Improving Learning Motivation for Out-of-Favour Subjects

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Abstract: Many curricula encompass subjects that are deemed less interesting or not important by a large share of students since they cannot perceive their true significance. It is an open question how students can be compelled to get involved with these subjects after all. This paper presents a novel concept how this can be accomplished. In particular, the paper argues that four important requirements must be met, namely that learning can also be accomplished in a less formal environment than regular lectures, learning may happen independent of physical presence at the university and whenever students see themselves fit, learning is based on small units, and students enjoy getting involved in the matter. As a proof-of-concept, this approach has been used in programming education for students of electrical engineering, based on sending short summaries via WhatsApp and adding playful elements. such as quizzes. An evaluation of the proof-of-concept over two terms provides indication of the viability and usefulness of the approach, but also highlights several opportunities for extensions and refinements.

1 INTRODUCTION

Occasionally, university curricula contain subjects which are not at the centre of interest of a large share of students. This may be due to the fact that students view them only loosely, if at all, related to the core subjects of their study program. For instance, many students view non-major subjects such as, e.g., computer programming as foreign matter with limited relevance in non-computer science majors such as electrical engineering. Consequently, students frequently lack motivation to get deeply involved in the subject matter, resulting in poor performance. Nevertheless, such out-of-favour subjects are contained in the curriculum for a reason. Therefore, students need to be coaxed into getting involved in these subjects after all.

Thus, the research question is: “How can students be successfully teased into getting involved in subjects that they originally find dull?”. To answer this research question, the paper presents a concept that may contribute to master this challenge. This concept rests on four core elements which are discussed in section 2, namely that learning can also be accomplished in a less formal environment than regular lectures, independent of physical presence at the university and whenever students see themselves fit, learning is based on small units, and students enjoy getting involved in the matter.

As a proof-of-concept, the general concept is instantiated in the context of computer programming in an electrical engineering study program for freshmen students. Section 3 presents details of this approach which has been offered twice, each across a complete term. The success of this approach is evaluated quantitatively and qualitatively: quantitatively by an analysis of usage behaviours, qualitatively by a questionnaire-based survey, accompanied by additional interviews. The details and the results of the evaluation are included in section 3, along with a comparison of related work. The paper concludes with a discussion and an outlook.

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2 GENERAL CONCEPT

Making students work more intensively on subjects that they do not like is a challenge. Students are supposed to spend more time and effort on these subjects, yet additional time is not feasible within the curriculum without sacrificing other subjects. Therefore, additional or intensified engagement needs to take place beyond formal learning settings, ideally embedded into normal student life. In addition, there should be as few and simple roadblocks as possible for getting started. This entails that communication with the learners should use popular channels which do not need to be newly established. Furthermore, learning should not impose too much of a burden on students, i.e. should happen almost unnoticed. This implies small learning chunks that can be accomplished without spending too much time. Finally, students should be "rewarded" for getting involved. Such a reward might be additional fun, e.g. by elements with a game-like flavour.

We identified four key components of our concept which link together in such a way that small tasks are sent out to students over a communication channel that they use anyway. The tasks are small enough to be completed in a couple of minutes, wherever and whenever students feel like it. If they master the task, they obtain a virtual achievement.

2.1 Outside the Formal Context

Student learning does not take place only in university, but rather in everyday life, e.g. through exchanging information with friends or fellow students, or searching for information. Historically, educational institutions have been regarded as the central place for learning, but non-formal learning becomes increasingly popular, also with the facet of lifelong learning (Reischmann, 1995, 2002). Thus, it is important to create opportunities to enable learning outside of firmly defined classroom settings.

2.2 Brain-Friendly Learning Elements

Several memory theories exist in psychology (Atkinson and Shiffrin, 1968; Baddeley, 1998, 2002). One of them, Cognitive Load Theory (Sweller, 1988), states that learner's working (or short-term) memory has a limited capacity. Sweller explains three types of cognitive load: intrinsic (how complex the task is), extraneous (distractions that increase load), and germane (linking new information with what is already stored in long-term memory). The last aspect is in line with newer learning theories such as constructivism (Arnold and Siebert, 1999; Braslavsky, 2001; Glasersfeld, 2001). An information overload reduces the effectiveness of teaching. Following Cognitive Load Theory, learning should therefore happen in small learning units, so-called micro learning elements.

2.3 Motivational Components

Self-determination theory (Deci and Ryan, 1985) distinguishes different types of motivation. The most familiar distinction is between "*intrinsic motivation*, which refers to doing something because it is inherently interesting or enjoyable, and *extrinsic motivation*, which refers to doing something because it leads to a separable outcome" (Ryan and Deci, 2000, p. 55). Lecturers of non-major subjects cannot rely on intrinsic motivation to promote learning and therefore need to know how to stimulate different types of extrinsic motivation, e.g. by giving incentives as a downstream reward for successful implementation. Incentives are divided into immaterial (e.g. approval or title) and material incentives. These incentives should ideally boost intrinsic motivation as well.

In order to transform passive media consumption (Spitzer, 2012) into an active one, learning elements should be enriched with incentives. The goal is to introduce students to a learning offer that they use voluntarily and intrinsically motivated. To foster voluntary participation and active engagement, a comprehensive incentive mechanism is proposed which combines intrinsic and extrinsic motivators.

2.4 Digital Learning Environment

The most important criterion is the migration of the learning content into the everyday life of students. For this, the content needs to be included in a less formal scope directly in the everyday routine without much additional effort, using an appropriate medium.

Consequently, a suitable solution is subject to several constraints: the learning environment must be a digital one so that it can be used independently of time and place. In addition, it already has to be an existing component of the student's daily life.

3 CASE STUDY

For the proof-of-concept, computer programming for non-computer science majors (in our case: electrical engineering) was chosen. In that context, the four core elements of the concept need to be made more

concrete for students enrolled in these compulsory courses. Frequently, non-major computer science students are less motivated in the subjects than students who only take the subjects voluntarily or study computer science as a major.

Our surveys of the last terms indicate that many students come directly from secondary school (academic high school or higher secondary vocational school) without previous practise. Also, our students are non-major computer science students, which do not have programming as their actual study goal, but electrical or automation engineering, renewable energies, and similar goals. This often means that intrinsic motivation to learn programming is rather limited. Yet, with digitalization software takes over more and more central functions and programming turns into a cross-sectional discipline, also for non-majors.

In order to learn programming, it is important to bring in continuity. Contact-hours devoted to learning programming at universities are continuously decreasing. To ensure continuity, learning possibilities outside the classroom are required since classes are already filled with theoretical issues. In addition to continuity, practise is essential for being able to apply the newly learned concepts. Furthermore, motivation and time are correlated since a lack of intrinsic motivation comes along with devoting leisure time to other things than programming. Thus, the question is: How to involve students in programming outside the university in order to increase motivation for the matter?

In our electrical engineering programs, programming is a compulsory non-major subject in the first terms with a workload of 8 out of 210 ECTS points, split over two consecutive terms. Programming has four contact hours per week which encompass 2 hours lecture and 2 hours of lab exercises. At the beginning There is quite a lot of time between the classes, during which students tend to forget part of the material that has not yet been consolidated. Therefore, a short daily repetition on a medium that is already widely used seems to be a good start.

Most students are so-called “digital natives” (Prensky, 2001), i.e. they have already grown up with news services, messengers, and social media. This implies that eLearning offers should be expanded continuously by making use of novel technology and digital tools. Spitzer also points to a shortened attention span of young people (Spitzer, 2007, 2012), which needs to be taken into account. Therefore, learning materials need to be distributed over smaller learning units. The incentive for students to focus on a new, largely unknown (learning) offer can be achieved through playful elements such as quizzes (Hamari et al., 2014; Muntean, 2011). Young adults typically are inclined to play which can be exploited for motivating students to continue learning.

3.1 Research Design

The study was conducted twice in an iterative fashion, i.e. some modifications due to findings in the first run were already incorporated in the second iteration. In particular, one year after the first run, the same project was repeated with a new cohort of students based on revised texts, occasionally accompanied by digital media such as (animated) images or short videos. The quiz component was also revised and the quiz questions were expanded and doubled in total number, allowing student to obtain more comprehensive feedback.

The research design is composed of several components. The objective usage data and their analysis form the basis. On the subjective level, the same questionnaire is used at the beginning and end of the term (in two waves), where students were requested to rate statements using a five-point Likert scale. The questionnaires were supported by qualitative interviews.

3.2 Methodical Approach

A messenger service was used to send out regular summaries of the currently taught content, as a repetition of what had been learned, outside the lecture. The content to be learned was summarized with varying degrees of detail and at varying lengths. These summaries were initially sent on the day of the lecture, then experimentally at different times of day throughout the week in order to determine the interaction rate. In addition to purely informative messages, students should be stimulated to interact to a larger extent and get involved with the material also beyond formal classes. Therefore, questions and quizzes were used to address the students’ natural play instinct. A (knowledge/transfer) question about the previously read content was asked. Students answer the question voluntarily. Answers were checked for validity by a bot and the result reflected back to the students as a message. The result check is based on deposited rules policy with affiliation to the corresponding question. The quiz components consisted of purely textual questions, small tasks and multiple-choice questions with predefined answer options. These short quiz tasks and summaries were designed in such a way that they could be solved or

internalized in just a few minutes and are therefore a good filler for time gaps. The format thus corresponds to small, easily digestible learning snacks. The procedure just described is based on the three theories of enriched learning, micro learning (Hug et al., 2006), and gamification (Deterding et al., 2011a), which are described in the following sections. The last subchapter shows the importance of an already used communication channel to be able to include the learning elements into the daily life of the students.

3.2.1 Enriched Learning

The term informal learning is not used uniformly in literature, let alone that there is consensus of what actually constitutes informal learning. Therefore, in this paper, the approach used is called **enriched learning** and defined subsequently.

Enriched learning builds upon formal learning, i.e. within an organised structure. In this particular case, formal learning is extended in terms of flexibility (independent of place and time) and manner of implementation, lower commitment, and lower time and financial effort (Knowles, 1950). This approach should make it possible for students to learn in an organised framing, but in a less formal scope, outside the university directly embedded in everyday routines. In summary, enriched learning is defined as targeted formal learning with a fixed and organized curriculum, which, however, is characterized by flexibility in terms of place and time, and low commitment, and low time expenditure.

3.2.2 Micro Learning

To ensure that learning remains possible at any time and regardless of location, the methodology of microlearning (Hug et al., 2006) was applied and the messages were sent in microcontent format. Micro learning divides the learning context into so-called micro content (Hug, 2005), i.e. many small learning units which are absorbed more easily and processed faster and easier by the brain. The content and the understanding to be conveyed is usually checked at the end of the small learning units by answering questions, e.g. in the form of a quiz. Learners decide where and when to learn. Time, content, curriculum, form, process, learning preference, and mediality are the dimensions of micro learning (Hug, 2005). They can be adjusted individually to learning situations. The idea of micro learning is in line with Cognitive Load Theory (Miller, 1956; Sweller, 1988). Nowadays short attention span of young people (Spitzer, 2012) is a further reason for dividing the content into smaller learning units, which ideally do not exceed the attention span. This phenomenon is also evident in teaching and research, where people are increasingly turning to micro learning (Leong et al., 2021).

3.2.3 Gamification

Gamification in learning settings aims at improving students' motivation and engagement. Additional small gamification elements such as rankings or badges for outstanding achievements can often suffice as impulses to make tasks more interesting (Hamari et al., 2014; Muntean, 2011). Deterding et al. provided a definition and classification of the term gamification which essentially characterizes gamification as "the use of game design elements in non-game contexts" (Deterding et al., 2011a, 2011b).

Traditionally, educational institutions usually motivate their students already. For the correct fulfilment of specifications and the associated completion of tasks, students are usually awarded points. Students are thus rewarded with more points for desired behaviour and punished for undesired behaviour. In this point system, badges are awarded similar to grades whenever certain thresholds are reached, such as "mastered the module very well". If the performance at the end of the term is sufficient, the student can advance to the next higher term, or to stay in the jargon of games: Advance to the next level. Programming was promoted by gamification elements like quizzes which create incentives. The play instinct of students is addressed with gamification to continue learning.

A pre-study (*Figure 1*) at the start of winter term 2019 shows that more than 2/3 of our students can be motivated better with gamification elements (*first bar from left*). The next question was aimed at the explicit desire that playful elements are consistently present in the lecture-accompanying eLearning course (*second bar from left*) and that these are then also used (*third bar from left*). At the end of the term, more than 90% of the participating students reported that they had used the additional offers with gamification elements in the lecture-accompanying eLearning course.

3.2.4 WhatsApp

Based on observations in class and several interviews with volunteers, possibilities to repeat course content beyond university confines in their daily business were identified. It turned out that most surveyed students shared a habit of using social networks and messenger services. These results are also consistent with data we analysed in winter term 2018/2019.

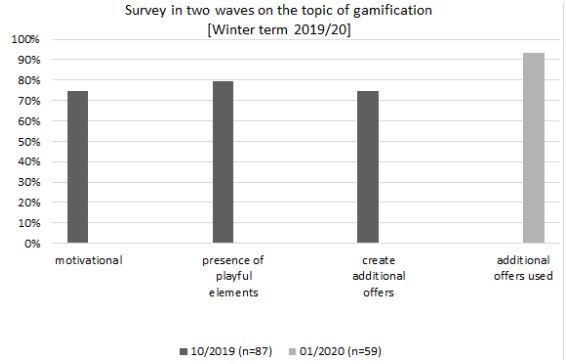

Figure 1: Pre-study extract (*winter term 2019/20*).

These data indicate that almost 90% of all young people and young adults surveyed actively use social networks (Statistisches Bundesamt, 2022) and social networks play a role in their private lives (McDonald's, 2017). The youngsters among the approximately 42.8 million users of social networks in Germany (Statista, 2019) spend an average of around 214 minutes a day in social networks (mpfs, 2021). Closer examination and review of the requirements revealed WhatsApp as a widespread messenger service, which a large part of the students already use on a daily basis.

Over 98% of teenagers actively use WhatsApp every day (Faktenkontor, 2022). In another survey, 92% of the young people surveyed stated that they used WhatsApp several times a day (elbdudler, 2018). Thus, the most important decision was made for the medium and at the same time the problem to install an external application especially for the study was overcome - WhatsApp is already installed on their mobile devices anyway. A messenger service was selected because it combines all the requirements, such as time- and location-independent learning, and can be included in everyday life through the familiar environment - and is thus a perfect complement to the classic classroom lecture. A messenger service like WhatsApp, however, also imposes some constraints with respect to the length of the messages: messages need to be short enough, but not too short to avoid losing essential aspects.

3.3 Current State of Research

WhatsApp is a messenger service developed to communicate with family and friends which is used to send text messages as well as short voice recordings, pictures, or videos. In February 2020, WhatsApp reached two billion monthly active users (TechCrunch, 2020). Yet, by 2020, only one study applied WhatsApp in higher education in Europe (Venter, 2021): Existing studies do not integrate WhatsApp in a didactic concept, even if a lecturer uses WhatsApp in a course (Al-Omary et al., 2015) or WhatsApp is used to give feedback to students (Sugianto et al., 2021). WhatsApp is often used to organize courses (Alabsi and Alghamdi, 2019) or for improving communication between students and lecturers (Najafi and Tridane, 2015) or with peers (Albers et al., 2017; Jackson, 2019), for collaboration within classrooms (Venter, 2021), but usually not as a didactical element within a complex learning setting.

Quizzes in education follow a similar line. Some studies exist, but either the research focusses on technical aspects (e.g. Balog-Crisan et al., 2009; ElYamany and Yousef, 2013; Gordillo et al., 2015), or the research highlights quizzes as a single learning element without embedding them in an overall didactic concept (e.g.: Cavadas et al., 2017; Cicirello, 2009; Pollard, 2006). Only few studies contain an overall didactical setting (Gamulin and Gamulin, 2012).

3.4 Observations, Experiences, Evaluation and Results

The research shows that there is no published approach to date that combines the four key components described earlier. As described in the research design, the study was conducted twice. For this purpose, the uninterpreted observations were written down, the collected data (usage data, survey questionnaires and interviews) were evaluated and finally analysed, interpreted, and discussed.

3.4.1 Observations and Experiences

After the introduction of the messenger service at the beginning of winter term 2018/19, the number of registrations increased rapidly to a total number of $n > 100$. After an initial euphoria the demand and the perceived interaction decreased until it stagnated with a fixed number of users towards the fifth lecture week. Often the questions that were sent with the summary were overlooked and not answered, especially if the question was in the middle of the summary. Since this question often got lost in the summary without getting the desired attention, the question was sent as a separate message after a short time, initially directly after the summary, later at different times. Students often asked questions in WhatsApp that were not covered by the bot's rules for technical reasons and were not compatible with the instructor for time reasons.

These questions can roughly be categorized into three categories. The first category was from the beginning of the term until about the third week of the term, when the questions were all about organizational things like lecture times, lecture rooms, and similar issues. Towards the end of the term, the questions had a similar background and focused almost exclusively on the upcoming final examination and its formalities. The interesting category for the lecturer was chronologically between the third and the penultimate week of lectures, there were isolated questions about the content of the last lecture and a few questions about the lab exercises. These could be the basis for deepening in the next practice hours. During the weekly repetition at the beginning of the lecture, many students also picked up their mobile phones, probably to solve the question asked by the lecturer with the help of the summary from the messenger service.

In the second run in winter term 2019/2020, the number of participants increased rapidly at the beginning of the term and flattened out around the third week of the term. Over the term, more than 100 active students used and interacted with the service. The phenomenon from the first run with the extracurricular questions to the chatbot at the beginning and especially towards the end of the term was observed again, despite several hints from the lecturer to the students, although not to the full extent.

3.4.2 Evaluation

The basics of the evaluation from winter term 2018/19 are based on two waves of questionnaires with all students present (*Figure 2*). The first wave was carried out after the introductory session with references to the topics to be covered and the description of the messenger service. More than 90 students participated, but only 64 students completed the questionnaire. The second wave was distributed in the last lecture hour with a response of approximately 70 copies including 45 complete ones. Only complete responses were included in the evaluation and the resulting outcomes. In addition to the idea of sending summaries and quizzes via the WhatsApp medium, the survey also asked whether this feature was useful in the area of learning support and repetition. In addition, it should be evaluated which incentive is decisive for the use of this offer. The desired length at the beginning of the term was also asked at the end with the actual length of the summaries. In addition to the motivation to use this service, the current usage statistics were also compared. Volunteers (n = 5) were invited to a personal interview after completing the examination at the end of the term and this was subsequently evaluated. The number of active users over the whole term was always above 85 students.

Also, in the winter term one year later, the same questionnaire was distributed in two waves at the beginning and at the end of the term. The first wave of the questionnaire was administered during the third week of classes and was designed to capture initial impressions and assumptions. More than 120 students participated, 87 students fully completed the questionnaire. The second wave was distributed during the penultimate hour of lectures and had a response of approximately 90 copies including 59 complete ones. Only fully complete responses were included in the analysis and resulting findings. *Figure 3* shows a relevant excerpt of the evaluation of the survey questionnaires for the winter term 2019/20. The questionnaires were supported and evaluated by means of voluntary, qualitative interviews at the beginning (n = 10) and at the end of the term (n = 7). The number of active users was always above 105 students throughout the term.

In both diagrams (*Figure 2 and Figure 3*), the darker bars reflect the expectations at the beginning of the respective term (1st survey wave) and the lighter bar at the end of the term then reflects the self-reflective feedback (2nd survey wave). The first question tried to find out whether WhatsApp is suitable for the project of sending short summaries and quizzes to students. The second question was related to the specific length of the individual messages and summaries: Is the targeted average length of the messages appropriate or not? After the question of format, the third question assessed the content of the summaries, i.e. has the content of the summary been very helpful and understandable from the student's point of view? Following this, the fourth question is to provide legitimacy to the quiz questions at the end of each summary. The fifth question is for self-reflection on whether, from the student's point of view, the WhatsApp service is or was a meaningful and useful feature in learning support and revision. From this, the sixth question can be derived, whether students would like to continue using the WhatsApp service in the future. The last (seventh) question is a hypothetical one. Extension of the rule-based bot with an "artificial intelligence" so that all questions from the student side that are not directly mapped can also be answered automatically. Both the free-text questions in the surveys and the follow-up interviews were used to validate previous results. For example, the seventh question was justified by the fact that a possible feeling of shame can be very profound

among first-term students and therefore they often do not dare to ask the lecturer. A digital learning assistant could provide a remedy here. All seven questions highlight the high readiness of use and its conviction from the student's perspective. The relative statement across the two different cohorts also shows a similarly high significance.

3.4.3 Results and Discussion

The reactions of the students in both trials after the announcement and introduction of the service were very positive in the first attempt (before their self-test) and had an encouragement of almost 100% without any headwind. Also, the resume at both ends of the terms were uniformly positive with a few suggestions for expansion. Even after evaluations of the interviews and surveys, students issued no negative opinions of the about the offer. Students' opinions on the difficulty and number of quiz questions varied greatly from "exactly right" to "too few and too simple, please more to puzzle over".

Messages sent at different times in a familiar medium were actively used by over 50% of the students in the course (n = 85 respectively n = 105). Active use refers to regular interaction (mostly answers) with questions from students over the course of an entire term. In surveys and interviews across both terms, the participants stated that 70% consider the possibility to offer a very useful service and more than 80% consider the service as useful for learning support and repetition. During the term, it became apparent that the time and length of the sent messages plays a vital role with respect to response rates. The longer the message was or the later it was sent, the less interaction there was. Occasionally there were answers on the following day (approximately 20% of all answers). The highest interaction is from Monday to Friday between 7 pm and 10 pm with an active participation of nearly 77%. The time slots 6 pm till 8 pm on the weekend (Saturday/Sunday and holidays) achieve a similarly high quota. The length per message should not exceed 1.600 characters, as WhatsApp will then hide this with the note: read more (status submission of the paper). This additional click on 'read more' and scrolling length makes users shy away from reading the text. Over the term and after evaluation of surveys and interviews, it is apparent that the summaries must be sent out promptly after the lecture, in order to receive the necessary attention. Furthermore, questions must be sent individually and not together with the summary, otherwise they are easily overlooked. Students highly appreciate proper formatting and structure of the message, e.g. bold headlines, enough read-friendly paragraphs, or source code in italics. The use of emojis to make the text more structured and to enable faster entry points when reading was also considered useful throughout. Several times the combination of learning content and modern techniques was praised as well as the automatic memory in a trusted environment, so that the learning material is not forgotten from one class to the next. A change of the mobile device can be seen as a critical point because previous messages are lost. In case of a loss or change of mobile phone, it is desirable to obtain all previous summaries and questions again on a new device, so that a learning gap can be avoided.

In conclusion, the second round of the project also showed that students would like to see the expansion of such digital learning assistants and also directly substantiate this with ideas. The most common request was an adaptation of the learning content. Thus, most students wished for adaptive summaries on a continuum between "short and concise overview" to "somewhat more sophisticated and detailed summaries". The same also applies to the quizzes, which, according to multiple statements from students, would have liked to have "tough brainteasers which require specialist knowledge". These points can be incorporated very well as requirements for future implementations.

Students reported that they used the summaries and questions as "perfect exam preparation" (Pseudonymised student). The success in the written exam cannot be justified exclusively by the usage of the messaging service, but the statistics show that basics and theory can be conveyed very well via a messenger service and that students have achieved better results on average with the use of the method.

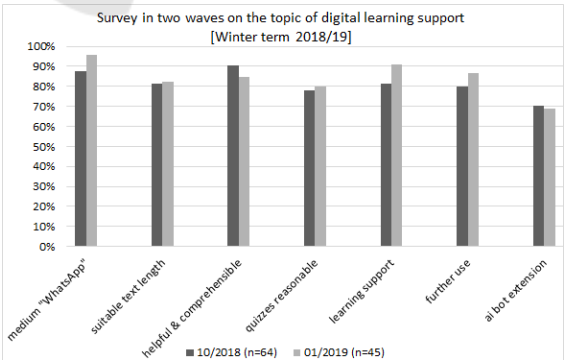

Figure 2: Survey extract (*winter term 2018/19*).

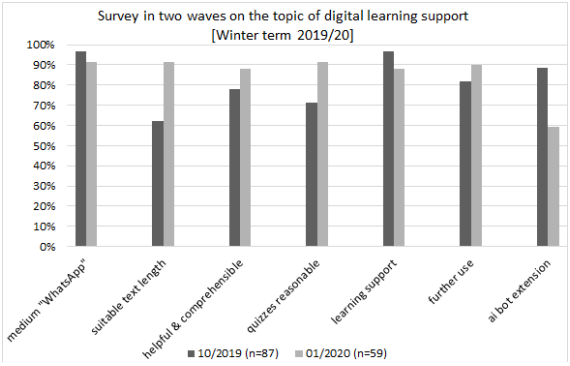

Figure 3: Survey extract (*winter term 2019/20*).

The added value for students was large (according to the student statements), at least for basic chapter and theory, while the (time) effort was very low. However, the students also stated that they did not consider this offer useful for all subjects.

For the research question posed at the beginning, this means that this approach constitutes a possible way to improve learning motivation for out-of-favour subjects to less motivated students in an entertaining way outside of lecture and to increase their interest in the long run. Yet, the approach has not yet exploited its full potential, and the students' wishes should be incorporated in the further planned cycles for a comprehensive and widely accepted offer of digital learning assistance.

4 CONCLUSIONS AND FUTURE WORK

The aim of this project was to increase the interest and thus also the motivation of students in subjects that are rather unpopular. To this end, a concept was presented and developed based on four core elements, namely that learning is also possible in a less formal environment than in regular lectures, independent of physical presence at the university and whenever students see fit, that learning is based on small units and that students enjoy engaging with the material. In the concrete implementation of the proof-of-concept of this concept, this meant short learning units in microlearning style outside the university (enriched learning) in familiar surroundings and already used medium (WhatsApp) with gamification elements, such as quizzes, as motivation drivers. The micro learning approach was chosen as the basis in order to divide the learning material into small brain-friendly parts, which can be quickly understood. In addition, students need to take very little time to read summaries or answer short quiz questions, so that the small learning unit can be "hidden" in everyday life. The added value on the student side is clearly visible after only a few messages. For instructors, effort is limited after initial creation of the material, i.e. summaries, quizzes etc. The latter incurs considerable effort, but the material can simply be reused in future issues of the course. The initial creation of the summaries and questions in the quiz pool takes time, but they can all be reused in the following terms without problems. These short summaries and the questions from the quiz pool were sent via a widely distributed message service (WhatsApp), which is installed on the majority of students' smartphones and creates a familiar environment.

This approach can be recommended for the same target group, since both the acceptance among the students is very high, as well as the improvement of the activation to deal (intentionally) with the content of computer science is increasing. As well-intentioned advice from the students' side, it should be mentioned that the offer should be offered on a purely voluntary basis and that important information should also be disseminated over other channels.

The Novelty Effect, which describes a bias for newer technologies (Clark and Sugrue, 1988), cannot be completely disregarded. Although the proof-of-concept involved repeating the project with different cohorts, individually it was something completely new in their studies. Therefore, it remains to be seen whether the demonstrated effect is reduced due to the novelty effect, or remains constant. Therefore, it must also be examined whether long-term repeatability and transferability to other courses is possible. We were able to show that with the help of WhatsApp and a suitable didactic concept - in which individual assessment units are not planned too large and the completion time is a maximum of 2 to 3 minutes - students could be more motivated for less enthusiastic subjects with gamification elements. This is proven by the evaluation of the objective usage data as well as the evaluation of the survey questionnaires and qualitative interviews.

Future work might address expanding textual summaries permanently by short learning videos or audio recordings on a regular basis. Voice memos are becoming more popular and sent more often than text, according to feedback from our students. However, a possible down-side could be that voice messages cannot always be listened to immediately in direct comparison to text and could therefore remain unanswered for a longer period of time. Other frequently mentioned requests from students are the use of the channel for organizational topics, such as

room changes and appointments, more concrete examples on the topics and summaries and a few difficult puzzle tasks to clear up. Also, students (approximately 55% of all students) would care for answers to individual questions through this channel, but this will probably take a lot of time as long as this cannot be covered by an automated bot with "artificial intelligence". During the evaluation of the communication between the students and the lecturer, the appeal and the personalization were very often noticed. Basically, the content should be in the foreground of the methodology, but the unidirectional communication can be extended to a more bidirectional communication by personifying the messenger service. As soon as the bot with "artificial intelligence" receives a name and also a profile picture, the impersonal message of a system would become the personal learning consultation, which one would rather ask for advice than a thing. Ideally, the bot as a digital learning companion would select the same answers or better ones as a lecturer, so that, according to the Turing Test (Russell and Norvig, 2016), no difference is discernible for the learner.

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