Motivational Active Learning in Blended and Virtual Learning Scenarios

Engaging Students in Digital Learning

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ABSTRACT

The way people learn has changed over the last years. New pedagogical theories show that engaging and active learning approaches are particularly successful in improving conceptual understanding and enhancing the students' learning success and motivation. The Motivational Active Learning approach combines engagement strategies based on active and collaborative learning models with gamification. While many active learning models rely on in-class setups and active and personal interactions between students and between instructors, MAL was designed to integrate active learning in different settings. Our research project focuses on enhanced learning strategies with MAL in different computer-supported scenarios. This chapter outlines the potential of the pedagogical model MAL (Motivational Active Learning) in the context of blended and virtual learning scenarios; it also summarizes relevant literature and discusses implications and future work.

Keywords: Active Learning, Virtual Learning, Blended Learning, Motivational Active Learning, Gamification, Virtual Worlds, Open Wonderland, Digital Learning, Online Learning, E-Learning

INTRODUCTION

"I'm always glad to work in pairs (groups) in the class as well as discuss the study material in the lecture. I like integrated exercises and practical tasks to be solved immediately after the theoretical part is presented." (Student talking about MAL)

As this student of an interactive course format states, active and collaborative learning approaches are valuable tools to support and engage learners in classroom settings. It is well established that collaborative assignments and interactions among students and instructors support the knowledge transfer and enhance the conceptual understanding of the learning concepts and the students' problem-solving abilities (Hake, 1988; Augustine, 1990). Many modern pedagogical models based on constructivist approaches integrate such interactive interactions in classroom settings. Most of these models focus on

fostering the learner's understanding of the taught concepts. However, in self-directed learning scenarios, such as home assignments or distant learning students would need more motivating and engaging support.

The learning model Motivational Active Learning (MAL) is one successful implementation of such learning activities and is used in classrooms to engage students in an interactive and motivating way. MAL is inspired by the active learning format TEAL (Technology Enabled Active Learning), which reformed the way physics is taught at the Massachusetts Institute of Technology (Dori & Belcher, 2005). For MAL, TEAL's main features are generalized for other fields than physics and enriched with further engaging design elements inspired by game design theory and gamification. It uses a mix of mini lectures, interactive assignments, collaborative activities, interactions with the instructor and peers, and feedback methods motivated by gamification strategies. Integrating game design elements in such settings can be used to create an exciting and motivating learning atmosphere through engaging and in-time feedback (such as badges, points, rankings), constant challenges and mini-tasks (small assignments with immediate feedback), and positive reinforcement (reward of extra work instead of punishment of failures) (Pirker et al., 2014; Sinha, 2012)).

While this and similar methods have been proven to be successful in classroom settings, we want to go a step further and discuss MAL's capabilities also for blended and fully virtual scenarios. More and more learners tend towards virtual and digital learning. Tools such as MOOCs (Massive Open Online Courses) help teachers to provide the learning content and assignments in a user-friendly and assessable online environment to a large number of students. However, many concepts of successful constructivist pedagogical models are hard to integrate in online environments. Thus, online and self-directed courses often suffer from high drop-out rates, and reduced success rates. It is crucial to map different online activities to engaging features of active learning models to support and motivate learners.

In this chapter we discuss the pedagogical approach MAL with focus on the gamification and active learning aspects. The chapter is divided into three major parts. In the first part we describe related work with focus on online learning solutions. In the second part we introduce MAL and explain it based on (1) blended learning scenarios and (2) fully virtual scenarios. We conclude by discussing the prospects, the potentials, implications, and future work.

BACKGROUND AND RELATED WORK

Gen Y and New Forms of Learning

Our modern world has changed dramatically over the last century and is vastly influenced by various media and technologies, such as electronic games, computer, mobile devices, social media, and the participatory web. Consequently, learning has also significantly changed from passive and repetitive learning to active learning with new tools. After the generations of the "Baby Boomers" born between 1945 and 1965 space explorer generation, and the "Generation X" born between 1965 and 1985 influenced by the growth of mass media, the "Generation Y" or "Gen Y" born after 1985 is grown up with computers and mobile phones (Wikipedia, 2015). Gen Y is influenced by a world which is connected, accessible, interactive, and open. Gen Y can be characterized as "individualistic, independent, confident, ambitious, team-oriented, direct, empowered, and driven achievers who depend on technology as their support system". Gen Y learning must be "captivating as they share and learn with their peers. The teachers have subsumed the role of a facilitator rather than an authority figure as it were with the other generations" (Chang & Gütl, 2010). Consequently, such a new generation calls for new learning and teaching styles supported by technology which is reviewed in more detail in the following sections.

Active and Collaborative Learning

Active learning formats have been adopted by many educational institutions to optimize the students' learning experience, foster their problem-solving abilities and enhance their conceptual understanding.

Active learning refers to a pedagogical model, which integrates different interactive assignments and activities such as group discussions, in-class group assignments, and direct interactions with instructors. Particularly in STEM fields, such approaches are an important way to teach abstract concepts and focus on problem-solving abilities instead of simply reciting theoretical concepts (Hake, 1988).

One important pedagogical model is TEAL (Technology-Enabled Active Learning), a format which is designed to optimize physics education at the Massachusetts Institute of Technology. It uses the concept of small lecture/content pieces interrupted by constant interactions such as conceptual questions, desktop experiments, interactive physics simulations, and group discussions. In particular, TEALs combination of collaborative and interactive activities with in-class technology setups (simulation software, experiment setups, personal response systems) is used to enhance students' problem-solving abilities and their conceptual and visual understanding (Dori & Belcher, 2005).

However, such in-class setups are often very expensive and not flexible. The current trend tends towards self-directed online learning scenarios. More and more learners want to learn in their own space, in a time- and location-independent way. We will discuss online learning forms in the next section with focus on drawing the attention of potentials and drawbacks for active and collaborative learning setups.

E-Learning and Online Learning

E-learning, online learning, blended learning and virtual learning are currently important topics in educational research. But what are the differences between these pedagogical approaches; what does the implementation of these look like; and what are the main effects on the student's learning process? These questions will be discussed in the following sections.

E-learning is defined as electronic communication (asynchronous and synchronous) to create and confirm knowledge. The Internet, including its different communication technologies, is the basis for e-learning. Furthermore, e-learning is the foundation for online learning and blended learning. Online learning combines independence, through asynchronous communication technologies, and interaction. Therefore, users of online learning are space and time independent (Garrison, 2011).

Online learning is strongly related to Learning Management Systems (LMS). LMSs are software tools for the administration and management of courses and course content. Features of learning management tools include course registration, presentation of learning content, and assessment of student performance (Carliner, 2004). Rahman et al. have found that some students avoid using certain features of LMS, such as submission tools, communication tools, and self-evaluation possibilities. They prefer these activities in the form of face-to-face interactions or manual tasks (Rahman et al., 2010). Another study by Bonk et al. has evaluated the effects of different kind of distance-learning technologies on the student's learning experience. The results have shown that there are some problems with using Learning Management Systems, because these tools are often not flexible enough for the students' and instructors' requirements (Bonk et al., 2002).

In summary, LMSs in online learning setups are software tools with many different features. However, many features are often not used by the instructors or the students. Also, despite the large number of features, the systems are often not flexible enough for the users' needs. Many important activities of active learning models (peer discussions, hands-on experiments, or interactive assignments) to engage users and to support the enhancement of their conceptual understanding are hard to integrate and implement in such environments. Thus, many e-learning setups are combined with regular in-class meetings. We call such hybrid learning setups blended learning. In the next section we describe aspects and prospects of blended learning.

Blended Learning

E-learning is not only the foundation for online learning setups but also for blended learning (Garrison, 2011). Blended learning is a combination of face-to-face, in-class interactions between students and instructor, and digital and/or online learning scenarios. The pedagogical goal is to foster students' engagement and to use the advantages of internet-based learning (Garrison & Vaughan, 2008).

Chen and Jones compared blended learning to a traditional course at a university in the United States. For this comparison, they split the students of the course into two groups. One group of students was enrolled in the traditional course with face-to-face interaction between instructor and students twice a week. Lectures and discussions were setup as in-class activities for this course. The second group of students was enrolled in a course with a blended learning setting. These students had a two-hour online meeting each week and four face-to-face meetings at the university. Both groups had the same instructor and the same grading system. The study has shown that some results of the evaluation were the same for both groups. The students' learning outcomes and the students' perception of the course were the same. However, some results clearly differed between the two groups. Students in the traditional course setting liked the clarity of the course instruction more. On the other hand, analytical skills of students were fostered better in the course with the blended learning setup. The authors suggest that the blended learning approach may improve the learning experience and broaden the understanding of concepts in the field. One reason for this might be that by learning at the computer, the students make use of more additional resources on the Internet. Therefore, traditional learning approaches and blended learning can both be improved by using elements of each other. For example, students of the traditional course should use resources on the web to a greater extent (Chen & Jones, 2007).

Another study at the University of Granada evaluated a blended learning course on general accounting with 1,431 students. The objective of the study was to evaluate the effects of student's perceptions of the blended learning activities on their learning outcomes. The course was split into a face-to-face part with in-class activities and into activities in an e-learning environment. Students had the possibility to use websites for finishing the in-class activities. The e-learning environment consisted of single tasks and collaboration tasks (e.g. activities in forums and wikis). Students should use the content of the face-to-face lectures for finishing these e-learning activities. The results of this study show that by using a blended learning format for the course, they were able to reduce the dropout rate. Moreover, the combination of traditional face-to-face learning and e-learning activities had a positive effect on the final marks of the students (López-Pérez et. al., 2011).

We can conclude that blended learning combines advantages of face-to-face learning and online learning to improve the student's learning process. But to achieve these positive effects of blended learning on the learning process, it is important to motivate the students to learn in such environments (Visser et al., 2002).

While blended learning scenarios support many features of different pedagogical models incorporating interactive and collaborative learning strategies, it is a challenging task to enable such activities in a fully digital and online setup. In particular, collaborative and cooperative learning forms are an important activity in traditional setups to engage learners. However, such activities are often hard to implement in a digital environment. In the next section we discuss the potential of virtual world environments as a tool to support different active and collaborative learning activities. We describe digital scenarios, which were designed to enhance the students' learning experience with digital motivational aspects with focus on collaborative online learning.

Learning in Virtual Worlds

Computer games are known to have a motivational and engaging effect due to their immersive and challenging character in combination with their short learning curve and an instant feedback/rewarding system (Siang & Rao, 2003). The goal is to merge learning and games so that the advantages of games can be used to learn about particular topics or gain practical insight into a specific domain. But in order for students to benefit from a game, it is necessary to focus on a sound pedagogical approach when designing it (Greitzer et al., 2007). Instructional scientists as well as subject matter experts have to work closely with the developer team to avoid pitfalls like passive learning paradigms and linear teaching methods. Student-centered approaches as well as an interactive, immersive environment are essential for learning success. Also, in today's world, socializing and networking are becoming more and more important and are part of everyday life of students. For that reason, ways to collaborate with others have to be created. Virtual worlds have been found to provide a good platform for group-based learning, which is why many attempts to use them for education exist (Bainbridge, 2007; Berger, 2012; Pirker et al., 2013).

With the words of Bell (2008), virtual worlds are defined as follows: "a synchronous, persistent network of people, represented as avatars, facilitated by networked computers". While this should leave the reader with a good impression of what a virtual world is, it does not clarify what purpose such an environment should serve. In fact, there has been some controversy by various authors in this regard. For instance, Barnes (2010) and Novak (2012) do not consider Massively Multiplayer Online Roleplaying Games (MMORGs) like World of Warcraft or Guild Wars, which would satisfy all conditions of the definitional of virtual worlds set by Bell (2008) "real" virtual worlds, since they are mainly used for gaming and act in accordance with progression based systems, like completing quests and levelling-up avatars. In their opinion, virtual worlds should provide users with a free space they can use to socialize and be creative, without any strict goals or rules they have to follow.

Examples for such social worlds are Second Life, Open Wonderland, or OpenSimulator. Especially Second Life, which was launched in 2003, was very popular among its users. In general, there was a big hype about virtual world platforms from 2003 to 2008 (De Freitas, 2008), but interest has stagnated since then. There were, however, in recent years some attempts to use virtual worlds as learning environments. For instance, M. B. Ibanez et al. (2011) present in their work an approach for foreign language learning by using situated and collaborative learning in a setting which resembles the city of Madrid in order to immerse the students and that way improve the learning results. Moschini (2010) states, "Communication and social interaction are at the centre of virtual world social experience. Virtual worlds therefore present an ideal platform for the engagement of learners in constructivist-focused educational practice."

A great advantage of virtual worlds over 2-dimensional learning environments is an increased perception of presence and immersion, which means the user has the feeling of really "being there". While an increased sense of presence in the virtual space by itself does not necessarily lead to better learning outcomes, it can lead to increased motivation and commitment, especially if problems are to be solved that require several participants to work together (J. F. Chen, Warden, Wen-Shung Tai, Chen, & Chao, 2011).

Another benefit of 3D virtual learning environments is the rich set of communication channels (Gütl, 2010). Beneath text and voice chat, users have the possibilities to also get to know each other via the visual channel, which greatly benefits group formation and relationship building.

Virtual worlds also provide a great platform to implement active learning concepts. Active learning refers to an education model in which students engage with the learning material in many different ways. Besides reading, this can be listening to it, discussing it with peers or trying to apply it in practice. Very important is the fact that students actively engage instead of just passively absorbing information. There

are different ways of promoting active learning in classrooms, such as discussions, collaborative group learning or games. Collaborative virtual worlds take the same line by actively engaging their participants in learning activities and providing numerous possibilities to collaborate and socialize. Furthermore, they enable a "hands-on approach" even for things that would be impossible or too dangerous in real life.

In conclusion, then, it is clear that virtual environments have several advantages that make them valuable learning environments. But there were also some disadvantages identified in various studies, most of them related to technical shortcomings or usability issues, such as difficulties in navigation (Chittaro & Ranon, 2007). One can hope that - as technology progresses - these drawbacks will one day be a thing of the past.

PLAYFUL LEARNING WITH MOTIVATIONAL ACTIVE LEARNING

While blended learning and virtual learning strategies have great potential to enhance the learning experience compared to traditional e-learning environment, many pedagogical models are not designed to fit such environments. Also, as we have learned in the previous sections, using online environments often needs further strategies of user engagement to reduce drop-out rates and barriers to use such systems. Thus, we designed an active learning model, which can be used in different learning scenarios (blended or virtual), which incorporates different game design and gamification strategies to constantly motivate users. We first designed the pedagogical concept MAL (Motivational Active Learning) to enhance a computer science course, which requires the students not only to learn different theoretical concepts, but also to learn how to solve specific mathematical or algorithmic problems. While TEAL (Technology Enabled Active Learning) works well for physics courses, which integrate in-class experiments, and interactive simulations and animations, we designed MAL based on similar concepts to integrate in-class calculations and programming assignments. While typical TEAL courses require a huge in-class support by and interaction with instructors and teaching assistants we designed MAL to deliver more direct and automatic feedback. These feedback strategies are based on gamification technologies. A typical MAL lecture is separated into different units. Students would learn the main concepts in small lecture units. In these units the instructor explains the main concepts of the unit. After such a theoretical unit, students would try to use and foster the knowledge by solving small problems and assignments. In the area of computer science education such activity-unity can be designed as algorithmic or mathematical problems to solve, or small coding examples. Another possibility to engage students to think about the theoretical concept is a research or discussion question. Most of these tasks should be solved as a group. Optimal group sizes are 2-4 people. Before and after each theoretical unit students would solve individual quizzes to enable the instructor to compare their knowledge before and after the unit. Thus the instructor can adapt the speed and content according to the student's learning behavior and previous knowledge. This creates a dynamic and flexible learning environment. Figure 1 illustrates an exemplary structure of a MAL course with its different units and activities. This timeline illustrates the timeline of a 180 minute lecture on computer science concepts with a high focus on mathematical and algorithmic calculations.

Timline of lecture 2



Figure 1. Timeline of a lecture on computer science concepts with different units and activities

To solve practical assignments and quizzes a LMS system with automatic assessment integrations (e.g. Moodle) is used. In particular the task and feedback design are inspired by game design strategies. Details on these concepts will be explained in more detail below. In Pirker et al. (2014) first results of MAL are described in a classroom scenario.

In this section we focus on describing MAL and the motivational aspects of this model. In the following sections we describe implementations of MAL in blended and virtual learning scenarios.

Gamification and Game Design Strategies

Gamification is defined as "the process of game/thinking and game mechanics to engage users and solve problems" (Zichermann & Cunningham. 2011) or as also the "use of game design elements in non-gaming context" (Deterding & Khaled, 2011). Game design elements, such as badges, points, or ranking are used to design MAL's feedback systems more engaging and eventually also playful applications or scenarios. The main idea is to create a task/feedback cycle to maintain constant user engagement (Zichermann & Cunningham. 2011). Simplified, such a cycle can be described in two major steps. First, the user is given a small task with a very clear goal and clear rules to solve this goal. Second, the user receives feedback how successful he was in completing this task. In MAL we define two major kinds of feedback: (1) constant feedback, (2) motivational feedback. While constant feedback is immediate feedback after the tasks in the form of completion of points, motivational feedback is a feedback form to engage different learner types.

We use a categorization of learner types as inspired by Bartle's four player types (Bartle, 1996): Explorers, Achievers, Socializers, and Killers. Explorers enjoy discovering the gaming environments and gain knowledge and information. Achievers try to achieve, collect, and seek treasures. Socializers enjoy playing and empathizing with other players. Killers enjoy causing others failure.

If we map this categorization to gamified learning scenarios we can try to satisfy these different player styles also by providing different kinds of interactions and feedback. Performance feedback in the form of leaderboard information engages competitive learners such as killers. Badges and other forms of achievements support the motivation of achievers. Collaborative assignments and tasks are in particular interesting for socializers. Explorers enjoy the learning environment and can be engaged with bonus

content. Figure 2 illustrates how the single learner types act or interact with other learners or the learning environment.

Interactions and Small Tasks

In Mal learning units are delivered in smaller pieces to enable the constant interaction/feedback strategy. A single course unit is thus separated in smaller learning units, which are always interrupted by different interaction forms to foster the learning content and enhance the problem-solving ability required to understand the concepts. Such activities can be (1) collaborative assignments, in which students solve tasks (e.g. small mathematical problems, or research, or discussions) in groups of 2-4 people, or (2) individual assignments and assessments (e.g. quizzes, or smaller assignments). How these interactions are mapped to the course will be described in more detail in the following sections.

A concept, which is important to keep the course dynamic and flexible, is the introduction of concept questions before and after each small learning unit. First, a concept question is used to assess the previous knowledge of the students on the topic before they actually learn about this. After the small learning unit the same and similar questions are asked again to be able to compare the learning gains and gain insight if students have understand the learned concepts, or if there is need to recap some concepts.

One of the most important features of MAL is to allow errors. While typical learning settings would punish students for failing exercises, in MAL we try to allow errors, if they are willing to improve. This is supported by the possibility to redo single assignments, and also to be able to improve and be rewarded by finishing different bonus assignments.



Figure 2. Learner types based on Bartle's player types and their preferences of game design elements to enhance the learning experience

We can summarize the following main features of MAL:

- Small learning units (learning content is split into smaller learning pieces, which are interrupted by interactivities)
- Collaborative learning (students can work together on assignments and problems in the form of problem-solving, research, or discussion activities;
- Constant interactions (quizzes and concept questions, and collaborative assignments are used to foster learning content after each learning unit)
- Immediate feedback (for most interactions students will receive immediate feedback such as on their quiz performance)
- Motivational feedback (inspired by game design elements and gamification, the user will receive badges, points, and ranking information for engagement of different learner styles)
- Flexible and adaptive class design (assessment before and after small learning units allow the adaptation of the course content and the teaching speed on the class performance)
- Errors are allowed (learners can repeat assignments and quizzed and try to improve)

In the following sections we will discuss the integration of these features of MAL in blended and virtual setups.

MAL IN BLENDED LEARNING

In this section, we first give a theoretical overview of blended learning and then discuss elements of blended learning in the Motivational Active Learning (MAL) approach introduced by Pirker et al. (2014).

Blended learning is a learning approach that consists of two main parts. The first part is described as a "formal education program" where content and instructions are accessed online. Each student can individually control time, place, path, and/or pace during this learning phase. The second part of Blended Learning is a traditional learning location away from home, like a school building, where students are in contact with other students and a teacher who observes the learning process (Staker & Horn, 2012).

However, also other pedagogical forms influence blended learning. Examples for traditional on-site learning scenarios include traditional instruction and technology-rich instruction. Traditional instructions are characterized by personal contact between the teacher, who has control over the learning process, and the students. Typical activities for this technique are traditional teacher knowledge inputs and discussions. If the traditional instruction part includes some modern technologies like the internet, whiteboards or digital educational books, then we speak of technology-rich instruction. The common element of "traditional instruction" and "technology-rich instruction" is that the teacher has the control over the learning process (Staker & Horn, 2012).

In contrast, "informal online learning" and "full-time online learning" are typical learning practices in the "formal education program". If a student learns, plays an online educational game or watches an educational video in their own best interest and not because this activities are part of an assignment, then we could speak of "informal online learning". If students are able to learn the content of a course or subject via the Internet at their own learning place, we could speak of "full-time online learning", where no teacher is monitoring the learning process. Students have to control their own learning time, learning place, learning path and/or learning pace in this two learning practices (Staker & Horn, 2012). Thus, we can say that Blended Learning is a combination of traditional learning practices and e-learning.

We can describe four main models of blended learning, namely the rotation model, the flex model, the self-blend model and the enriched-virtual model. The rotation model is subdivided into the station-rotation model, lab-rotation model, flipped-classroom model and individual-rotation model. Staker and Horn describe each of these models in more detail (for more information see Staker & Horn, 2012). Here,

we will only discuss the station-rotation model, because this model is also used in the Motivational Active Learning approach.

The station-rotation model can be used for a complete course or only for a specific subject. The content of the course or subject are split into fixed stations. The model includes different activities, like group work, single work and traditional assignments (with pencil and paper). For the station-rotation model it is necessary that one of these stations is an online learning station and that students rotate through all of these stations (Staker & Horn, 2012).

The course "Information, Search and Retrieval" followed the Motivational Active Learning approach. The course was split into seven blocks; each of them was designed as "traditional instruction" with face-to-face contact between students and the teacher twice a week. The teacher had control over learning time, learning place, learning path and learning pace. The learning place was an educational room at the university. Each class was a mixture of different in-class activities, which are shown in Table 1. The technologies used by the students and the lecturer mostly predefined the types of activities. Students rotated between different kinds of in-class activities in each class. Figure 1 shows the activity flow for the such a lecture. In addition to the in-class activities, students had to do home activities, which are the "formal education program" (online learning part) of the Motivational Active Learning approach (see table 2). To ensure fair grading it was necessary that the collaboration form and the use of technology were specified by the teacher. However the students had control over their learning place, learning path/pace and to a certain extent also over the learning time.

Traditional learning instruction							
Activity	Definition	Technology	Social Aspect	Feedback			
Lecture	The lecture is divided into different blocks. Learning content and concepts are presented on power point slides.	Beamer, digital slides	Ex- cathedra teaching				
Recap Quiz	A small quiz at the beginning of each lecture about last lectures content	Moodle	Single task	Immediate			
Concept Question	Ungraded question about a new concept.	Moodle	Single task	Statistical Overview			
Concept Quiz	Questions based on previous concept question.	Moodle	Single task	Immediate			
Research Question	Internet Research assignments for peers / small groups	Internet, Moodle	Group task	Deferred			
Discussion Question	Peer / group discussions about new concepts / ideas / issues	Face-to-face	Group task	Deferred			
Small Calculation Task	Very small calculation tasks to practice learned concepts	Pencil and paper, Moodle	Group task	Immediate			
Advanced Calculation Task	Advanced calculation tasks to practice learned concepts	Pencil and paper, Moodle	Group task/ Single task	Deferred			
Programming Task	Programming exercises to practice learned concepts	Programming language of choice, Moodle	Group task	Deferred			

Table 1. In-class activities of the traditional instruction (as described by Pirker et al. 2014).

Table 2. Home-activities for the online part (as describe by Pirker et al., 2014).

Formal education program						
Activity	Definition	Technology	Social Aspect	Feedback		
Reflection Forum	In an online forum groups should discuss ast lectures' content and issues	Moodle	Group task	Deferred		
Reflection Quiz	A small quiz after each lecture to revise the content	Moodle	Single task	Immediate		
BONUS Task	Different kinds of optional tasks	Technologies of choice, Moodle	Single/group task	Deferred		
Written Assignment	Research and presentation of a topic	Beamer, Moodle	Group task (group of 4)	Deferred		

Other studies have shown that different kinds of learning interactions have a positive effect on students' learning process (Pierse & Sutton, 2012; Center for Faculty Excellence, 2009). The results of our study agree with these findings. We also observed that students liked the mixture of different kind of activities and lecture formats which were split up into small pieces of theoretical concepts followed by interactivities (see Figure 1). If there are, however, too many different tasks in one class, students become frustrated because they are stressed by doing all their tasks. Moreover, students were not able to concentrate on new tasks, i.e. if they had to start a new task when the previous task was not completely finished. As a result of this finding, the number of different kinds of in-class activities was reduced and the time for finishing tasks was increased (Pirker et al., 2014).

In contrast to the study results of Stuart and Rutherford (1978), which show that students are able to concentrate for a maximum of 10-15 minutes, our study has shown that with different kind of interactivities in a class – especially the combination of lecture and conceptual questions – students are able to concentrate for a longer time (Stutart & Rutherford, 1978, Pirker et al., 2014). The learning approach MAL fosters the collaborative skills of students. As shown in tables 1 and 2, activities were either designed as a single task or as a group task (group of 2 or 4 students). Pierse and Sutton have found that students learn more successfully if they can work in groups. Furthermore, activities in teams improve the student's engagement in content (Pierse & Sutton, 2012). The results of our study agree with the findings of Pierse and Sutton. In our case, the results have also shown that students understand topics easier in team work compared to working alone (Pirker et al., 2014)). A recent overview by Güzer and Caner, who evaluated multiple studies on blended learning, indicates that collaboration forms are a very important factor to create an environment of positive effects on learning (Güzer & Caner, 2014).

For each activity, students received feedback on their tasks. Two types of feedback were used in the Motivational Active Learning approach. First, the immediate feedback, which students received immediately after submitting the finished tasks via Moodle (e.g. feedback for quizzes and short calculation tasks). For some other activities, for example programming tasks, advanced calculation tasks and research questions, students received deferred feedback, because of the manual correction required. An evaluation after the course has shown that students preferred activities with an immediate feedback. This finding confirms the results of other studies (Smyth et al., 2012). Students had the opportunity to correct their assignments if they wanted. Two important results emerged from this system. First, students preferred correcting tasks with an immediate feedback. And second, only a few students corrected their tasks, in contrast to previous years. One explanation for the low number of corrections could be that the correction was an iterative process with more direct contact between students and teacher.

To summarize, blended learning is a learning approach with some positive effects on the learning process of students. A study has shown that blended learning reduces the dropout rate and students receive a better grading (López-Pérez et al., 2010). Furthermore, blended learning supports different skills of students. For example students complete assignments in their own way and try to find solutions for

problems. As a result, they foster their self-reliance. Students are more sensitive to their own learning process. They foster their time management skills and are able to know how much time is necessary to complete a task. Blended learning is able to give students the feeling that they have greater responsibility over their learning process, compared to a traditional learning environment. Additionally, Harding et al. noted that blended learning fosters students' self-discipline, because they work continuously on the online tasks (Harding et al., 2005). The design of MAL supports the integration in blended learning setups. First studies suggest positive results, which can enrich the learners' experience and their engagement for the course.

MAL IN VIRTUAL LEARNING

Motivational Active Learning (MAL) can also be applied in distance-learning scenarios to meet the demands of geographically dispersed people. In virtual worlds, people can meet independently of their current location to communicate or work together on a collaborative task. A project was carried out at the Graz University of Technology, where the principles of MAL were used to design learning scenarios in 3D virtual worlds.

For that purpose, the virtual world platform Open Wonderland (OWL) was extended in a way so that teachers could turn ordinary virtual worlds into learning environments for their students by providing information objects, so called "Items" for them. The students can obtain the information by hovering over an Item with their mouse cursor (they then see the information text in a pop-up window) or by clicking on the Item and choosing "pick up". In this case, the information is transferred into their "inventory", which is a kind of virtual "bag" each student has. To enforce group work and collaboration, the teacher is furthermore able to assign roles to the students, which prevent them from obtaining information from all the objects. Only students with a specific role can pick up certain Items. OWL itself provides the students with a range of communication tools, including text and voice chat. Additionally, the "Itemboard", which is a kind of Whiteboard where students are able to share Items they found, was implemented. Finally, to give the teacher a means to assess his students, and also to give students feedback about whether they have learned everything they should, a tool was implemented with which the teacher can design a little quiz for the students. If the students answer all questions of the quiz correctly, they are teleported to a new location, which could be, for instance, the next level.



Figure 3: Process of the learning round-trip in a virtual world

With the implemented tools, teachers can create a range of learning scenarios. As an example showcase, a collaborative learning scenario which follows the principles of MAL was designed. First, a group of students meets in a virtual world, the teacher has created for them. Then, the teacher assigns them their user roles, which determine which Items they are able to pick up. Following that, the students start exploring the world and try to find all the information objects the teacher has provided for them. If one student is not able to pick up a specific Item, he has to ask his fellow students for the information. After the students have collected everything they could, a brief phase of information exchange takes place where the students make sure that everybody knows about all the information. Ideally, for every piece of information one student has to give to someone else, he is also in need for a specific piece of information of that person. To round up the learning round-trip in the virtual world, the students finally take the quiz the teacher has designed for them. If they answer everything correctly, they are teleported into the next level, where the next cycle of the learning process starts. This way, the students have the chance to (1) collaboratively absolve the learning task, (2) do a quiz for every level and thus chapter of the learning topic, and (3) receive immediate feedback of whether they understood everything in the current level/chapter correctly. In line with the MAL approach, students are also allowed to make errors in the quiz, because they are always able to go back and search for further information or talk to their fellow students again if they are not able to answer a question of the quiz. In Figure 3, the exploratory learning process, consisting of five steps which correspond with the MAL approach can be seen.

Step of learning process in the virtual world	Feature of the MAL approach	
(1) The students meet online by logging into the virtual world.	-	
(2) The teacher assigns each student a role. Students can see their current role at any time.	-	
(3) The students start exploring the virtual environment and try to find all information objects the teacher has provided for them.	collaborative learning / interactions between students	
(4) The students share the information they found. Ideally one student gives away a piece of information he has in exchange for some information he was not able to obtain.	collaborative learning / interactions between students	
(5) Each student individually does a quiz on the learning topic to make sure he has understood everything. This also gives the teacher a possibility to assess the performance of the students.	constant activities / immediate feedback / allowance for errors; if students are not able to answer a questions of the quiz they can always go back to step (3) or (4)	

Table 3: Steps of the learning process in the virtual world and according MAL features

A typical component of the MAL approach, the *motivational feedback* in form of badges or leaderboard information is missing in this learning scenario, because in OWL there is no tool for this yet. For a future version of the learning scenario, such a tool could be implemented. Criteria for a badge or a score could be how fast a group of students was able to absolve one level, for example, or how many questions of the quiz they were able to answer in total, and groups could also receive bonus points if all members were able to solve the quiz, which again would emphasize the collaborative nature of the learning scenario. A

teacher now can use this learning scenario for various topics. All he has to do is find appropriate 3D models and create a virtual world which resembles the learning topic for his students. For this project, an example virtual world was designed, where students should learn about ancient Egypt. The world was called "Virtual Egypt World" (VEW) and populated with models suitable for a desert environment. The topic the students were to learn about was the Osiris myth, an ancient Egyptian story. Heart of the VEW is a pyramid the students can explore. At the entrance of the pyramid, there is a non-personal character (NPC) themed as Egyptian nomad character (see Figure 4 -a). Students can talk to the NPC in guided dialog by selecting answer alternatives and the NPC answers according to a predefined knowledge base.

Students can receive hints on how and where to find relevant information. The pyramid itself consists of three levels, whereas each level is built like a maze and a bit smaller than the level before due to the pyramid-shaped structure. Each upper level is also only accessible via a ramp hidden in the level below it. In order to reach the top level, the students have to find their way through the mazes on the first two floors. The parts of the Osiris myth are hidden inside five statues of Egyptian deities which were distributed in the pyramid. Figure 4 -b) shows the statue of Isis which provides information relevant in the context of the Osiris myth. Beneath the five Egyptian statues also three other objects with information attached to them were hidden in the world, but their information is not connected to the Osiris myth.



(a) Chat bot

(b) Item module





(c) Item board

(d) Quiz module

Outside the pyramid, students can find the "Itemboard" where they are supposed to meet after exploring the pyramid and share the information they found (see Figure 4-c). The place where the students can take the quiz is symbolized by the all-terrain vehicle (see Figure 4-d). The truck was chosen as an analogy to 'driving away' after having learned everything about the Osiris myth. If the quiz is successfully completed, the student are teleported to so-called 'Congratulations World' receiving information on the successful completion of the learning task, but this is only the case in the first prototype. Future versions could include further levels with more difficult mazes or other pieces of Egyptian history to learn about. In a first evaluation of the VEW prototype test participants stated that they liked "the constant communication and that teamwork was necessary to solve the final quiz". They also liked that they had to search for the information and the "sense of adventure", which was conveyed that way. Points of criticism were the old-fashioned graphics of OWL and the clumsy controls. Often, students found themselves stuck into a wall or not able to navigate out of a small room any more. Besides that, test participants mostly agreed that the system would be a valuable addition to learning from textbooks in schools, because through collaboration with other students and the interactive environment the students are likely to feel motivated and encouraged. Moreover, through the virtual environment the students would have a reference to the topic they are supposed to learn about. This could be especially useful in the subject of history where historical buildings or locations could be recreated.

We can conclude that MAL not only combines the positive effects of Blended Learning and Virtual Learning, but also adds gamification elements to foster student's motivation.

FUTURE RESEARCH DIRECTIONS

Learning engagement is becoming an increasing interesting topic in primary, secondary and tertiary education (MacGregor, 2014). The new generation of learners requires more active involvement and modern learning activities. (Chang & Gütl, 2010; Taylor, 2010) Karen MacGregor (2014) emphasizes emerging trends on learning engagement. One important aspect focuses on learning by doing rather passive knowledge consumption. Learners want and also need to be "released from classroom in order to learn". Communication and information sharing on a global scale by means of technology is also listed as another important trend in this context. In order to support engagement and motivation, gamification is an increasingly important tool to be applied in educational settings (Hamari, Koivisto, & Sarsa, 2014). The introduced Motivational Active Learning (MAL) approach, based on gamification strategies, provides the foundation for designing engagement learning, and has been successful applied for in-class, blended and distance learning. First findings are promising; however there is still room for further improvements and research. Selected aspects will be discussed in the remainder of this section.

Evaluations of the showcases have shown that students prefer either collaborative or competitive learning activities; this is also in line with findings from (Pirker & Gütl, 2015). Generally, Bartle (1996) has shown that gamer can be classified into four gamer types (killer, achiever, explorer and socializer) along the two dimensional world vs. other players and acting vs. interaction. Research on supporting gamified learning tasks and related game mechanics as well as possible correlations with preferred learning types would be of great interest. This might lead to personalized or adaptive gamified tasks.

So far, MAL has been applied in learning settings for a small number of learners. There is, however, also the need for learning settings on a much larger scale. In particular MOOCs have been raised a lot of interest in the e-learning community. The advantage of open learning access from all over the world and the flexibility for the students, there is the very high attrition rate up to 99 % of all enrolled learners (Gütl, Hernández Rizzardini, Chang, & Morales, 2014). The problems include procrastination, isolation and the lack of guidance. Gamification is seen as an interesting approach to increase the engagement and motivation (Gené, Núñez, & Blanco, 2014). Research on how gamified tasks in general, and MAL-based

learning activities can support MOOC learning and if attrition can be reduced may pave the way for an important research strand. A similar situation also with high attrition rates of more than 50 percent has been identified in beginners' courses in computer programming where in some of the classes several hundred students trying to follow the lectures. Students face problems in understanding the concepts. (Vihavainen, Paksula, & Luukkainen, 2011) MAL-based learning approaches can introduce small exercises and hands-on experience in class. Research aspects might include the scalability of large classes as well as aspects of knowledge acquisition, motivation and influences of attrition rates. Another identified area of application of the MAL approach is in the context of online experimentation. Remote labs, pocket labs and simulations are state-of-the-art for hands-on experiences in natural science and engineering. Related issues include difficulties for students to become familiar with tools and equipment and handle complex assignments and experiments (Pirker, Gütl, & Astatke, 2015). Research in this context might focus on the applicability of MAL in classroom and for distance learning settings. A promising stand of research is to investigate onboarding strategies to attract and familiarize students with lab tools and equipment.

CONCLUSION

This book chapter has put the focus on the Motivational Active Learning (MAL) approach developed by the Enhanced Motivational Media Technology Group at Graz University of Technology. The research and development of the MAL approach was motivated by the fact that requirements and expectations for modern learning and teaching settings have changed significantly over the last years. The Y generation entering tertiary education has grown up with Internet access and early computer usage, mobile devices and game devices. This group has a different behavior pattern in media consumption, communication, and consequently different expectations in educational settings. Passive learning content consumption and traditional face-to-face and distance learning settings are no longer sufficient for Gen Y learners. [Chang & Gütl, 2010]

Over the last years, learning engagement approaches have tried to overcome the issues related to the new required learning styles from Gen Y students. These approaches include active involvement and a mix of learning activities. Inspired by the promising and increasingly popular concept of gamification [Kapp, 2012; Hamari, Koivisto, & Sarsa, 2014] as a tool set for engagement and motivation, the MAL approach was designed by appropriate game mechanics, such as collecting points, batches, leader board, and small activities. Rather than being punished for mistakes and knowledge deficits, errors are allowed and learners are encouraged to improve and learn from their errors. The concept is based on continuous, motivational feedback and guidance.

The MAL approach provides a framework for designing educational settings for presence learning, blended learning and distance learning. MAL supports its application in a broad range of subjects of natural science education, engineering and computer science. A course in computer science on the subject "Information Search and Retrieval" has been designed as a mix of presence and blended learning by individual and group learning tasks. Evaluation has shown overall promising results in terms of knowledge acquisition, motivation end engagement. Because of the continuous, motivational feedback and guidance for improvements, the setting also required formative assessment activities. In order to keep the operational effort low, automated and semi-automated approaches are beneficial in this context. The second showcase was designed as learning experience in a virtual world learning environment as collaborative learning activities. Results have also shown that the MAL-based learning design has motivated the students and they also mastered the acquisition of knowledge in the learning setting. The feeling of immersion, however, was limited because of issues with the graphical representation of the virtual world and the limitations of the human-computer interfaces in the virtual world. Overall, MAL has been proven to be a promising pedagogical approach for modern learning settings for students in tertiary education. Future applications have been identified to overcome the issues of high dropout rates in MOOC environments and also to improve online experimentation. It is also seen to have

large potential for the application of the approach in primary and secondary education in order to engage school students and raise interest in science topics.

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KEY TERMS AND DEFINITIONS

Active Learning: Pedagogical model that integrates interactive, collaborative, and problemsolving activities as main part of the learning process.

Blended Learning: Learning setup in which learners learn parts of the content in digital and online environments and part in face-to-face setups.

Collaborative Learning: Learning setup in which peers or groups learn together or are engaged to solve intellectual problems together.

Gamification: The integration of elements inspired by game design into non-gaming context.

Massive Open Online Course (MOOC): An open access e-learning course or environment, which allows a large number of participants to participate in a course.

Motivational Active Learning (MAL): A pedagogical model, which incorporates learning strategies from active learning and collaborative learning combined with gamification strategies.

Open Wonderland (OWL): An open-source virtual world framework, which is used to build own virtual world environments.

Technology-Enabled Active Learning (TEAL): An active learning format used to teach freshmen physics at MIT.

Virtual World (VW): An online multi-user environment, which allows social interactions with other avatars and the environment.