for participants to post anonymously the results from the task as PDF, picture, and text. Participants can seek help from the tutor and the community under the *Microtraining task post* posted to understand the task. Tutors oversee the exchange of the community in the comments and provide helpful information and guidance when necessary and can be tagged in a comment. After finishing the task and posting the results in the associated wiki entry, the community can reflect and discuss personal learning objectives and results in the wiki comments. However, if participants join after the four days, they still can do the task and add new insights in the comments and results to the wiki later. If a task is worked on later, the participants miss out on the active discussions accompanying the task, as these are completed at that point, but they always have the possibility to start a new discussion if the knowledge regarding a topic changed. The knowledge regarding a topic, changes and grows over the time with new contributions of participants. This fulfils an important point of constructing knowledge and keeping it up to date which is based in aspects of Constructivism and Connectivism.

The wiki always provides a visual representation of the CoP's current state of knowledge on topics, but also encourages participants to question the information and, if necessary, to replace it with more up-to-date information while it is worked on collaboratively. The knowledge in the wiki is built like in the Constructivism and Connectivism approach. There are two types of wiki entries that are mostly created by the tutor or with a consolidation of the tutor by community members. The first type are the topic wiki entries that summarize the *Microlearning* and *Microtraining task post* information, as well as the results regarding one topic of one week. This type is created by the tutor or community member who was responsible for the *Microlearning* and *Microtraining task post* which is summarized in the wiki entry. The second type are introduction wiki sites that explain, how to participate in the Learning Community e.g. how to structure a wiki entry or participate in a task. These entries are mostly created by tutors but can be adapted if the community members feel the need to do so. The wiki entries (see Figure 5) both have the same basic structure, which can be adapted and expanded as needed.

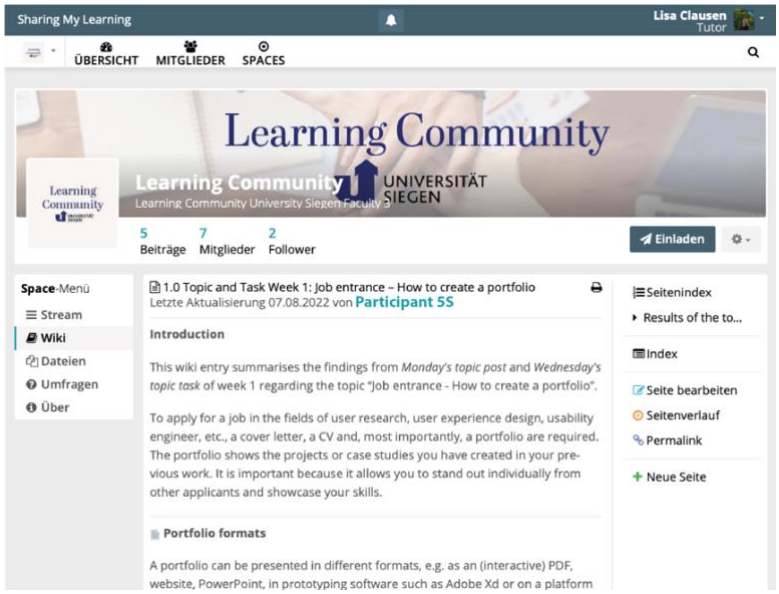

Figure 5: Learning Community space wiki

The basic structure of the wiki contains a title, a short introduction of the topic, then the body of the wiki consisting of the topic with subheadings and a paragraph called “Links and references” for sources. For each wiki contribution, the appropriate sources from which the information is obtained, are linked. Topic wiki entries in addition contain the paragraph “Results of the topic task” where people can enter their results. If errors are found in the wiki entries, they can be edited directly or discussed in the comment section below the wiki. The wiki also safes all changes in versions and can be restored, if necessary, under page history (transl. Seitenverlauf). The wiki entry contains a small index that displays different chapters to jump to specific points in the entry, a Permalink, and an activity stream that shows, who was the last person changing the entry. The quality of the information in the wiki is first checked by the responsible person guiding the *Microlearning* and *Microtraining task post* as well as the people who voluntarily join the task and discussion. Even with a high number of members like of the encyclopaedia platform Wikipedia the quality of data is not guaranteed. This is the reason why in the Learning Community space wiki the knowledge of the community is not only viewed as the current state of knowledge regarding a topic but a starting point to get to know a topic and to then continue to do research individually. This way of usage was proposed by Jennings (2008) for learning with an wiki and reflects a core value of Connectivism. Therefore, the focus of this e-learning concept is communication, motivation, and well-being with providing a good solution to exchange mostly informally information and providing students with the possibility to critical evaluate information and discuss it in the comments.

To motivate participants to contribute and to support the communication among members, it is not enough to try to establish a Community of Practice with creating a learning practice with *Microlearning posts* and *Microtraining task*s to establish a discussion. In addition, the social presence of member must be supported especially due to the text-based communication in the Learning Community space and the lower medium-richness. As a social network, Humhub offers the function of creating a profile that can be used for self-presentation and networking with other members. The user account in Humhub offers information about the person, can be edited and then made publicly available for all community

members. In the pre-study (chapter 4, p. 35), it is found that specific information is considered important by students in order to get to know other students. This information is used to formulate questions which participants can then complete in their profile description.

- Name, Age, Gender, Birthday
- Title (*Tutor or Community Member)*
- Current living place, Country of origin
- Before studying at the University of Siegen I worked/ studied ... *(job title, degree program, work, and travel)* in …(*country)*
- I'm studying ...*(current degree program)* at the University of Siegen and I chose my degree program because ...
- In my current study project, I am doing…
- At the university I am also… *(working student + chair, Fab lab activities, study council etc.)*
- In my current semester I am attending the following lectures…(*lecture names)*
- After my studies I would like to...*(job title, PhD,…)*

In addition to the pre-study interviews, a short research is conducted to take a look at how apps, that focus on finding friends in a new city, help people to introduce themselves. The application (app) Bumble is chosen because of its friend searching function (Bumble Inc, 2022). The app offers some sentences which users can complete and present in their profiles to introduce themselves. The following sentences are selected from Bumble and integrated in the profiles of the participants to create a more personal profile but also respect their privacy and not reveal too sensitive information. This was considered important by the participants of the pre-study (chapter 4.2, p. 36):

- In my spare time I am interested in...(*hobbies, sports, voluntary work,…)*
- Something I learned far too late is,...
- I am far too enthusiastic about,…
- My favourite thing to do as a child was...
- The thing that inspired me most...*(person, book, quote,…)*
- These are three things I would take with me to a deserted island....
- My favourite song or artist...
- If I could be in a series/film, it would be...
- I have been on trips to... (Bumble Inc, 2022)

While the suggestions for designing a profile given by participants in the pre-study are more focused on the study program and profession of the students, the sentences by Bumble offer a more personal introduction with hobbies and interests. In the pre-study interviews all participants stated that they often didn't knew how the other students looked, because in the online lectures the cameras weren't used an most students didn't had a profile picture. For this reason, a photo should be uploaded by community members and if they want, they can provide links to social networks such as LinkedIn and Xing in order to stay in touch after graduation. The profile set up (see Figure 6) is chosen in such a way that a personal impression of the community member is created.

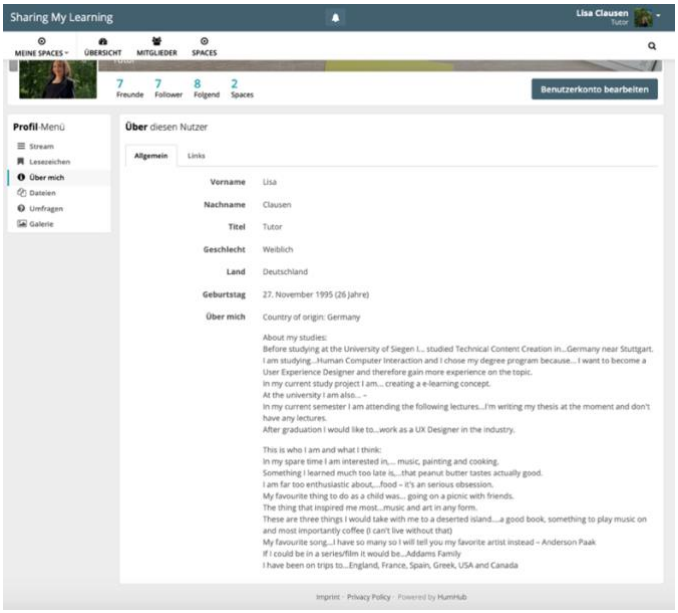

Figure 6: Filled out profile based on design suggestions

The profile of participants and tutors look the same with the only difference, that instead of the title "Tutor" they have "Community Member". When participants involve in discussions, they are able to visit the profiles of the participating community members. With the provided information participants are not only able to see them more as fellow students and community members but can also understand their point of view with information regarding their professional background or interest. This can support the well-being of students while discussing as a social presence is created, negative communication effects can be diminished and the building of an understanding for others is supported. Befriending communities members that e.g. have similar interest can also help to feel less isolated and to build a social network beside the Learning Community. Mentioning and tagging members in posts can also support communication between members. The concept is documented on screenshots which can be found on the CD enclosed with this thesis (file path: /MasterThesis/03_Main-Study/04_StudyScreenshotsDocumentation).

6 Main-study

The main-study evaluates whether the concept developed in chapter 5 (p. 39) helps students to learn informally in a cooperative communication exchange and to actively engage with other students. The improvement of their well-being and motivation is evaluated and compared to the e-learning situation during COVID-19 pandemic. The results help to improve the concept and its implementation in Humhub and test if it has the potential to improve the learning experience from students.

6.1 Preparation and procedure of the main-study

Study participants

For a meaningful valid result according to Guest et al., (2006), in the context of a small qualitative study, six participants are necessary to get a first impression regarding a topic. Six students (see Table 3) are selected according to the purposive sampling approach as study participants (Baxter et al., 2015; Flick, 2009). To join the study, participants have to meet three criteria. First, the students have to have started their studies at the University of Siegen one semester before or during the COVID-19 pandemic, without having been enrolled at the university before. Students from these semesters had to establish new social contacts when moving to Siegen in the beginning of their online studies and can reflect if the concept could have helped them. Second, the students should belong to the same or very similar degree program of one faculty of the University of Siegen to have a similar study and thematic focuses, which provides a basis for knowledge exchange and collective learning. The last criterion states, that the students shouldn't know each other well, which is given due to different semester or study programs in order to evaluate, if the concept helps students to get to know each other while exchanging information and learning together during the evaluation.

	Participant 1J	Participant 2C	Participant 3L	Participant 4R	Participant 5S	Participant 6A
Age	25	25	24	27	32	28
Gender	Female	Female	Male	Male	Female	Female
Country and City (current living place)	Germany, Leipzig	Germany, Siegen	Germany, Karlsruhe	Germany, Siegen	Germany, Siegen	Germany, Munich
Study program	Human Computer Interaction (HCI)	HCI	HCI	Business Informatics with focus on HCI	HCI	HCI
Start and end Study program	Oct 2019 – Sep 2022	Sep (Oct) 2019 – Nov 2022	April 2020 – April 2022	April 2020 – 2023	Oct 2019 – March 2023	Sep 2020 – Dec 2022
Current Semester	6th semester	6th semester	finished	5th semester	6th semester	4th semester
Study program online or offline	one semester offline, rest online	one semester offline, rest online	only online	only online	one semester offline, rest online	only online
Before study program	Bachelor Communication and Psychology	Bachelor's degree in	Bachelor's degree in China, master's degree	Bachelor Business Informatics in	Bachelor Media Studies, and Job	Another master's degree

occupation and place	and internships in Görlitz Germany	Toronto, Canada	in Human Factors in Chemnitz Germany before joining HCI	Mönchengladbach Germany	as journalist in Siegen Germany	in Psychology in Lisbon Portugal
Moving to Siegen	Yes	Yes	Yes	Yes	No	Yes
Already know students before starting study program	No	No	One Person	No	No	No

Table 3: Main-study – participants demographic overview

The six participants are all master students and a homogeneous group aged from mid-twenties to early thirties. Four identify as female and two as male. All participants lived in Siegen during their online studies and five participants studied a master's or bachelor's degree in other cities or countries before moving there for their study program at the University of Siegen. Only participant 5S studied a bachelor's degree at the University of Siegen and lived there, before starting her master program. Since she joined the study as a substitute for another participant who had to end the study for personal reasons shortly after the start and fulfils the other sampling criteria she could participate. Four participants study the master's program Human Computer Interaction and participant 4R studies the master's program Business Informatics with a focus on HCI. Both are from faculty three of the University of Siegen. All participants are in their final semesters and have studied online most of the time due to the COVID-19 pandemic, which required online study from March 2020 to October 2021/March 2022. Four out of six participants did not know anyone at the beginning of the study, only participant 3L knew one person through the HCI Facebook group shortly before the start. This was neglected due to the short period of time before the start. Participant 5S knew a PhD student, but they didn't study together. As the participants are in their last semester and studied mostly online, they are able to give valid answers to questions regarding their e-learning experience. Most of the participants don't know each other well as they are in different semesters and courses.

Study structure

The study consists of three parts, all of which are conducted online. This includes the preparation, a two-week evaluation of the concept, and subsequent interviews. In addition to the six participating students, I will accompany the evaluation as a researcher in the role of the tutor and prepare the learning content and provide support if requested.

Preparation phase

One week before the test, participants receive data protection documents explaining the study process, the documentation of personal data, the processing and storage of data and the rights of participants. After the participants have read and signed the data protection document, they receive a link under which they can register within the social media network *Share My Learning*, which is already created with the open-source platform Humhub for the University of Siegen. The registration data is then sent to the study facilitator so that I could access the profiles and prepare them for the study. Preparing the

profiles includes adding the profile questions to the About Me section so that participants can answer them and enrich their profile for a stronger social presence. The profiles are also added to the Learning Community space that is created to test the concept. In addition, the participants are befriended so that they are able to view each other's profile information. The preparation is done by the study facilitator to ensure that all participants have the same starting point before the study and to avoid misunderstandings in the profile design and joining the right space. Four days before the evaluation, the participants receive a detailed study schedule (Appendix C, p. 103) informing them about the steps before the start of the study, the course of the study and the interviews at the end with exact dates. For the preparation, the participants are supposed to lock into their profile and fill in and complete the information requested, as well as to upload a photo. In the next step, they are asked to take part in a topic voting in the Learning Community space which their profiles already follow and to choose a topic of their choice from four that are presented and are worked on in the two weeks of the evaluation. The voting is anonymous so only the number of votes is displayed. The four topics are chosen so that they are not discussed in the formal study lectures of the participants but have a thematic relevance for them. The topics are:

- Career entry and designing a portfolio
- Inspiration portals for creative work in the software development
- Book and source presentation of particularly exciting and helpful work
- Techtalk – presentation of currently interesting technologies and innovations

In the voting, the participants chose the topic career entry and designing a portfolio in first place. The second place went to the topic of interesting technologies and companies, which builds the topic for the second evaluation week, so that each participant receives the chosen topic and can be asked about it in the interviews. One of the participants left the study shortly after the vote before the start of the first evaluation week. For this reason, participant 5S joined the study at short notice as a substitute. She therefore, did not participate in the voting, but in the first and second evaluation week. However, in order to be able to make a statement about the voting later, she was informed in the interview about the function, and the question was adapted.

First evaluation week

On Monday of the first week, the previously agreed topic, career entry and designing a portfolio, is published by the tutor in a *Microlearning post* (Appendix D, p. 104) based on the APT approach, with pictures and an open reflective question. The post is written so that it deals with one topic, has a fixed structure of heading, introduction, topic, questions, links, and references, and forms a self-contained understandable knowledge unit. The links serve to deepen the topic if interested. Participants are instructed to read the post and answer and discuss the question in the post, in the comments below until Wednesday. The post is designed to take 5-15 minutes to read and to answer the questions in the comments. On Wednesday, a thematically in-depth *Microtraining task post* (Appendix D, p. 104) is posted with the task of creating a portfolio side for one project. The *Microtraining task post* contains the task, necessary information in the form of links and short explanations and the instruction to post the solution as PDF and JPEG, and the 2-3 most important findings on a provided wiki page. The results of the task are discussed in the comments under the wiki page. The wiki page summarises all the

knowledge regarding one topic of one week and the results and thoughts of the participants. Questions regarding the task are discussed in the comments under the *Microtraining task post*. The *Microtraining task* has to be done with all steps by Sunday and takes about 15-20 minutes to complete. The Microtraining structure is not based on Robes (2009), as the explanatory information is kept shorter to allow more time for the task and reflection. 4 minutes were planned for the text of the task explanation and approx. 16 minutes for the task processing. In order to enable a shorter and quicker processing for students for large tasks, a template prepared by the tutor is offered. Participants have the choice to use the template or to create an individual solution with more effort. The aim of the first evaluation week is to test the APT approach, the Microlearning and Microtraining approach, as well as the interaction of participants with the content and other participants. The motivation to work on a self-selected topic is also tested. In addition, participants have to take a look at the profiles of other participants to be able to answer interview questions regarding the topic of social presence.

Second evaluation week

In the second week of the evaluation, on Monday a *Microlearning post* (Appendix E, p. 105) on the topic of Techtalk - Technology and Innovation is posted. This is done without a prior voting as the second-placed topic from the first voting is used to give all participants a chance to edit a topic of their choice. Participants are instructed to read the post and answer the question in the comments below by the following Wednesday. The post is structured according to the APT approach and has an editing time of 5-15 minutes. On Wednesday, the *Microtraining task post* (Appendix E, p. 105) consists of a UX problem that is posted on the topic of Techtalk- Technology and Innovation, which was presented on Monday. According to the Adult Learning Theory, a real problem is taken which is to be solved according to the Human-centred Design process. To make the task fit into the format of a Microtraining, a template is created to help the participants solve the task in a short time. Participants have to enter their results as PDF and JPEG on a provided wiki page. The wiki entry link is provided in the *Microtraining task post*. The wiki summarises the topic and results of the second week. Questions regarding the task are asked in the comments under the *Microtraining task post*. The *Microtraining task post* must be done with all steps by Sunday and has a work time of 10-20 minutes. Participants are encouraged to look at the solutions of other participants and comment on them under the wiki entry. The aim of the second evaluation week is not only to test the points of the previous week, but to give participants the time to get used to the platform and the concept in order to be able to give more valid statements in the subsequent interviews.

Interviews

After the two-week evaluation of the concept in Humhub, semi-structured interviews are conducted individually with each participant regarding their experience with the platform and concept. The interview guide can be found in Appendix F (p. 106). The questions focus on communication, motivation, and well-being, the knowledge gained and the technical implementation in the Humhub platform. The interview is designed to last approximately 25-40 minutes. The recordings are then transcribed into six edited transcripts (Appendix G, p. 108) without word crutches and misstatements and analysed with the qualitative content analysis method with the software MAXQDA. For this purpose, codes are created

based on the interview guide, with which the transcripts are coded in the software. The MAXQDA file can be found on the CD enclosed with this thesis (file path: /MasterThesis/03_Main-Study/05_Analysis of Interviews/AnaylseResultsMain-StudyMasterthesisLisaClausenWiSe22.mx22). The process is documented in an Excel spreadsheet. The Excel spreadsheet also contains an analysis of the activities of the participants in Humhub such as comments and contributions. The Excel spreadsheet can be found on the CD enclosed with this thesis (file path: /MasterThesis/03_Main-Study/05_Analysis of Interviews/AnalysisResults_MainStudy_Master thesis_LisaClausen_WiSe22.xlsx). The results of the analysis are summarized below.

6.2 Results of the main-study

Online study and e-learning participation requirements

For participation in the online studies, all participants used their laptop. Five out of six participants used two devices for their online studies. In addition to the laptop, tablets and smartphones were also used. Four out of six participants already had all the technical devices they needed at the beginning of their online studies. Only two participants bought small technical devices for ergonomic reasons and because of their work environment, to not disturb others. Five of the six participants had good internet access most of the time and were able to participate in their online study. Minor internet access problems these five participants experienced were no access while switching the internet provider, network outages at the beginning of the pandemic, and problems due to the German internet infrastructure. Only participant 5S had a bad internet connection due to a construction site. When internet problems occurred, participants tried to access it through their mobile data, friends or public places like a dormitory or library. These results are important as the devices used, as well as the internet access are important requirements to use the e-learning concept developed in this thesis. Participants with a good internet access could use the concept. However, for those who struggle with the internet access or have limited access to devices it's important to provide information that can be downloaded and used offline.

Evaluation of the open-source platform Humhub

The first impression of the platform is mostly positive. When opening the Humhub platform for the first time, four out of six participants have a good first impression, while two participants feel overwhelmed by the amount of information. The Learning Community space, wiki and navigation are found to be good and easy to use overall, but with need for improvement. The participants note positively the idea of the platform because of the easy exchange with community members and their contributions, as well as the learning topics and tasks that are offered.

> *„I like the structure because I thought it looks really structured and calm and made a tidy impression to me and I liked the fact that I could also see the people I was working with or connected with and on the other side all the content of the topics we were dealing with." (Participant 5S, 2022, Appendix G p. 140)*

The notification function keeps participants informed about the activities and contributions. The profiles of members are described as well written. The platform is felt to be practical and complete with a clean and tidy design. Only two of six participants consider the design outdated. The idea of the wiki usage is

rated positive, but some wiki functionalities are criticized. The navigation in Humhub is found to be problematic by two participants as they rather use the links in posts or the notification function instead of the menu. The menu is often overlooked. The overview presentation of different spaces is seen as good, but it is criticized that there is no clear distinction between spaces that users already joined and others. The comment function is criticized by one participant in missing more elaborate expression possibilities and media, as well as typography. In summary the problems mentioned contain wiki functionalities, a lack of interaction possibilities, and navigation problems within the platform, which should be improved.

Learning Community space

The Learning Community space is perceived rather positively by three participants and rather negatively by two participants. Participant 4R has negative and positive aspects regarding the space. Therefore, most participants like the Learning Community space. All participants like the *Microlearning posts* and *Microtraining task posts* and the discussions with other community members in the comments.

> *„I would say at the beginning you needed some time to get used to it and to the daily posts there but in the end, you got to know somehow how it works and I think in the end you had a good exchange of information where the people give their knowledge. I also think it was very well for me because the topic was also related to what I was interested. Yes, I would say like if the people are very interested in the topics, you see that there can be a good exchange." (Participant 4R, 2022, Appendix G p. 132)*

The participants like the Learning Community space stream and its structure. The atmosphere in the Learning Community space is perceived as good. The participants dislike the menu as it was too small, wished for more exchange between students, and a stronger visual and time distinction between the posts in the stream of the space. The comprehensibility of the navigation within the space was criticized and should be improved.

Learning Community wiki

Five out of six participants liked the idea of the wiki as a collaborative source of information on weekly topics and task results, as well as the discussions in the comments. Problems are encountered with editing, the index and finding the wiki. The edit button is perceived as being too small, and participants feared editing things at the same time without realizing it. There is also a fear of being able to change the whole text rather than a specific point.

> *„So, in the first moment I had some difficulties to find the functionality to edit the entry because yeah, I didn't see this Seite bearbeiten at the beginning. After I saw it, I struggled with if it's ok to change this site now because I could edit everything because I then had the feeling that I could crash something of the theoretical information given. I don't want to change that information I just wanted to put in my results." (Participant 1J, 2022, Appendix G p. 108)*

Participants want an index within the wiki entry so that they do not have to scroll to the point where results can be entered, which is perceived as time-consuming, but could jump there directly. The process of uploading results as documents and images is seen as easy to use by five of six participants.

Only participant 3L is a little confused by the different upload possibilities, but he still manages to upload the results. Greater anonymity is suggested, as when editing the wiki, the name appears on the page. The wiki comment section couldn't be used unless the tutor made an initial comment and enabled the function. The wiki index when entering the wiki is felt to be confusing, as no distinction is made between different types of wiki entries. The wiki is often found via links in the assignment and not via the menu, and there is no clear distinction between the design of the wiki and space page. Also, the idea behind the wiki with the summary of a topic, the presentation of results and discussions in the comments is liked by most participants, the functionalities are criticized the most and therefore, have to be improved.

Informal learning via Microlearning post and Microtraining task posts

The *Microlearning post* which contains information regarding a voted-on topic and a question which should be answered under the post, is liked by all six participants. They all enjoy the topics and information, easy to read text, the structure, and the links to get more information. The participants also positively evaluate the structure with the headings, dividers, and emojis. The PDF to download the information is only mentioned by one participant as positive aspect. The length of the text is perceived different. Four participants find the length good, one participant finds it is too long, and another one very short. Four out of six participants feel that the amount of information is sufficient. Participant 2C suggests having more information on the task and then less information on the topic post. Participant 4R simply wants less information and the questions at the beginning, so that one does not have to scroll through the information first. Participant 4R also wishes for more pictures in general. All participants like the number of topic posts per week, as they also need time for the small interaction in the comments afterwards, and the task later in the week. Participant 1J notes that she would like to have more topic posts during her exam period, if related to lectures, to be prepared better. She also suggests receiving all the information at once, so she doesn't have to keep checking the platform. Five out of six participants are able to learn something new from one or both *Microlearning posts* and from sharing their experiences in the comments. Participant 1J could not learn anything new, but the comments inspired her to change her study work. The open questions which initiate the exchange in the comments are found to be interesting, as participants have to reflect on what they read and compare it with their own experiences, as well as those of others.

> *„I really like the topic posts on Monday because I think it always introduced something to me. For example, the portfolio – what is important in a portfolio, what kind of format should you take and what content should be there. So that's really informative for me and at the end, there are always these open questions to provokes you to think a little bit about your own experience and understanding in designing a portfolio or finding a new cool gadget for the second week and then you made some comments. You kind of reflect on your experience but also the information you just gained from the post, and you combine these together and made a comment and others would do the same thing and you obviously can learn from others. […]" (Participant 3L, 2022, Appendix G p. 121)*

All participants experience the exchange between the participants as meaningful and interesting. The *Microlearning posts* are liked by the participants and only need small improvements.

The *Microtraining task posts* are enjoyed by all six participants, and everyone is able to learn something new or interesting through one or both tasks and through the commentary discussion. The task is perceived as an important practical addition to the topic post. All participants feel that the workload for the two tasks is good and saw the provided templates as support for completing the tasks in a reasonable time. The freedom to decide how much time to invest in a task with using or not using the template is appreciated. The level of difficulty is described as challenging enough to focus only on the task, but also easy enough to complete it quickly and feel motivated and happy afterwards. The small tasks are perceived as motivational. All participants like the number of tasks per week but suggest that the number of tasks could be changing depending on the learning objective or semester phase, e.g. semester start, exams. To improve the task post it is suggested that a note in the task states that the results don't need to be perfect. Also an estimated time of how long the task will take and more anonymity when posting the results on the wiki could help students to feel less pressure to achieve a perfect result and to better manage their time.

> *„I'm a person who easily compares herself to others so I prefer the anonymous solution because I would struggle not that much to hand in something that isn't perfect. In my opinion I would also just look at the other examples for gaining some input, some information and some creative new things for me and there wouldn't be the thought of no she's so perfect why can she or he do everything. I don't know and I like the idea of anonymous examples more than seeing a person connected to it." (Participant 5S, 2022, Appendix G p. 140)*

A task is posted on anonyme spots within the wiki however, the wiki activity stream displays the names of who edited the wiki. Participants also would like to have one day more time to work on the tasks and a specific day to comment and discuss the results when most participants uploaded their results. The tasks are perceived overall as good, but the criticized points need to be considered.

Communication with other participants

The communication takes place in the comments under the post and under the wiki entries. Three participants feel encouraged, and three participants do not feel encouraged by the *Microlearning and Microtraining task posts* to contact other participants during the two weeks of evaluation. Four participants perceive the communication in the comments between participants rather positively. Participant 4R for example appreciates the exchange because it was very goal and topic oriented, and he could learn from other experts. The communication is perceived as respectful and constructive, and the participants like the discussion that develops from the results of the task and their own reflection over it. Two participants have problems with the communication in the comments. Participant 1J doesn't think this is a real discussion and participant 6A agreed and explains that she thinks that the comments are often made at times when she finished the task and moved on.

> *„I thought it was like everyone just did what they had to do means doing the tasks but there wasn't necessary a discussion or conversation happening. I think it was also that you would post something and then a comment will appear two hours later but you already doing something else and you're not*

having the time to go back and answer, because you probably already moved on. Maybe that had an influence that no discussion was happening." (Participant 6A, 2022, Appendix G p. 147)

Also, four of six participants state that they would like to connect more with others through more time, more active communication technologies such as chats, and more conversation in the comments, since the practice of sharing their experiences is highly valued. Because the communication is limited to the comments and chat functions are missing, none of the participants reached out to others independently of tasks and posts. The communication between participants is liked, but the concept and the support with more communication functions must be improved.

Well-being

Five of the six participants have a more positive feeling about using the concept and the platform. Three participants route their positive feelings in the tasks and discussions. Participant 3L explains that his positive feeling towards the platform and concept are based on that he feels engaged and productive when using it and has a meaningful exchange with others but could easily switch off to focus on other things, unlike other social media platforms. Participant 5S states that she likes that she has a safe space where she feels comfortable to learn and share experiences together. She feels motivated by the sense of a safe community. Participant 1J and 4R had negative feelings at the beginning and doubts whether they would be able to complete the tasks due to a currently stressful personal life. Both participants state that they had fun while doing the tasks and therefore have rather positive feelings towards the platform and the concept at the end. Only participant 2C has neither positive nor negative feelings. She has fun participating but states that she did not know the people well and she feels that there were too few participants to engage with.

Motivation

The motivation is analysed regarding different aspects of the concept and tool: The motivation to participate in topic and task posts, the motivation to contribute own content for the community, and the motivation to get in touch with other participants. The motivation to participate in topic and tasks is highly influenced by weather the participants vote for a topic or not. Five out of six participants like the voting and state that it is important for them to have a say in what they learn and that it increases their motivation to participate.

„Yes, I really liked it because I want to have the portfolio task. I would say that this is also necessary because I would maybe not be so motivated for the other tasks. I would also do it but in general I think it's more specific and I think the motivation is higher with the voting." (Participant 4R, 2022, Appendix G p. 132)

Participants like the fact that the voting is not every week which gives them the opportunity to discover different aspects of a topic in a series. Participant 3L also notes that it would be better to show the voting results anonymously at the end, as there could be a bias in the voting if the status of the vote is constantly shown. Only participant 1J has no opinion on the voting, as all the topics offered are interesting to her and she believes that even if a topic is presented that she does not like, she still has

the chance to learn something new, discover a new interest or learn something important for the future. The motivation to participate in the *Microlearning post* and *Microtraining task post* varies for all participants and is depending on whether they consider the presented topic as interesting or important for themselves, whether they voted for it, how much effort they think it takes to participate, and whether they have enough time to complete the task. Participant 1J, for example, feels less motivated as she already knows the topics and notes that she would be more motivated if a more interesting topic was presented. Participant 6A feels that the first task is not very motivating as she estimates the effort is very high. In the second task she is motivated because she has voted for the topic and there is more time available in her private life. Most of the factors influencing the motivation to participate can be supported by design and topic of the *Microtraining task post*. Regarding the motivation to contribute content by themselves for the community all participants indicate that they would prepare *Microlearning* and *Microtraining task posts* for the community. Only two participants are worried that they might have problems to find a topic or create a task. Therefore, tutor support is suggested by the participants. The motivation to engage with other participants varies. Participants are hesitant to get in touch with others because of limited communication opportunities, little time to learn about the concept and the platform, little time to get to know each other, and not enough offered icebreakers. Three participants feel a little motivated to get in touch with others, two participants don't, and one participant feels both ways. This motivation could be improved with the same measures that improve the communication in general.

Social presence and profile design suggestions

To create a social presence, participants have to answer several questions in their profile and provide specific information about themselves. Five out of six participants like the suggestions and questions on how to write a good profile. All participants explain that they wouldn't know what to write without the support. Participants state that the suggestions provide security in being able to present themselves in a way that others also do. A lot of participants feel insecure to share too much or too little and too formal or informal information, when writing a profile description. All questions are liked by the participants only the film question is disliked by participant 4R and 1J as they perceive it as irrelevant. Participant 2C is the only participant who doesn't like the suggestions on how to design her profile, because she considers herself a very private person and does not like to reveal information about herself on social media platforms in general.

> *„Yes, I'm more of a private person so I don't really like answering and showing questions like that. I mean it's useful in social media and communities where you want to get to know each other but stuff like where I live or my birthday I don't want to give. I'm just more of a private person." (Participant 2C, 2022, Appendix G p. 116)*

She and participant 5S have concerns about privacy. Participant 5S feels uncomfortable sharing her address when she realized that everyone could see it. She also thinks that sharing ideas is a risk as they can be stolen by someone else. The other four participants have no privacy concerns about the data they share. All six participants including participant 2C say that they are curious about how other participants fill out their profiles and like to compare their answers.

> *„That is very contradicting, I don't like to share information, but I like to read it from other people. It was nice to see what kind of music they like what they do in their free time and stuff like that. That were questions I find interesting. […]" (Participant 2C, 2022, Appendix G p. 116)*

They like the job and study-related information, as well as the private information about hobbies, etc. to discover similarities and gain insights into the other community members. All six participants are able to get a first real impression of the other community members as people. Only participant 1J notes that some questions related to studies, would help her more, as in her opinion the general questions are not answered honestly and nuanced. The remaining participants prefer the study-related questions, but also appreciate the generic questions for additional and deeper insights into the community members. Five out of six participants see the profile information given through the profile suggestions as helpful, to have a starting point for contacting other participants they do not know. Only participant 1J states that she would like to have a communication tool within the platform, such as a chat, to contact them and that then the information could be helpful. However, she is not sure if she would even then contact other community members. The suggestions for the profile descriptions are mostly approved by the study participants as they give a first impression of the community members as people and serve as a starting point for more informal communication between the students. Only small improvements were suggested by the participants and should be implemented.

Community

Three participants have more of an individual feeling and experience during the two-weeks of evaluation of the concept and the tool, two participants have a community feeling, and participant 3L feels both. Participant 1J has no sense of community but says that this is due to the very short and limited testing period, and that with a longer use or through the integration into a course a community could form. The community feeling is also missing for participant 2C, which is due to the lack of physical connection and group work. Participant 6A also feels that group work could help to create a sense of community. Participant 3L likes that he has more of an individual feeling when commenting on the *Microlearning post* on Monday but feels a sense of community when discussing the results of the *Microtraining task post* on Wednesday by sharing different opinions about a common experience. Participants 4R and 5S also like the shared experience of discussing topics and solving tasks together and feel a sense of community through the shared interest and goal. The sense of community is already perceived by three participants but needs to be strengthened, to include more participants with steps like group work, additional physical offerings, and a longer usage time.

Concept impact on study experience during COVID-19 pandemic

Five out of six participants think that in the extreme situation during COVID-19 pandemic when they had to learn online, the concept and the tool would have helped them to have a better learning experience. Only participant 6A doubts that the concept and the tool could help, as she had a similar experience during COVID-19 pandemic in a course where they tried to establish discussions in moodle. However, in her opinion, the concept as well as the use of the Humhub platform could positively impact the study experience, if more discussions can be established. The five other participants note that they feel the

platform could provide a space to meet other students, as conversations did not happen after lectures or during lunch during the COVID-19 pandemic.

> *„Yes definitely, because you had some lectures or some meetings every week, but everyone had just a black screen no one said something and after 90 minutes everyone left the meeting. I think if you have such a community where you have to interact because of the tasks I think you have more the feeling that there are some other people. That you can meet other people in your studies more than if you just have some videos to watch alone at home or some meetings where no one talks without the professor." (Participant 1J, 2022, Appendix G p. 108)*

The Learning Community space is also mentioned as a point where participants could get help with questions and feel more connected, with the private space still being separate from the study space, unlike on platforms such as WhatsApp. All six participants say that the concept and platform could have improved the communication between students during the COVID-19 pandemic online study in creating a place to find help, have interesting and meaningful discussion and get in contact more easily.

Concept integration into the study program of students as digital service of the university

Four of the six participants see no problem in the workload of the concept and the platform and consider it possible to participate during a semester. Participants 5S and 6A have some concerns and feel that the concept would work if it is offered as part of a course or in a blocked time period from the university to use the platform. If the concept is not offered this way, people are too busy with their studies and personal lives to participate, in their opinion.

> *„I'm not sure usually when there's so much else going on, stuff that is not essential automatically falls to the side. If the community is a part of the lectures and the studies and theirs is like planed time for it maybe in a class or less homework, then I think it could really work." (Participant 6A, 2022, Appendix G p. 147)*

The other four participants state that they would need some pressure to join the community but as soon as they would experience benefits, they would be motivated to stay. It is also explained that it is important that the usage of the platform isn't mandatory. Participant 3L explains that he likes the platform as it not only offers to get to know students of the same semester but also the new students that arrive every semester which motivates him to continue using the platform. He also explains that if he has too much study stress, he might skip the platform for a week and then continue to use it. Five out of six participants would use the concept and the platform if it is offered by the University of Siegen as a digital service. Only participant 1J is not sure. She states that she would only use it if it is part of a lecture or she directly benefits from it for an exam. The other participants say that they would use the platform even if they are in their final semesters but not always participate in tasks as they have a lot to do. They also say that it is interesting for not only meeting new students in their first semester but to learn and feel more prepared for starting their careers after their studies. It is also noted that the platform Humhub and the concept are liked more than the currently used moodle platform as it is more structured, offers more interesting information, and has a better design. Most participants would use

the tool and the concept, so the idea offers a first step to create something new that could support students.

Results of the analysis of activities of the participants in Humhub during the two evaluation weeks

Monday *Microlearning post*: In the first week, most participants seem unsure when to look on Humhub and where to comment, and only two participants comment on time. Reinforcement from the tutor motivate the others to participate in commenting. Participants also seem to take more time between commenting on the *Microlearning post* and starting the *Microtraining task*. In the second week, three participants comment without reinforcement within the time frame before the Wednesday *Microtraining task post* and seem more accustomed to the concept and Humhub. The reinforcement from the tutor motivates the other three participants to join the comments later. The three later comments from participants 6A, 5S, and 4R appear a few days later. From the two weeks it can be concluded that a longer use of the platform helps participants to slowly get used to commenting, but participants should have more time and a fixed main commenting time for a more active exchange. The reinforcement by the tutor appears to have a motivating influence on the participants to comment. *Wednesday task post* results and comments in the wiki: The example and template seem to help the participants to create a portfolio and share their results in the right way on the wiki. However, more tutors support is needed to help participants to understand where, how and what to upload, as two participants experience problems in the first week. More instructions could also support this process. As no participant needed the support of the tutor in the second week, this proofs that longer usage time and practice help students to participate successfully. The low comment activity under the wiki task post in the first week could be due to the comment function only being available when the room administrator/tutor opens the comment section with an initial comment. This is noticed in the second week of evaluation when participant 1J wants to comment but could not and therefore, asks the tutor for help. In the first week the comment section was open four days after the tutor presented the task. This happened unintentional in order to encourage participants to comment, and without knowing that it was not possible for participants to comment beforehand. By opening the comment section earlier in the second week for the second *Microtraining task*, all participants are able to use the function directly after posting their results, which led to a higher comment activity as five participants commented. The comment function should always be available for participants. However, it also seems that participants need more time to get used to the concept and to know where to post results and where to comment. Both points could explain the higher comment activity in the second week of the study. It can be concluded that participants are able to engage in the tasks and discussions but need an extra day to finish their work in time before the next topic starts. A longer period of use, improvement of the communication functions and the concept, tutor support and more guidance could help to use the concept and the platform successfully. These points are also mentioned by the participants in the interviews.

7 Concept and tool improvements and high-fidelity prototype design suggestions

The platform is found to be good by four of the six main-study participants, so only individual functions are improved through design and conceptual proposals. Improved Humhub functions are visualised in high-fidelity prototypes which are created in Adobe Xd. Since the Humhub platform is an open-source platform, it should be possible to integrate many of the suggestions however, the effort to do this is neglected due to the time limitation of this thesis. The design proposals are therefore, to be understood as improvements of a first development iteration of the e-learning concept and platform Humhub. It's important that although the platform is in German, the concept and test were conducted in English. This is why functions are presented in German while the integrated concept and content that can be contributed to the platform is in English. Language options for the platform are soon available. A large representation of the high-fidelity prototype design proposals can be found in the Appendix H (p. 153) or on the CD enclosed with the thesis (file path: /MasterThesis/04_High-fidelity-Prototype).

7.1 Community Learning space – stream improvements

Learning Community space stream

In the stream of the Learning Community space, it is criticised that the space menu (transl. Space-Menü) is too small and moves when scrolling. This is why the notification function, integrated in the clock symbol, is often used for navigation in the platform, as it offers links to the newest activities of other participants. The navigation between the different learning space areas such as the stream and the wiki are seen as being incomprehensible and confusing. Also, a back button is missed by one participant (see Figure 7). In the new high-fidelity prototype design proposal, the space menu is enlarged and highlighted in colour which can be seen in the comparison between Figure 7 and Figure 8. It also contains the name of the space to show that this space menu is for the Learning Community space. The location of the participant in the Learning Community space is emphasised by a strong contrast in the space menu of the current position within the space and the colour connection to the middle part of the website which contains the section specific content of the space (see Figure 8, red square). This design decision is based on one of the Gestalt laws of perception. The law of similarity states that objects with similar characteristics e.g. here the colour, are perceived as belonging together (Jacobsen, 2014; Pinatti, 2020a). In addition, the mid-section for the section specific content is given a heading that also shows the position of the user in the Learning Community space (see Figure 8, red square). The space menu is anchored with the other menus and the Learning Community space header and no longer moves when scrolling down (see Figure 8, green square) (Hammer & Bensmann, 2009; Jacobsen, 2014). A back button is not implemented so that only the browser back button is used as this is common on other social media platforms such as Facebook and LinkedIn (LinkedIn Inc., 2022; Meta Platforms, 2022). The display of other community members on the side is criticised by one participant but welcomed by another participant and therefore, is not adapted (see Figure 8, black square).

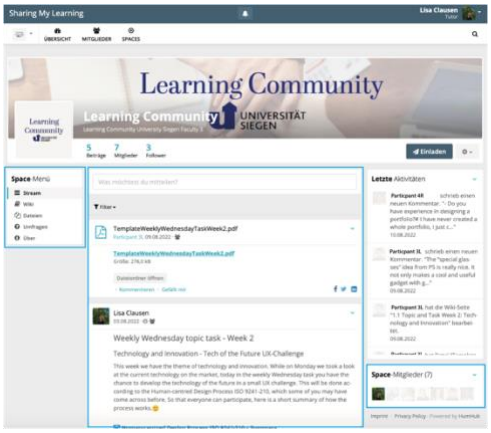

Figure 7: Old Learning Community space – stream

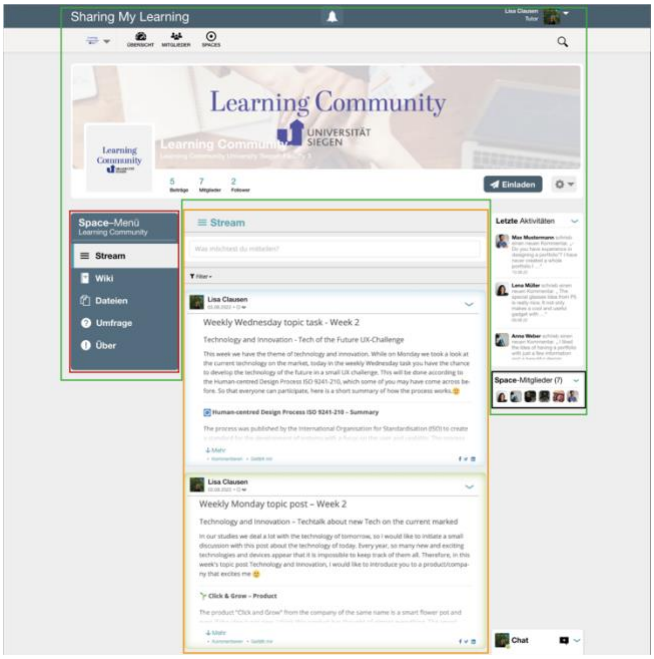

Figure 8: New Learning Community space – stream

Microlearning and Microtraining task posts and voting improvements

The different types of content (*Microlearning and Microtraining task posts*) in the Learning Community space are criticized for looking too similar, which leads to a longer search for the right post. It is also criticized that older posts are difficult to find, and one has to scroll for a long time. To improve that, in the new high-fidelity prototype design proposal are different colours that can be assigned to the different posts in the stream of the Learning Community space. A blue outline for *Microlearning post* and a green outline for *Microtraining task post* (see Figure 8, orange square). To find past posts more quickly, the filter function in the stream (see Figure 9) should be adapted with the option to filter by time phases and dates. This is done by the time phase (transl. Zeitraum) function in the new high-fidelity prototype design proposal (see Figure 10, red square).

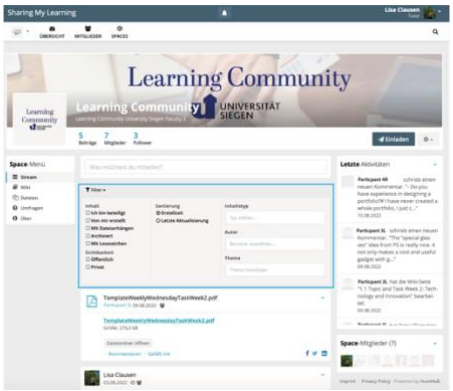

Figure 9: Old Learning Community space – filter

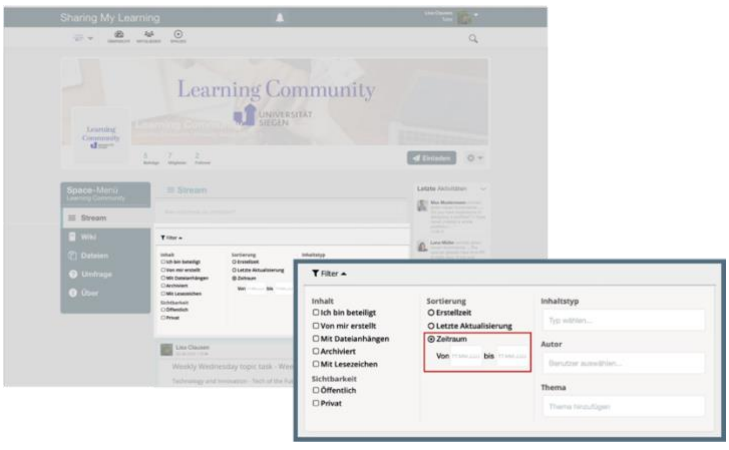

Figure 10: New Learning Community space – filter

Participants want more pictures in the posts, a little less text in the *Microtraining task post* and more in the *Microlearning post*. It is also suggested that there should be a note in the *Microtraining task post*

that the results do not have to be perfect and an estimate of how long the task will need. This is important to take the pressure off the students to do too much and can easily be written in the *Microtraining task post* as a disclaimer. In the posts themselves, more images can be used and, if thematically possible and without losing meaning, the text can be shortened in the *Microtraining task post* and transferred to the *Microlearning post*. One participant suggests shifting the days, on which the assignment is posted, so that one would not have to work on the weekend, However, participation in assignments is voluntary and can be made up for later if one foregoes a more active discussion with other students, as this will then already revolve around a new topic. The proposal is therefore, not implemented. One participant suggests posting all information on one day, which also isn't implemented because the activities should be spread over the week, so that participants are motivated to visit the platform more often to actively join discussions. Another participant wants the reflective question at the beginning of the post so that one does not have to scroll through the information first. The idea isn't implemented as a reader could be tempted to not read the information in the post and to provide wrong answers. One participant notes that the current design of the voting could lead to a distortion of the vote. This could happen as the current state of the vote, that is always displayed, could tempt voters to choose the topic with the most votes instead of the one that appeals to them the most. In the vote, the results of the voting in the new design are only be displayed at the end and not during the process. This is already possible as Humhub offers such a voting function. If participants want to contribute posts for the Learning Community, they stated that they need the possibility to get support by the tutor.

Communication

One criticism regarding the communication is, that comments under wiki posts appear at different times, which causes that it is not being perceived as a proper discussion. It is also noted that there is no round of introductions or icebreakers to help participants in the community to get to know each other better in the beginning. Conceptually, communication could be improved by offering a fixed period of time after posting all results on the wiki to discuss them. This would promote a more active discussion and thus also the sense of community. The discussion could take place in the comments or in a joint group chat. A tutor could support the discussion and moderate it if needed. A short introduction round before the fixed discussion period starts could create an ice-breaker. The sense of community could also be improved by a longer use of the concept and platform, and more discussions. The comment functions are criticised by one participant regarding the typography, as well as the lack of multi-media messaging options and functions such as emojis. It is also noted that the last comment is difficult to recognise, and it is therefore, hard to catch up with the current stand of the discussion. The typography in the comment function is not different from other social networks such as Facebook, LinkedIn etc. and is not adapted (LinkedIn Inc., 2022; Meta Platforms, 2022). The option to post multi-media elements such as images, videos, or smileys already exists in the current comment functions and is already used by other study participants (see Figure 11). To make the most recent comment more visible, it is highlighted in the new high-fidelity prototype design proposal with a slight indent, a larger image and font. Also, a filter for the comments to sort them by topicality and relevance is added (see Figure 12, red square). The

improvements are inspired by the design of the social networks LinkedIn and Facebook (LinkedIn Inc., 2022; Meta Platforms, 2022).

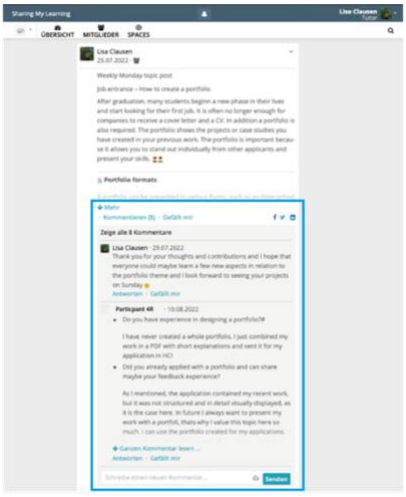

Figure 11: Old Learning Community space – comment section

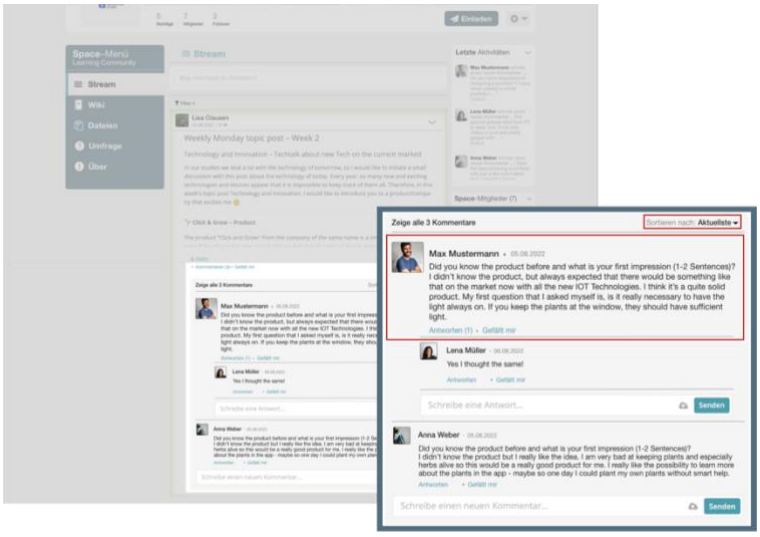

Figure 12: New Learning Community space – comment section

Four out of six study participants criticize that there isn't a chat function that allows participants to have more private conversations, more easily ask questions, and socialize. The chat function was also seen as an alternative to exchanging phone numbers, as some participants perceive this as too private. A chat function like on other social networks such as LinkedIn or Facebook should therefore, also be integrated in Humhub like in the new high-fidelity prototype design proposal (see Figure 13). It should be always available on the platform. In addition to the possibility to communicate more actively and almost synchronously, the chat can also show who is online (green), offline (grey) or busy (red) and thus help to decide with whom to communicate directly (see Figure 13).

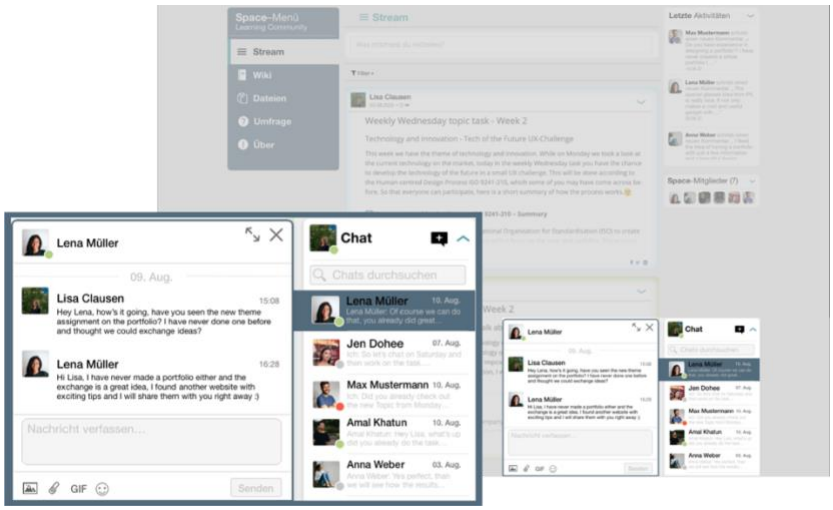

Figure 13: Learning Community space – chat

Community feeling

Three participants do not feel a sense of community while using the concept and platform. In order to improve that, they suggest that the concept and the Humhub platform should be used for a longer period of time, that group tasks should be offered, and that complementary physical meetings should

take place. In addition they propose that participants in the community should be able to publish small contributions on own projects and topics with video and pictures, in order to discuss them with the community and get other opinions to improve their project and grade. A longer usage could strengthen the community feeling as participants can get to know each other better. Group work could be integrated into assignments from time to time but should not be compulsory as participants in the pre-study state that poor group work can lead to feelings of isolation. Participants in the community should be able to actively contribute content to the community, but the learning interests of the community should always be considered. Physical meetings every few months could offer students the opportunity to network more with other students e.g. networking event. The networking event could also be used to deepen a topic in which there is particularly great interest. The proposals should be implemented in the concept and tested in the next development iteration if they improve the community feeling.

7.2 Community Learning Space – profile improvements

The profile design is criticised for asking for very private data such as the address (see Figure 14). The current profile form has a field for the address which is removed in the new high-fidelity prototype design proposal (see Figure 15).

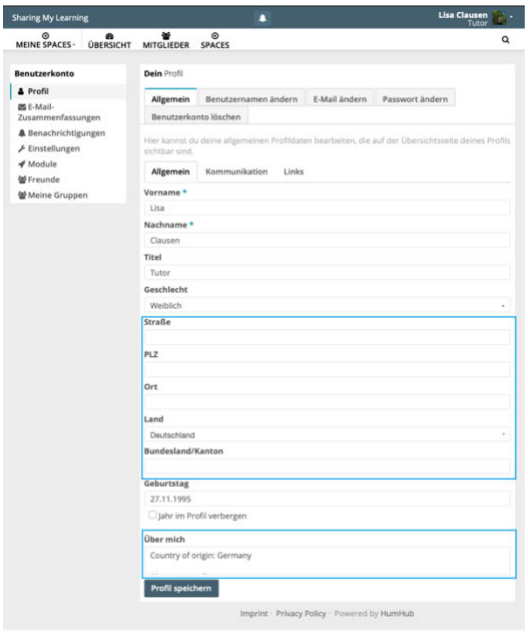

Figure 14: Old Learning Community space – profile

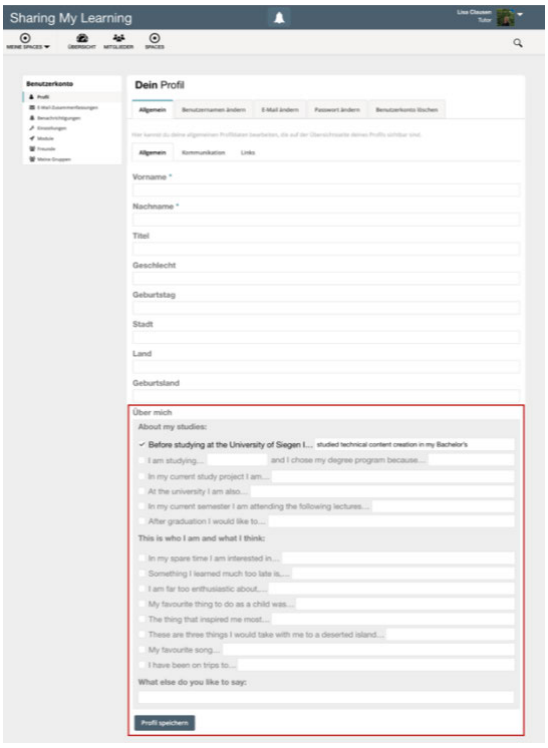

Figure 15: New Learning Community space – profile

As study participants did not like the film question, it is removed from the profile questions. The questions identified to enrich the profile always have to be copied into the about me section (transl. Über mich) in the current design which is too small to show them all. This is why a lot of study participants didn't immediately fill out all questions, till they were advised to scroll down and fill out the rest (see Figure 14). It is better including the questions in the profile form like in the new high-fidelity prototype design proposal (see Figure 15, red square). One participant does not like the generic questions and notes that these tend not to be answered spontaneously but with the intention of

presenting oneself as well as possible. This point is a problem within online profiles and in CMC and is known as hyperpersonal perspective (Walther, 1996). Creating a community atmosphere in which participants feel comfortable enough to be themselves could diminish this effect to an extent.

7.3 Community Learning Space – wiki improvements

The wiki is considered one of the most important concept functions by study participants but is also the most criticized in terms of its functionality. The comment function under the wiki is criticised because participants in the role of community members can only comment if someone with admin rights, e.g. a tutor, has set a first comment. The comment function should always be accessible to everyone. It is also suggested by study participants that comments under the wiki entry should be anonymous depending on the topic and task. However, anonymity diminishes the social presence in computer-mediated communication which leads to negative behaviour in discussions (chapter 2.2.1, p. 8), which is why this proposal is not implemented. Stronger vertical linking between wiki entries is suggested by one participant and can be considered when increasing the number of contributions.

When the wiki is opened via the space menu (trans. Space-Menü), the index (trans. Index), of the entire wiki is displayed first. In the current version, all topics are located in one row and can only be structured by name in their automatic alphabetical order (see Figure 16). Study participants find this confusing due to the two different wiki entry types: Topic entries, which contain the weekly topics, and introduction wiki entries, which explain the Learning Community. In the high-fidelity prototype design proposal, index groups that combine several wiki entries on one topic can be formed (see Figure 17, red square). The most important wiki entries of an index group are directly visible, and others can be accessed through a drop-down menu. The index group can be created separately with the button new index group (transl. Neue Index-Gruppe), and wiki entries can be assigned to it, or wiki entries can be created first and then combined into one group.

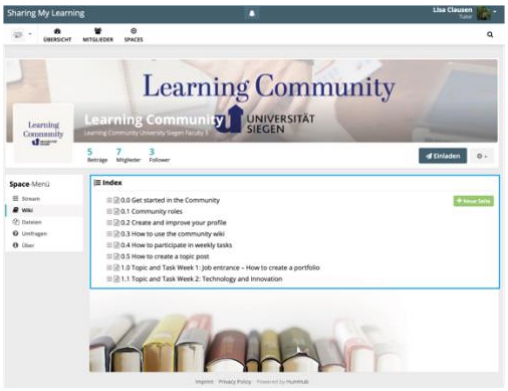

Figure 16: Old Learning Community space – wiki

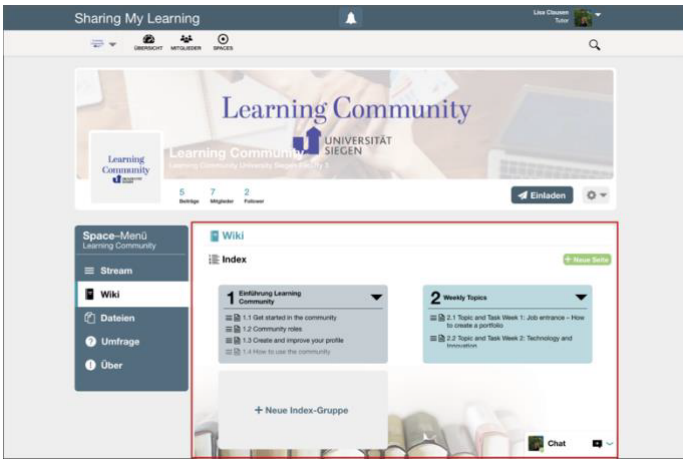

Figure 17: New Learning Community space – wiki

When study participants opened a wiki entry, there is criticism that there is no index for the content, so that one could jump directly to a chapter. A page index is available in Humhub but only forms when selected heading formats are used for the wiki entry (see Figure 18). As a design suggestion, it should be possible to mark headings and add them to the index. This gives more formatting freedom and can

increase the readability. The page index menu (transl. Seitenindex) in the high-fidelity prototype design proposal is enlarged and displayed as a separate segment (see Figure 19, red square). It is also firmly anchored with the other menus, the header of the Community Learning space and the chat function so that they are always visible when scrolling down the wiki entry (see Figure 19, green square). Study participants also criticise that they could not find the edit button (transl. Seite bearbeiten Knopf) because it is too small and moves when scrolling down the wiki page (see Figure 18). The edit button is enlarged and highlighted in a blue colour and is anchored so that it remains visible with the other menus and wiki functionalities when scrolling down the entry (see Figure 19, orange square).

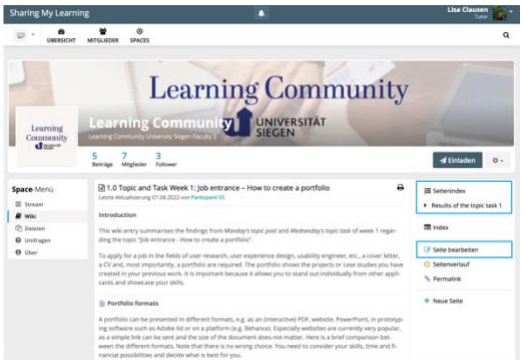

Figure 18: Old Learning Community space – wiki editing button

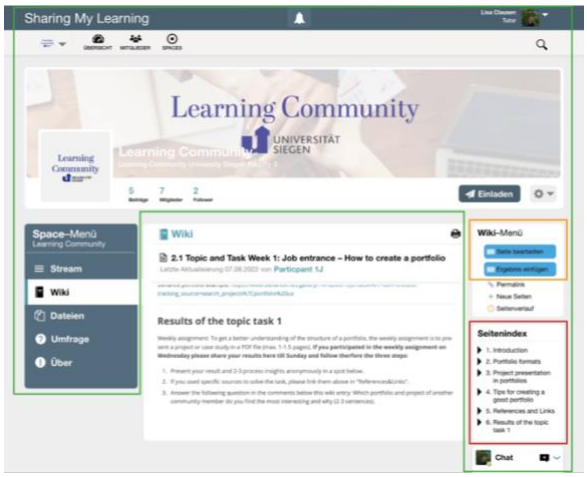

Figure 19: New Learning Community space – wiki editing button

Participants in the study criticise, that when editing, they could only edit the entire wiki entry and were afraid of accidentally changing other parts while working (see Figure 20). In the new high-fidelity prototype design proposal participants can only edit individual sections, with the function new section (transl. Neuer Abschnitt) which is added to the editing options (see Figure 21, red square). A section is represented by a grey dashed line and adapts its size to its content (see Figure 21). Study participants also criticise that they cannot see whether another participant is currently working on the same part and fear about which changes are subsequently adopted by the system. In wikis, individual sections are often locked while they are edited (Koch & Richter, 2009). This solution is not adopted, because it severely restricts the collaborative creation of a wiki entry. In this design proposal individual sections can therefore, be locked or unlocked for others by the participant during editing. This is done by clicking on the grey lock symbol. In the locked state, the lock is closed and orange, and the whole section is marked orange for others. In the open state, the lock is grey and open, and several participants can work on the same section (see Figure 21). Participants working collaborative on the wiki entry could be shown in real time with a coloured and named marker which facilitates coordination in the digital space. Real-time collaborative work like in the high-fidelity prototype design proposal could be a great improvement for the wiki and strengthen the sense of community (see Figure 21). The design for the real-time collaborative work is inspired by google.docs (Google Inc., 2022).

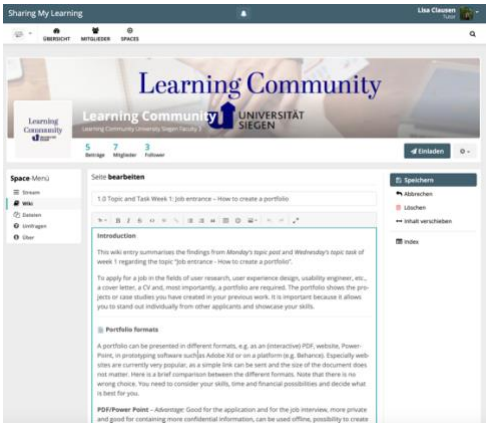

Figure 20: Old Learning Community space – wiki editing

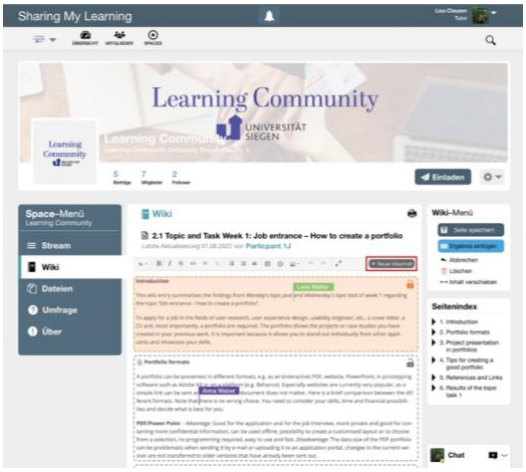

Figure 21: New Learning Community space – wiki editing

When inserting results, study participants criticise that they cannot enter their results directly in the intended place in the wiki entry and always have to scroll down (see Figure 22). In the new design, there is a colour highlighted, insert result button (transl. Ergebnis einfügen) with which they can jump directly to a free space to enter their results (see Figure 23, red square). Another criticism is that the results are not displayed well so that they can be compared, similar to the picture grid in Instagram. The results can be presented in a grid as shown in the new design, so that a direct comparison is possible. However, instead of using the basic suggestion to show only the result pictures, the whole results are shown as the textual information might be important for other participants to make a comparison (see Figure 23). Study participants note that results cannot be entered anonymously because the name appears in the wiki page history. A solution is that once participants have entered the results, they can decide whether they want to save them anonymously (transl. Anonym speichern) or under their name (transl. Mit Name speichern) (see Figure 23, green square). This is implemented to take the pressure off participants to submit perfect results. This function is only accessible for the presentation of results of tasks in the wiki. When editing other wiki sections or commenting, a name is always shown, to motivate participants to take responsibility for their contributions.

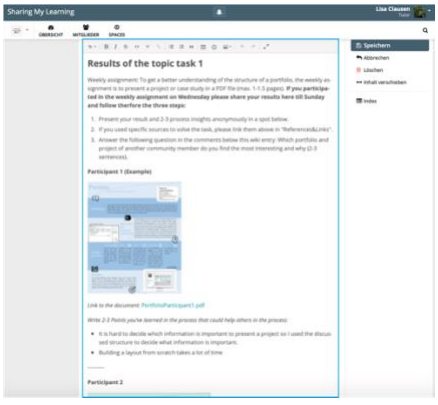

Figure 22: Old Learning Community space – wiki task results

Figure 23: New Learning Community space – wiki task results

8 Discussion – limitations and outlook

This chapter discusses both the limitations, the possibilities, and perspectives of this work. The limitations reflect the concept focussing on the results of the main-study, as well as the procedure of the main-study and its influence on the results. The outlook provides initial ideas on the direction in which the concept could be developed further.

8.1 Limitations

The evaluation of the concept has some limitations that need to be considered when looking at the results. The evaluation period of two weeks is too short to analyse topics like communication, well-being, and motivation in depth. Also, the establishment of concepts like the Community of Practice approach need more time. As the main-study is short and focuses more on evaluating the concept than the features of Humhub, a detailed evaluation of Humhub is needed to improve usability and user experience. This was not possible within the time constraints of this thesis. As I actively supported the discussions during the evaluation in the role of a tutor, my influence on the participants must also be considered, which in turn influences the results of the main-study. Thus, it may be that the participants formulated their comments differently, e.g. more elaborately than they normally would. Since the tutor role is also part of the concept, it is important to test the concept with another person for this role in order to evaluate this concept aspect. This could provide answers to open questions like who would be suitable to take on this role in the university context, e.g. student assistant, lecturer, etc. A change in the participants' behaviour could also possibly be observed with a different tutor. To ensure that all study participants test all aspects of the concept once, they are given a fixed study plan (Appendix C, p. 103). Even though the concept specifies that the learning units are always set on a fixed day, it would be important to observe how participants engage with it over a period of time without direct instructions. The results of the study show that the concept and the Humhub platform are positively received, with little criticism of individual features, which are addressed with suggestions and high-fidelity prototype design proposals in chapter 7 (p. 59). Due to time constraints, only one development iteration is possible, but a longer evaluation of the improved concept and a change in the evaluation process are necessary to create a better e-learning concept.

The evaluation of the approach to informal communication shows that only half of the participants feel encouraged to discuss with others and although four participants find this communication positive, two criticise that they do not consider it a real discussion. The motivation to reach out to other participants is low for three participants, non-existent for two, and there is no communication outside of the tasks. Participants state that the discussion spans several days and is too asynchronous, and that technical communication features such as chats are missing. The original intention of asynchronous communication is to allow participants to flexibly participate in their stressful daily study routine. However, it can be observed that the existing communication in the comments, although perceived positively, is negatively affected because it is too asynchronous and based on a medium that is not rich, e.g. text in the comments. Negative effects include slow relationship building, isolation, less communication, etc. Even key e-learning concept approaches such as shared learning content in a CoP

or the promotion of a strong social presence with profiles could not fully mitigate these effects. A change of the platform e.g. WhatsApp towards a more active discussion is probably not made by the participants due to the greater effort involved. Communication should be improved by almost asynchronous communication possibilities such as chats in the platform, as already mentioned in the design improvements of the first concept evaluation in chapter 7 (p. 59). A higher number of users could also lead to a more active discussion through more contributions. An analysis of student activity shows that in the first week, encouragement from the tutor is necessary for students to participate in the discussion. In the second week, more students participate in the discussion on their own initiative, but again the tutor provides support to get everyone involved. The tutor seems to be able to support the discussion, but it could be that in the role of the researcher as tutor, students feel more obliged to accept the invitation to participate in the discussion. An evaluation with a more neutral person as tutor is necessary to test whether a tutor can support the discussion. From the activity analysis, it also appears that participants get used to the concept over time and also participate more in the discussions due to prolonged use. These findings need to be considered and tested in the next development iteration which was not possible in this thesis due to time limitations.

The evaluation on the topic of well-being shows that most participants have a positive feeling about using the platform. Only one participant feels that she does not know the others well and wishes for more participants. The topics and the exchange with other participants are positively evaluated in the study and mentioned as a reason for positive feelings during the test. Getting to know the participants through the profiles with the profile design suggestions may also have contributed to this, as these are seen by five of six study participants as helping them to get to know each other better and to make initial contact. Despite feeling comfortable and getting to know others a little, many do not feel a sense of community, as three participants feel an individual feeling, two feel a sense of community and one participant feels both. The reasons given are the short duration of the test, no physical meetings and group work, and too few participants. Building a community with people who do not know each other takes more than two weeks. To get more valid results, the improved concept would first have to be tested over a longer period of time with more participants, both with and without physical meetings and group work, to find out what strengthens the sense of community. Group work in particular is criticised in the pre-study when it is carried out with poor team members and should therefore, be tested before it is integrated into the e-learning concept. Increasing the sense of community, and thus improving the psychological need for relatedness could contribute to well-being and communication and should be improved in the next iteration.

The evaluation on the topic of motivation shows that the motivation to participate in learning content and tasks depends on whether they choose the topic, how much effort is estimated for participation, and whether they have time for participation. The choice of topic is perceived by five out of six study participants as very important for the intrinsic motivation to participate. This could be explained by the fulfilment of the psychological human need for autonomy, which improves intrinsic motivation and well-being, as participants can decide for themselves what they want to learn. This influence on what to learn is also based on the concept foundation with Constructivism, Connectivism, and Adult Learning Theory.

Five participants would use the concept as it is, one participant only if the topics are important for her exams. Even though the concept offers the possibility of collecting the expectations and wishes of the students with a vote, it will never be possible to take all wishes into account, which can lower the motivation of individuals. However, individuals have the opportunity to contribute to these topics themselves if they are relevant to the communities learning focus. The possibility to create own contributions to the community on a topic is positively viewed by the study participants. This could be explained by the fulfilment of the human psychological need for competence to be able to do something, the need for relatedness by helping the community, as well as autonomy in the choice of topics. It can also be more extrinsically motivated to get feedback, e.g. to improve a project for a better grade. That students can create learning content for students, thus learn from each other, and build knowledge together should be tested in the next iteration, as in this work only the tutor created learning content. In the study, four participants state that the workload of the concept is feasible during their studies, while two think they need an additional lecture, or a period of time provided by the university. The participants also state that they enjoy the small tasks because they can achieve a result quickly, learn something helpful, and feel motivated. The workload and the time available influence the participants' motivation, which is probably why they prefer small tasks, as they can easily integrate them into their daily study routine and also satisfy the psychological human need for competence fast. The analysis of the participants' activities in Humhub shows that although the tasks are small, many need more time to participate and engage in discussions than was foreseen. One reason for this could be that many participants are in their last semester, writing their master's thesis and therefore, have little time. The main-study confirms that even if the topic is interesting, motivation is also influenced by the time and effort available for participation. The concept needs to be tested over a longer period of time with a larger number of participants to analyse what amount of effort and time allows students to participate during their studies and how this affects the motivation and well-being. In addition, there are other human needs whose fulfilment can increase motivation and well-being and which could be addressed in a further iteration with the concept design, such as the need for stimulation, described as the urge to experience something new (Hassenzahl, 2020). These steps were not possible in this work due to time constraints.

Regarding the context, it should be noted that the work focuses on e-learning in Germany, as the state of digitalisation in the country, at the universities and how the COVID-19 pandemic is dealt with varies from country to country. If the e-learning concept is used in other countries, it must be analysed whether the concept is suitable, whether it needs to be adapted to local conditions or whether it cannot be used. When evaluating the concept in terms of its context, the students' immediate factors that influence the use of the e-learning concept and the Humhub tool were briefly analysed, e.g. internet connection and access to the necessary devices. The literature review additionally analysed the infrastructure in which the concept is embedded, e.g. in this thesis specifically the university environment. Both aspects are only briefly addressed and require further research. In terms of immediate factors, participants in the main-study had temporary minor problems with internet access and one participant had permanent problems. The results confirm the study of Stammen & Ebert (2021) which stated that 91.6% of their participants had internet access but 39.7% had smaller issues once a

week. Most study participants encounter smaller issues but mostly had a good internet access. Since none of the participants had to buy major equipment to take part in the study, this is not an affirmation of the study of Stammen & Ebert (2021) where 18,9% planned to buy new devices, 28,4% planned to buy new devices when having the financial means, 10,6% bought new devices. As this study is very small, the results only offer a first insight. Although the socio-economic factors related to the use of e-learning are briefly presented, the concept should be tested with more participants from different socio-economic backgrounds, e.g. parenthood, study abroad students, etc., in order to analyse the influence on the use of the concept in more detail. This could help to get more valid results on how to adapt the e-learning concept to enable as many people as possible to participate. The broader context of the e-learning concept developed is also briefly explored through the Infrastructuring approach, with the eight characteristics by Star & Ruhleder (1996) and Star & Bowker (2002). However, the various aspects can only be analysed superficially and only slightly considered in the design, as many only become visible after a designed system has been integrated for a longer period of time. It is important to explore the characteristics in a long-term study, with a focus on the University of Siegen, where the concept is to be embedded. The infrastructural approach helps to answer questions such as how exactly the more formal lectures and the concept influence each other, which student tasks the system will additionally support, whether it will establish itself as a long-term solution and be integrated by other faculties and universities, whether students use the concept as intended or appropriate it, whether the system is seen as an alternative to e.g. moodle and replaces it, and whether Humhub as a platform provides a stable technical basis. These points should be investigated in a further iteration. Another question that should be explored in terms of context and that could not be addressed in this study is how students can be persuaded to switch to a new platform. WhatsApp and Telegram groups, which are also used for study exchanges, offer the advantage that the platforms are already well established in the private sector. That's why it is necessary to plan how the concept and Humhub can be successfully introduced to students with various options such as an introductory event in the first semester etc. Establishing the e-learning concept with the Humhub tool in the context of the students and the University of Siegen offers many research opportunities for future work.

When evaluating the concept and the platform, participants are asked to assess whether it could have helped them during the COVID-19 pandemic online lectures. Five participants say that such a concept would have helped them, one participant has doubts. It is difficult for participants to make a valid statement about how the concept would have affected their study experience. This is due to memory mistakes which can be caused when asking people about past events, as well as it is hard to predict how something would have effected their lives in the past (Baxter et al., 2015). However, as students had challenges with informal communication, motivation, and well-being and no solution was available, an improvement through the concept cannot be excluded. The impact of the concept could be tested at distance universities to see if online-only teaching can be supported by the concept, but further research is needed to get more valid results. For regular universities that offer e-learning in addition to face-to-face and online lectures, the test results are more valid because the effects of the COVID-19 pandemic had already subsided by the time of the main-study and the participants had mostly online lectures but also some face-to-face lectures. Five out of six participants in the main-study would use the

concept if offered by the University of Siegen and liked the idea of having this option as part of a stronger digital offering alongside their lectures. This suggests that the concept can improve the study experience if it is used alongside face-to-face and online lectures. The concept offers therefore, an initial answer to the research question but due to the high complexity of the topics communication, motivation, well-being and learning it needs further research regarding the limitations of this work to ultimately improve the concept.

8.2 Outlook

The concept developed has the potential to improve the field of e-learning in terms of informal communication, motivation, and well-being based on current technologies. However, there are a lot of interesting directions for the platform to develop in the future. The platform is initially optimised for use with laptops, but it is evident that mobile use and services have increased significantly in recent years. Exploring a mobile use of the concept and platform could offer many interesting new opportunities to enhance the e-learning experience. For example, new platforms such as Tiktok have caused a shift in recent years towards shorter and often video-based content units, which are particularly popular on smartphones. Picking up on this trend could be interesting for the e-learning concept. New technologies such as Virtual Reality and Augmented Reality are gaining popularity in various application areas, especially smartphone applications. These new technologies could also change the field of e-learning and should be considered in the future. In order to keep up with digitalisation, the change of information, and the knowledge derived from it, the e-learning concept should always offer the possibility to implement or adapt new technology trends that support and enhance learning. This enables the creation of a digital learning experience that evolves with the progress of digitalisation and information. The concept focuses on informal collaborative e-learning and is not only suitable for enhancing digital learning in universities but can also be used for other collaborative learning purposes e.g. for example a programming learning community. In the future, the concept could help many people to meet the challenge of lifelong learning in various fields, which is necessary to keep up in a rapidly developing digital information society in the 21st century.

9 Summary and conclusion

This thesis answers the research question "How to design a motivating e-learning concept for students for a social (informal) exchange of information in the digital age?" in a first development iteration. Therefore, a concept is developed from a literature review and qualitative pre-study and evaluated in a qualitative main-study. The COVID-19 pandemic caused higher education institutions to quickly convert their almost exclusively face-to-face teaching to e-learning offerings, which often led to solutions that had not yet been optimised and made the current challenges in the field of e-learning more visible. Three e-learning core problems are identified and analysed: Communication (informal), motivation, and well-being and briefly the context. In the case of the communication, it becomes apparent that informal communication among students is particularly limited, which has a negative impact on the exchange of learning content. Due to the poor communication, students feel demotivated and isolated. The reason is that often there is no face-to-face communication, which is the richest medium consisting of non-verbal and verbal elements and a social presence. E-learning and computer-mediated communication often use less rich media that convey fewer non-verbal elements and social presence, leading to negative effects such as increased anonymity, slower relationship building etc. Motivation and well-being challenges in e-learning often lead to procrastination, concentration problems, feelings of isolation and lower student satisfaction with their studies. This is, because e-learning needs self-directed learning, which in particular requires intrinsic motivation. According to the *Cognitive-Rational Model of Motivation*, motivation is a function consisting of the situation, action, result and the resulting consequences. The expected outcome and the resulting consequences of students are important for their motivation to learn. Intrinsic motivation and well-being according to the Self-Determination Theory arise from the fulfilment of the three human psychological needs competence, autonomy, and relatedness. The Cognitive Evaluation Theory adds that the three needs are influenced by interpersonal events and context. The Organismic Theory explains that extrinsic and intrinsic motivation are a spectrum. Besides pure intrinsic motivation, there is also Identification level motivation, e.g. a person who identifies with a goal and does things they do not want to do. Another motivation is the Integrated Regulation e.g. appropriation of extrinsic regularities to correspond to one’s own values. During the pandemic, the need for relatedness was limited by contact restrictions and poor communication. The autonomy was limited by the fact that students could not choose between online and regular lectures, and the need of competence was limited because implicit feedback was restricted by poor communication possibilities. The context influences not only the psychological needs but also the whole e-learning experience. The location of learning changes from the institution to the home with a shift from face-to-face to e-learning. Due to this, studies have shown, that socio-economic factors have an increasing impact on the e-learning experience of students, e.g. internet access, device access, parenthood, housing situation, etc. Learning times also changed from a fixed study schedule to more flexible learning times with e.g. pre-recorded lectures, which could lead to stress and a feeling of permanent readiness to learn.

To design a solution, learning is based on Constructivism, Connectivism, and Adult Learning Theory. Constructivism states that learners have prior knowledge and live in a world with different realities of

individuals. Through social interactions, individual's reality changes, and new knowledge is constructed. Learning takes place in a social context. It also enables the motivation and interests of the learner and self-determined learning. Connectivism adds that not only people and institutions but also machines create knowledge and construct it together with people. The Adult Learning Theory is considered due to the target group of mostly adult students. It states that adults learn differently than children do. The three learning approaches are taken as a basis to find methods and approaches that address the three focused challenges more specifically. Informal communication and well-being are improved with the Community of Practice and Artistic Pedagogical Technologie*s* approach. The CoP focuses on forming a community or group of interacting people, who share a common interest and practice, here learning, and have senses of belonging with in a loose and voluntary cohesion. Members construct knowledge in exchanges and discussions seeing artefacts of others. The APT approach is focusing on fostering community, social presence, creativity with using creative elements e.g. photovoice approach where pictures are shared with a reflective question to stimulate discussion. To improve the motivation and well-being the Microlearning and Microtraining approaches are chosen. Both focus on informal exchange and motivation and are based on Microcontent which is a short structured, self-contained, and independently understandable unit of information. If people can learn from Microcontent it is called Microlearning and if there is a qualification or task in it, it is called Microtraining. To consider the wider context of the students and solution to be designed, the eight characteristics of the Infrastructuring approach are briefly considered. Infrastructuring considers e.g. physical, digital, cultural etc. elements, and the relationship between them regarding the designed system. To implement the approaches technically, it is determined that a social network tool with wiki and weblog functions is suitable. The open-source platform Humhub is chosen because it enables this combination and is already used by the University of Siegen to host several projects. In a qualitative pre-study, semi-structured interviews are used to evaluate initial ideas based on the literature review approaches. A concept is created from the literature review approaches, the pre-study and the platform Humhub.

The concept consists of the social network *Share my Learning* which was already created and used with Humhub at the University of Siegen. In *Share my Learning*, a space is created. A *Virtual Cooperative Learning space* and Community of Practice are established within the space. The VCL in the space consists of three functions to establish an e-learning environment. The coordination functions consist of the role tutor with admin rights and the role community member. Tutors can support community members. Communication functions are enabled through comments, notifications, and collaboration functions through the wiki and learning content. The Community of Practice focuses on reading, editing, and discussing learning content collectively and documenting the collected knowledge in a wiki. The learning content is consisting of *Microlearning posts* and *Microtraining task posts* in weblog form based on the APT approach that are posted in the space. One topic is covered per week and members can vote for it every two weeks. The topic is presented by a tutor as a *Microlearning post* and *Microtraining task post* once a week. The *Microlearning post* presents the topic with pictures and a reflective question to stimulate discussion in the comments and can be downloaded as a PDF. The *Microtraining task post* is posted two days after the *Microlearning post* and consists of a task to be worked on and the results posted and discussed in a linked wiki entry. One wiki entry summarizes the topic of one week and offers

a representation of the current knowledge of the CoP regarding this topic. The results are discussed in the comments under the wiki entry. Members can get to know each other through profiles. These contain a profile picture and follow a fixed structure with questions whose answers enable to get to know each other better and strengthen their social presence. The learning contributions and profile information promote informal exchange between students. The influence on the topics and the short learning units are intended to motivate them and the entire concept promotes the students' well-being in e-learning. The concept is intended to supplement the lectures students are visiting. In the qualitative main-study, the finished concept is tested in a two-week test and evaluated with semi-structured interviews. The results are used to improve the concept with proposals and the technical implementation in Humhub with high-fidelity prototype design suggestions.

The conclusion is that this thesis offers an important added value to the topic of e-learning, which still has a research gap, especially with regard to the challenges of informal communication, motivation, and well-being. This work offers a first important step to close the gap and a foundation for further research projects that can jointly enrich the research field of e-learning and thus support many people in the world in their learning journeys. The concept answers the research question in a first iteration and offers the potential for the integration of many more ideas. It also is adaptable to the rapidly advancing digitalisation and the new possibilities that this is offering. In this way, a good e-learning experience can be created for students for the future to come.

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