

# Fully Automated Virtual Lessons in Medical Education

Utilizing Moodle2 and Campus-Online in connection with a special interface MOMOS V2

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**Abstract**— The Medical University of Graz fosters a blended learning concept in medical education where classroom and virtual lessons alternate according to a well-planned didactic concept. Hence from the very beginning eLearning was introduced also virtual lessons were a part of the curriculum. In the first years the handling of the virtual lessons was purely manual resulting in a huge amount of administrative efforts for the teachers and the staff. Since 2008 we consecutively introduced software and interfaces between the learning management system and our central administration system in order to automatize virtual lessons as much as possible and significantly reduce the administrative efforts from the teachers. With the introduction of version 2 of this interface called MOMOS we have now also a good usability for the administration staff. In this paper we describe how we applied our infrastructure managing virtual lessons in medical education to our modular based curriculum. Furthermore we give some evaluation results from students on the usage of one specific virtual lesson implemented as an eLecture. Last but not least we give practical experiences and conclusions from the evaluation results applicable in general to higher education and not restricted to medical education.

**Keywords**— *eLectures, virtual lessons, modular curriculum, web based trainings, blended learning*

## I. INTRODUCTION

The Medical University of Graz (Med Uni Graz) is active in eLearning since the years 2002 where the Virtual Medical Campus (VMC) was first launched [1], [2], [3]. In the same year also a new modular based curriculum for the diploma study of human medicine was introduced. Within this curriculum it was also foreseen to perform a part of the lessons purely virtual. The main strategy of the university is to foster a blended learning concept meaning a didactically well planned alternation of classroom and virtual lessons. In the first years the virtual lessons had to be handled purely manually, meaning that teachers had to monitor continuously the tasks which were performed by the students and had to calculate manually a mark for the overall module which consists of a large number of lessons.

In 2006 the Med Uni Graz introduced a new central administration system called "MEDonline" which is a derivate of Campus Online [4]. This software holds all data in

connection with the planning of the curriculum, e.g. all lesson dates, student basic data, marks, rooms and so on. The entire planning and execution of the studies is based on this system. In more detail students who attend special lessons are enrolled within MEDonline, marks will be entered by the teachers at the end of the lessons and MEDonline automatically calculates marks based on predefined keys.

With respect to the purely virtual lessons it was a clear goal of the Med Uni Graz to automate them as far as possible in order to reduce the administrative work of the corresponding teachers. Teachers should concentrate on the update of the virtual teaching materials and the continuous support on individual questions raised by students during executing the virtual lesson.

Hence the technical goal for the automated virtual lessons was to automatically enroll students for the virtual lessons within the modules they have applied, to actively present them all tasks to be performed in connection with the virtual lesson within our learning management system VMC/Moodle and finally to transfer all the results back to MEDonline and automatically calculate a mark. For an automated calculation of results we defined so called web based trainings (WBTs) which must consist of questions with answers storable within the system such as multiple choice questions, single choice questions, calculated questions, matching questions or true/false questions. These WBTs are represented as quizzes within our Learning Management System (LMS) VMC/Moodle.

The first satisfying technical realization of such a system we introduced in October 2010 using Moodle 1.9 and a specially developed interface called MOMOS V1 (MEDonline Moodle Interface) [5], [6]. This first implementation worked well from a teacher's point of view hence the virtual lessons were really fully automated by means of enrollment, presentation of the tasks to the students and the calculation of marks. However, the administration of the MOMOS interface was very tedious and could only be done by a programmer and database expert. With the introduction of Moodle2 in October 2012 we also developed a new interface called MOMOS V2 which now allows a comfortable administration of the virtual lessons without the need of a programmer and database expert.

In this paper we describe how the automated virtual lessons are implemented by utilizing this new interface and give some evaluation results from a pilot trial with virtual lessons implemented as eLectures.

## II. BASICS OF THE MODULAR BASED CURRICULUM

In order to understand the realization of the MOMOS V2 interface and the virtual lessons the basics of the modular based curriculum of human medicine of the Med Uni Graz must be briefly explained. The curriculum for human medicine consists of modules and accompanying lectures. The entire academic year is organized in six time slots, each with duration of 5 weeks. Furthermore the entire study year is organized in so called tracks, each track holding either 50 or 100 students, depending on either 6 tracks or 3 tracks are offered, see Fig. 1.

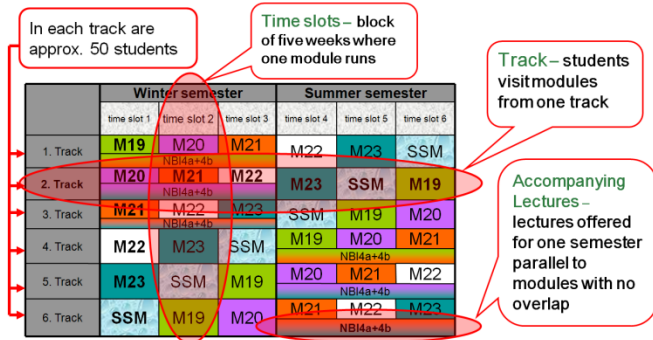


Fig. 1. 7<sup>th</sup> and 8<sup>th</sup> semester of the modular based curriculum human medicine

Usually students apply for one track and remain there. They pass the study year within a track along the 6 time slots. In each time slot one module is offered. Accompanying lectures are offered over one semester with no overlap to the classes of the modules. Modules represent a special topic of the curriculum and are usually performed by two clinics or institutes who can cover all the topics. Modules themselves consist of many correlated lessons of different types. Amongst them are also virtual lessons.

If virtual lessons reside within a module the maximum duration will be 5 weeks, it can be also less when the starting date of the virtual lesson is not right at the beginning of a time slot. In case virtual lessons reside within an accompanying measure, the virtual lessons can last up to one semester, again depending when the start date is set in MEDonline.

## III. REALIZATION OF AUTOMATED VIRTUAL LESSONS

In this section we describe the overall operation of the virtual lesson system from the view of the three main stakeholders: the teachers, the students and the administration.

### A. Virtual lessons from the teacher's view

Before a virtual lesson can be executed its content must be created. At the Med Uni Graz virtual lessons consist at least of a lecture part and a WBT. The lecture part is preferably a so called eLecture [7]. eLectures are recorded lessons where usually slides and audio is offered. In case the teacher also shows e.g. experiments also video parts are added. eLectures are usually offered in connection with highly interactive content e.g. animations, videos or virtual microscopes [8], [9].

For the development of the virtual content the teachers are supported by the department virtual medical campus whose affiliates are specialized on the development of interactive content and eDidactic. Once the content is created, teachers will not have further efforts besides a regularly update and the continuous availability per E-mail during virtual lessons are running in order to answer individual questions.

Our system enables teachers to set start dates within the duration of their module or accompanying measure according to didactic reasons. Hence it might be necessary that a virtual lesson does not start before a certain classroom lesson was performed. Students which are enrolled for the corresponding module are also automatically enrolled to the Moodle2 course with the virtual lesson. This planning is done with the normal planning of the modules within our central administration system MEDonline. Virtual courses are only formally distinguished from classroom lessons by having no specific room assigned but instead "virtual".

From now on the virtual tasks in connection with the virtual lessons are automatically presented to those students who are enrolled for a specific module or accompanying measure within VMC/Moodle. During the entire process teachers have no administrative work to perform.

### B. Virtual lessons from the student's view

Students are enrolled to modules and accompanying measures by a central administration department using MEDonline. If the module contains virtual lessons all students will automatically receive so called virtual tasks within our eLearning platform VMC which they have to fulfil until the end date of the module. All active virtual tasks are displayed on the start page of our LMS VMC/Moodle. An example is given in Fig. 2.

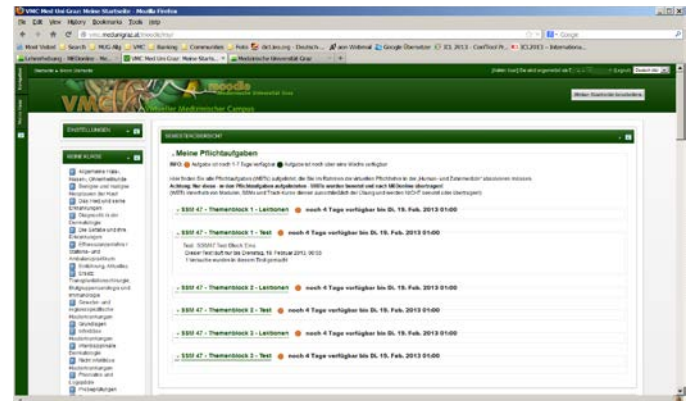


Fig. 2. Virtual lessons from a student's view

Students can see via the interface all open tasks, if they have already executed it or if it is still open, and a clear deadline until when they have to fulfil it, i.e. the number of days this task is still open.

All results are synchronized daily to MEDonline, where students can check the automatically calculated grade in combination with the other (classroom) lessons of the corresponding module. After the deadline the virtual task will be closed and the grade will be finalized.

### C. Administration of virtual lessons

With the upgrade of our LMS to Moodle2 we also had to upgrade the MOMOS interface between Moodle and MEDonline. Since the administration of virtual courses was very tedious in MOMOS V1 we completely redesigned this interface which is now very user friendly and can be used now also by persons not having programming and database skills.

The interface consists of three parts: the course overview, the course editing and the time slot editing mask. In Fig. 3 the course overview interface is visualized.



Fig. 3. Overview on virtual courses and their current state in MOMOS V2

In this overview a list of all virtual courses connected with MEDonline and their status can be seen. Within each line indications are given if they are active / inactive, when they start end and when the last synchronization took part. This interface provides full control over the courses by means of you can manually synchronize data with MEDonline, or make courses temporarily invisible (suspend courses) for students in order to e.g. perform urgent maintenance. This interface also provides a time machine interface meaning you can simulate with MOMOS certain dates which is e.g. helpful for testing in order to simulate if the results are correctly submitted at the end date of the course and the course disappears (becomes inactive) afterwards.

The course editing mask – visualized in Fig. 4 – provides a comfortable interface in order to add, remove and change virtual courses. Virtual courses are uniquely interconnected via MEDonline via a triple ID consisting of three hash numbers representing the study (e.g. human medicine), the module/accompanying measure and the lesson. Within VMC/Moodle each virtual task has an ID as well, which are represented by IDs starting “momos” and a unique number. This course has to be created first, then the course ID can be assigned within MOMOS to a specific virtual task which is connected itself to one lesson in MEDonline.



Fig. 4. Course editing mask of MOMOS V2

Finally the time slots mask as given in Fig. 5 provides all functionality needed in order to realize the time slots of the modules and accompanying measures as described in section II. For each time slot a module or accompanying measure with virtual lessons is offered a line in the table is added defining the start and end date of the corresponding time slots the modules are offered. Only within these defined time slots virtual tasks can be shown. Hence dates from MEDonline outside a defined time slot in MOMOS will be ignored. As explained before, due to didactic reasons virtual tasks may start later than the time slot start, but they will always end with the end of the time slot, hence the date given in the corresponding line.



Fig. 5. Time slot editing mask of MOMOS V2

With these three masks the virtual tasks can be efficiently managed by the department Virtual Medical Campus. It allows for efficient editing, adding and removing virtual tasks. And only once a year, before the start of a study year, within the time slot mask the time slots for the next year have to be defined for the modules and accompanying measures. This can be done by copying the slots from the last year and to adopt the dates for the new study year.

### D. Technical realization

MOMOS V2 is a plugin for Moodle2 developed in PHP V5 by eDaktik GmbH [10]. One of the most important technical achievements in comparison to MOMOS V1 is that the new version provides a web interface for editing course and timeslot data. In MOMOS V1 the display of virtual lessons was implemented as a plug in and included modifications of the standard starting side of Moodle. This resulted in a complicated update mechanisms, since an experienced technician was needed who took care that the MOMOS relevant parts were not overwritten by the update.

In MOMOS V2 the display of virtual lessons has been implemented as a standard Moodle block. MOMOS V2 seamlessly integrates now into Moodle 2 and updates to Moodle can be applied without affecting MOMOS at all. The connection from MOMOS to the Oracle database of MEDonline is provided by the PHP OCI 8 extension. For accessing the Moodle database standard Moodle library functions are used, providing independence from the underlying database (PostgreSQL). This makes the MOMOS interface robust against updates and there is no need for continuously modifications with the MOMOS source code every time a new version of Moodle is installed.

## IV. EVALUATION

In summer semester 2012 we first evaluated virtual lessons implemented as so called eLectures [11]. These eLectures were realized as an audio recording of the teacher with synchronized slides. In case the teacher also showed something to the students – e.g. explaining certain areas within a medical image

- also animations were added. Since these eLectures were on the topic histopathology also virtual microscopes were added so students could examine probes by themselves after they worked through the content of the eLecture. In Fig. 6 an example of such an eLecture is given including animations and a virtual microscope. The eLecture is implemented as a MPEG-4 movie so it can be viewed also on mobile devices. Our first implementation for the virtual microscope was Flash which was unable to be viewed on Apple devices. We now use HTML5 which is a new standard supported on many devices including Apple.

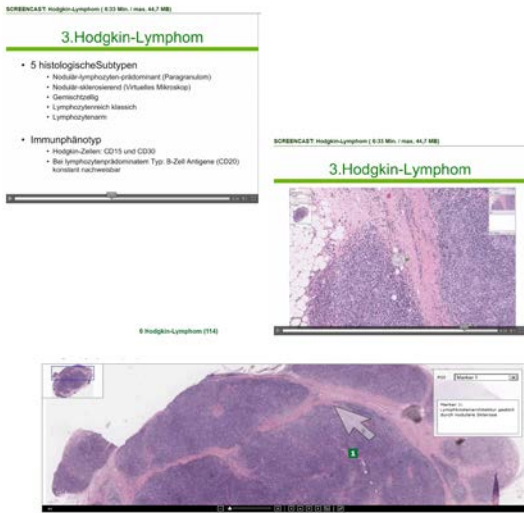


Fig. 6. Example of an eLecture with included animations and a virtual microscope

One of the most interesting findings was, that students preferred to have virtual lessons instead in this specific topic instead of classroom lessons, however, they also expressed the wish to have at least one voluntary “ask your teacher” classroom lesson where they can put individual questions face to face. This request was implemented in summer semester 2013. Under this new aspect another evaluation was performed, the results are presented in this chapter.

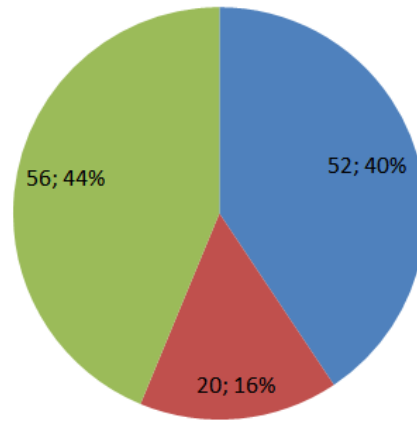
**A. Basic data of the evaluation**

The evaluation was performed online and sent to 340 students executing the virtual tasks within the second time slot (5 weeks) within the summer semester 2013. 128 students filled in the evaluation, which results in a return rate of 37.65% which is considerably high for an online evaluation (normally we assume a return rate of 30% for online evaluations).

**B. Results of the evaluation**

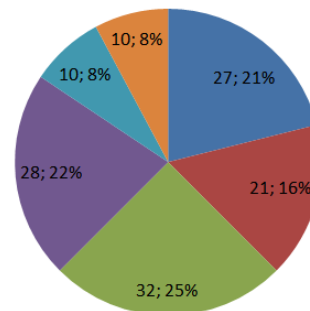
The evaluation consisted of eight closed questions and two open questions.

Question #1: I want the histology-pathology exercise in the future



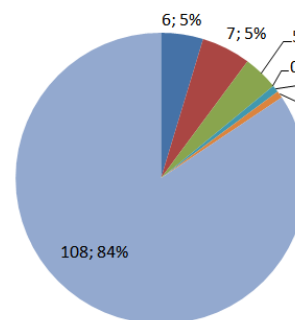
- offered purely virtual without presence part
- offered purely virtual without presence part but with improvements
- not as eLecture but as a normal lesson

Question #2: I think the additional classroom lesson “ask your teacher” is a helpful amendment to the virtual lesson in order to put individual questions to the teachers.



- strong agreement
- very true
- true
- meets less
- hardly applies to
- not at all

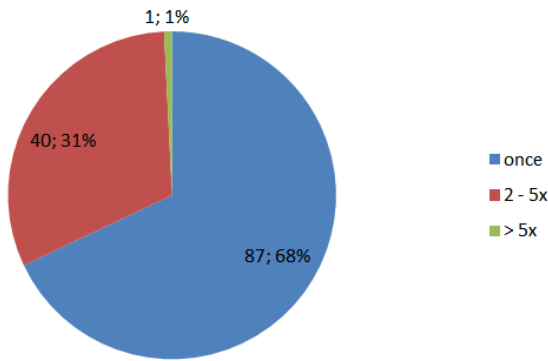
Question #3: During execution of the eLecture my questions per E-mail to the teacher where immediately answered.



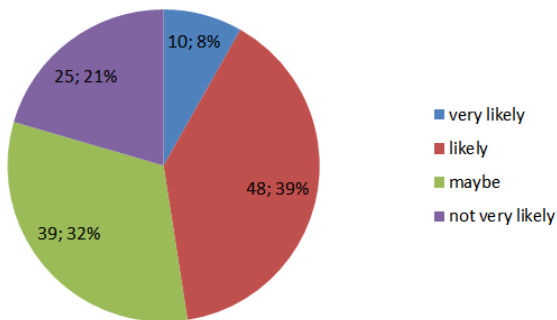
- strong agreement
- very true
- true
- meets less
- hardly applies to
- not at all
- I did not use this service



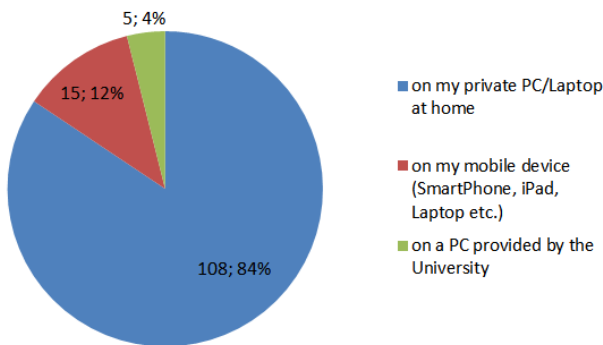
Question #4: I executed the eLecture



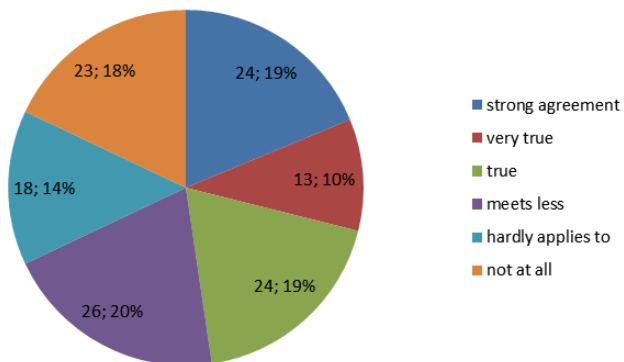
Question #5: from my current perspective it is very likely that the eLectures are also of use at a later stage in the study.



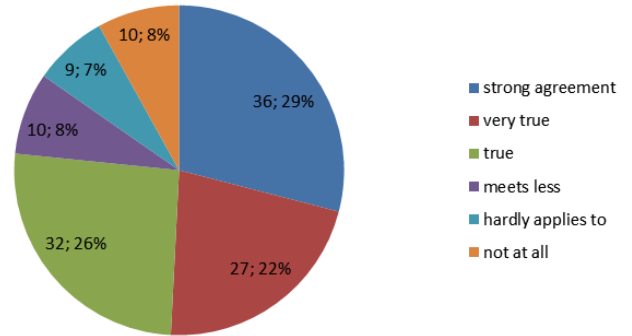
Question #6: I executed the eLecture



Question #7: For the future I would like to have more purely virtual lectures



Question #8: eLectures provided via the LMS VMC/Moodle are essential for my learning success.



## V. CONCLUSIONS

An important finding in connection with virtual lesson was to give incentives to all stakeholders included in the process, hence to students, administration and also teachers. For students the incentives are quite obvious and include time saving and independency, learning speed can be adjusted individually and different learning styles can be addressed. For the administrative people the usability of the new MOMOS V2 interface was significantly increased. With MOMOS V1 only people with programming skills could maintain the virtual courses, with the new interface these special skills are not needed anymore. We realized that it is also very important to find incentives for teachers, as the most obvious one – time saving – is not always the one they are looking for. Hence the Med Uni Graz supports virtual lessons additionally by provision of points for the habilitation and grants in addition also monetary compensation for creating and performing the virtual lessons. This is only fair due to teachers have to be there to answer individual questions of students and also have to regularly update the virtual content. Last but not least we think it is very important to support teachers with the creation of virtual content. The Med Uni Graz has an own department with affiliates specialized in the development of interactive content and eDidactics. This service is especially needed for teachers having no technical background which is for teachers in medical education very often the case.

From the evaluation results several conclusions can be drawn. First the majority (56%) of the students want to keep the histopathology exercise as a virtual lesson. This is a smaller part than for the last evaluation in summer semester 2012, where 73% voted for keeping the virtual lesson, however, for this evaluation we had only a return rate of 22% so the results are not 100% comparable. From the comments for improvement we could further derive, that many students tried to execute the eLectures from a MacBook. But the format we used for parts of the eLectures was not working on this platform. This will be corrected now.

62% of the students found the additional face-to-face lesson helpful in order to put individual questions. Since this was a clear wish of the evaluation performed in 2012 we expected a higher percentage, however, this result still expresses a clear wish to offer this lesson from now on permanently.

The service to write E-mails to the teachers was only used by 14% of the students. This can maybe explained by the highly self-explanatory content.

At least 47% of the students expressed that they might need this content also later in their study, which is still a high number and also justifies the quite high effort in order to implement the eLectures. It has to be said, that this is a self-assessment of students, since they cannot really know right now which will be needed again later on.

More than 84% executed the virtual lessons from home, which is not really surprising. But also 12% used mobile devices, which is a significant increase since the evaluation in 2012 were only 2% used mobile devices. This reflects the clear global trend that PCs are more and more replaced by mobile devices and tablets.

48% have a wish to further extend the virtual lessons. This percentage is not very high, however, it has to be added that from the comments it can be clearly derived that virtual lessons are wanted in order to replace pure frontal lessons in large groups rather than to replace exercises in small groups.

Last but not least a 3/4 majority (75%) of the students clearly explains that virtual lessons – i.e. eLectures - are very helpful for them in order to increase their learning success and for preparation for exams.

Comments from the open questions such as “thanks that you undertake all these efforts in order to provide us with these learning videos”, “virtual lessons are a great idea and shall be kept in combination with an ask your teacher lesson. The offer of virtual lessons shall be further extended”, “The virtual exercise is a good idea and well implemented. They give more flexibility on the time budget at home which is anyway tight” highly motivate us to continue with this service also in the future.

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