# Secondary Publication

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# A Study on the Use of Lecture Recordings in Different Mobile Learning Settings

## Primary publication

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# A STUDY ON THE USE OF LECTURE RECORDINGS IN DIFFERENT MOBILE LEARNING SETTINGS

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## ABSTRACT

Lecture recordings represent a convenient means to supplement traditional face-to-face lectures and also to establish pure e-learning scenarios. We provide lecture recordings to our students since roughly one decade by now. The recordings are used by traditional students present at the university's campus as well as students studying a virtual study path who are not on-site. In the last two semesters we have provided the lecture recordings in different complementary formats: a rich proprietary format based on special presentation software—well suited for desktop-PCs, notebooks, and netbooks—and a standard video format allowing the use on smartphones and other mobile devices. In this paper we present the results of a survey on the usage of the lecture recordings—especially considering the mobile use of the lecture recordings and the expected future potential. In particular, the two different student groups involved make these results interesting. In our perception the main finding is that mobile learning using lecture recordings is beneficial in specific situations, but not as a dominant learning model. A perspective can be seen in mobile learning as part of a broader ubiquitous learning scenario.

## KEYWORDS

Lecture Recordings, Mobile Learning, User Study, MPEG-4, Ubiquitous Learning.

## 1. MOTIVATION

Without any doubts traditional face-to-face lectures have their merits. Nevertheless, current and future conditions and requirements demand that these lectures are supplemented—or even substituted—by additional means. At that point, the requirements of lifelong learning and therefore changing learning environments become important. More and more students are in charge of earning money or taking care of their children and other relatives. Also, other students prefer to participate in part-time Master programmes for working professionals.

Lecture recordings are a valuable means in those situations. They allow traditional students to use the recordings in the wrap-up phase of a lecture and for exam preparation. Furthermore, they can be beneficial when a student is prevented from taking part in the lecture—due to illness or other reasons. Finally, students in an e-learning programme can use the recordings as complete substitute for participating in the lecture.

The increasing distribution of powerful mobile devices suggests considering the provision of lecture recordings for such devices too. In a visionary perspective, we could see students in public transportation, in a park, or even during workout following a lecture on their mobile device. However, at that point, some serious questions arise: How many of our students own such devices? Are the mentioned situations adequate for the consumption or processing of lecture recordings? Does this type of learning fit into today's students learning models?

We provide lecture recordings to our students since roughly one decade by now. Most of the time we provided the recordings in a rich proprietary format—based on special presentation software well suited for desktop-PCs, notebooks or netbooks. In the last two semesters, we have additionally provided the lecture recordings in a video format allowing the use on smartphones and other mobile devices. The recordings are used by traditional students present at the university's campus as well as by students studying a virtual study path who are not on-site. Based on this experience, we present the results of a survey on the usage of these lecture recordings—especially considering the mobile use of the recordings and the expected future potential.

At this point, it has to be mentioned that our understanding of mobile learning is rather pragmatic. We agree with O'Malley et al. (2004) defining *mobile learning* as "any sort of learning that happens when the

learner is not at a fixed, predetermined location, or learning that happens when the learner takes advantage of the learning opportunities offered by mobile technologies". However, trying to give a more precise definition of those—indeed various—settings classified as mobile learning, we defined four dimensions of mobile learning as shown in Table 1. Considering these four dimensions, mobile learning can be any form of learning for which the characterisation over all four dimensions does not include one of the three non-mobile characteristics (marked in italics).

Table 1. The four dimensions of mobile learning

| Place | Device | Time | Material |
|---|---|---|---|
| *at home* | *Desktop-PC* | *face-to-face learning* | paper-based |
| on the way | Notebook/Netbook | intentional learning | digital |
| other venue | mobile devices | in between learning | mixed |

The rest of the paper is organized as follows. Section 2 briefly describes the lecture recordings behind this study—including the two different formats: LECTURNITY's lpd and MPEG-4. The description and participants of the study as well as the design of questionnaire can be found in section 3. As main contribution, section 4 presents the results of our study. The paper concludes with some implications for mobile learning and ubiquitous computing in section 5.

## 2. LECTURE RECORDINGS

The area of application for lecture recordings is very versatile. On the one hand lecture recordings can be used by students that are prevented from following the lecture face-to-face due to time as well as place restrictions. On the other hand they can be employed by all students to look something up or to prepare for the exam—just to name a few opportunities. More details on different usage scenarios will be given in section 4. In any case the lectures have to be recorded first.

For our setting the lecture recordings are done via LECTURNITY[1], a presentation and screen recording software. Using a tablet-PC with build-in touchscreen and a standard webcam, LECTURNITY makes it possible to record everything that the audience would see and hear if actually attending the lecture: PowerPoint slides, annotations, demos given on the presentation PC, spoken voice, facial expressions and gestures. Afterwards, the recording can be published using LECTURNITY's proprietary lpd file format or choosing among common video file formats such as MPEG-4, Flash, or RealMedia. To explain the advantages and limitations of the different formats, the lpd file format and MPEG-4 are examined below.

### 2.1 LECTURNITY's Proprietary Format

Since lpd is a proprietary format, it can only be displayed within LECTURNITY player. Using this format and player, all recorded assets can be displayed simultaneously. As depicted in Figure 1, the screen is split into three main parts: most of the screen is used to show the current slide in full resolution with the annotations the lecturer is adding during the presentation. Moreover, all of the slides are used to generate a table of contents in the upper left corner of the window, allowing an easy navigation within the recording. Below, the corresponding video of the lecturer is shown to facilitate an experience as close to a real lecture as possible. Of course, the whole presentation is synchronised with the audio track of the speaker. Additional features such as performing a text search on all slides are available too. The average size of such a recording is 2.3 MB per minute with a low but reasonable quality for the video of the lecturer.

The player can be downloaded and used free of charge for Windows—and with some restrictions for MacOS and Linux. The lpd format cannot be used on mobile devices such as an iPhone, iPad or any Android smartphone due to the need for the special LECTURNITY player and frequent codec problems on Linux also suggest MPEG-4 to the user instead.

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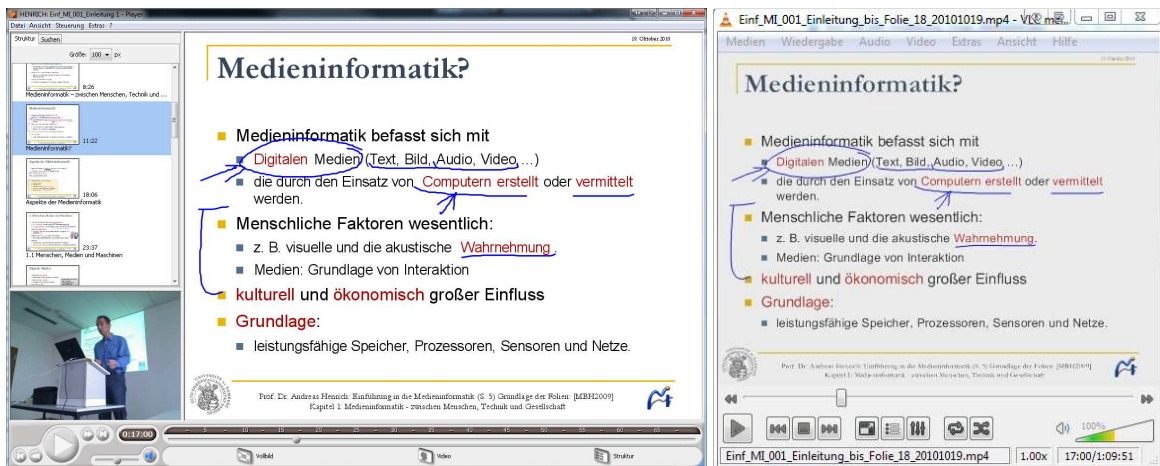[1] LECTURNITY – http://www.lecturnity.com

Figure 1. LECTURNITY's lpd file format in LECTURNITY player (left) and MPEG-4 displayed in VLC player (right)

## 2.2 MPEG-4

Therefore, in order to offer possibilities for mobile learning, the lecture recordings are also provided using the MPEG-4 file format. This allows most mobile devices to play at least the slides with annotations and the recorded audio of the presentation, as there is no special player necessary. A screenshot of an MPEG-4 recording displayed in VLC player is shown in Figure 1. Obviously, this format has some drawbacks, since it does not show a table of contents allowing content-based navigation, a search box nor the recorded video of the presenter to the user.

The resolution of the MPEG-4 video is reduced to 448*336 pixels to have a handier format which is considered to be especially important for mobile devices with reduced video playback capabilities. Overall, an average MPEG-4 recording only requires about 1 MB per minute of disk space.

## 3. DESCRIPTION OF THE STUDY

The foundation of the study presented in this paper is provided by a questionnaire specifically designed to survey the usage of lecture recordings—as described in the previous section—on mobile devices or, more general, in mobile settings. Therefore, this section, firstly, explains the different groups of students participating in this study. Since the choice of participants affected the design of the questionnaire, the second part of this section subsequently describes this design—also explaining the focus of our study. Having not only one but two differing settings is considered to be an important aspect of this study since it allows a more general view on mobile learning with lecture recordings. Finally, the last part of this section delivers some first insights on conducting the study whereas the actual results are depicted in section 4.

### 3.1 Participants

To be able to evaluate the usage of lecture recordings in a more general way, different groups of students have been included into our study and will be introduced in short up next.

The first, and maybe most obvious, group of students the questionnaire has been provided to is a group of traditional students. These students are enrolled at the University of Bamberg (UoB[2]) studying at the faculty of information systems and applied computer science and are therefore enjoying a quite typical university experience: students are present at the university campus, studying together with others is an important part

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[2] University of Bamberg – http://www.uni-bamberg.de/

of a student's life and, most important, students attend traditional face-to-face lectures in classrooms very often—and definitely for our setting—accompanied by supplementary digital assets, such as lecture recordings and others. Put in short, students of the first group are learning within a blended learning setting (Bonk et al, 2006).

Secondly, students studying a virtual study path in our virtual master programme information systems (Virtueller Weiterbildungsstudiengang Wirtschaftsinformatik, VAWI[3]) have been asked to participate in our study. These students have to completely rely on e-learning due to the fact that they are working professionals additionally studying part-time. Moreover, students are locally spread throughout Germany. Studying based on a traditional face-to-face lecture and on-site support is therefore impossible due to time as well as place restrictions. Hence, this second group is exclusively composed of distance students.

To get detailed insights on different teaching and learning settings and styles arising from this variety among our students see Henrich and Sieber (2009). For the purpose of this study it is only important to know that the lecture recordings are provided to both groups likewise in two different file types—LECTURNITY's lpd format and MPEG-4 within a learning management system along with other e-learning content and functionalities. Hence, recordings are available for download shortly after being recorded within the particular course of our learning management system.

## 3.2 Design of the Questionnaire

The design of the questionnaire followed the overall research objective to find out how mobile learning is actually used where the underlying definition of mobile learning is widespread—as pointed out in section 1. Since lecture recordings are provided in two different formats, special interest was on a maybe differing usage of recordings depending on the file type. Additionally, most of the questions were split in order to allow considering the dominant model as well as the overall situation that is users were able to answer the question twice: firstly, they were only naming their main and preferred option; secondly, they were allowed to name all options applying at least sometimes or partly by selecting multiple options. The questionnaire itself was divided into five sections that will be explained below.

The first section was comprised of questions concerning the *general usage of recordings*. To start from the very first, the participants were asked for an estimation of their usage. This includes quantitative information and a classification of the usage mode—ranging from using the entire recording to the use of small excerpts addressing selected slides. Continuing, the second part of the questionnaire tried to survey the *learning scenarios* the recordings were used for—in particular, if recordings are used as a substitute for or in addition to face-to-face lectures.

After gaining insights on the purpose of usage, the technical realisation was of interests. Put in other words, in the third part of the questionnaire the participants were asked to name the *devices* they own and use for watching the recordings—as dominant or "at least sometimes" choice. In addition, the fourth part was concerned with information on *places and auxiliary means of learning*. Students were also given the chance to briefly describe their typical learning situation.

Finally, in the fifth part the *capabilities for mobile learning* within current learning scenarios as well as current obstacles and drawbacks of mobile learning were enquired. The questionnaire concluded with the possibility to give any desired comment on mobile learning.

## 3.3 Conducting the Study

Spending some thoughts on implementing the questionnaire we decided to provide the questionnaire within the learning management system the students are used to and work with regularly—and also download the recordings from—in order to get as many results as possible. An invitation asking for participation reached the students and the questionnaire was available for participation for the time period of one week.

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[3] Virtual Master Programme Information Systems (Virtueller Weiterbildungsstudiengang Wirtschaftsinformatik, VAWI) – http://www.vawi.de/. VAWI is a joint offer of the Universities of Bamberg and Duisburg-Essen especially designed for working professional applying as part-time students.

In order to get the desired participants, we selected the courses of the current and past term (summer and winter term 2010/2011) where lecture recordings have been provided in both file types. The total number of recordings provided for each course is either 14 or 15, depending on the term the course is scheduled for. The courses employed to question the students are listed in Table 2. Details on the course contents are irrelevant for the purpose of this study. It only has to be kept in mind that all of our students are enrolled for an—at least to some extent—technical study path. Therefore an affinity to technical issues can be assumed to a certain degree and the results presented cannot be transferred to any learning setting without limitations. However—especially with the rise of Apple's iPhone and Android devices—smartphones, their advantages and peculiarities have appealed to a much broader audience and therefore somehow opened the doors for mobile learning.

Table 2. Courses included into the study by student groups

| UoB students | VAWI students |
|---|---|
| Computer Graphics | Information Retrieval |
| Information Retrieval | Web Engineering |
| Introduction to Media Informatics | |
| Web Engineering | |

## 4. RESULTS AND FINDINGS

The total number of students asked to fill the questionnaire is 146 where 86 students returned the questionnaire. This corresponds to an overall response rate of 59%. Table 3 shows the number of participants, responses, and response rates by student groups.

Table 3. Number of participants by student groups

| | UoB students | VAWI students | Overall |
|---|---|---|---|
| Participants | 88 | 58 | 146 |
| Total number of responses | 50 | 36 | 86 |
| Response rate | 57% | 62% | 59% |

Next, details on the results of the study will be given. In order to do so, the parts of the questionnaire—as described in section 3.2—are employed: the parts *general usage of recordings* and *learning scenarios* are described in the first subsection, whereas the following parts of the questionnaire correspond to the following subsections.

### 4.1 The Usage of Lecture Recordings for Learning

The general usage of recordings in our setting is very high. As shown in Figure 2, 62% of UoB students and 86% of VAWI students actually use all of the recordings provided. Only 4% of UoB students claim to use no recordings at all. Considering that nobody uses only 1-3 recordings, 96% of our students use at least 4-6 recordings per semester which is about one third of all recordings within one course. Looking at the two file types, there is only a slight difference between the overall usage and students using the lpd format. However, the MPEG-4 files show varying numbers: only 2% of UoB students and 20% of VAWI students use all of these recordings while at least half of both groups use no MPEG-4 recordings at all.

Taking into account not only the number of recordings but also the thoroughness recordings are worked through, the first significant difference of face-to-face and distance students becomes obvious. While only a third of UoB students works through recordings entirely, more than half of the VAWI students do so. Leaving aside the fact that there are different kinds of recordings and also incorporating students working pretty much through recordings, the numbers are significantly higher. In that case 82% of UoB students and 97% of VAWI students use recordings intensely.
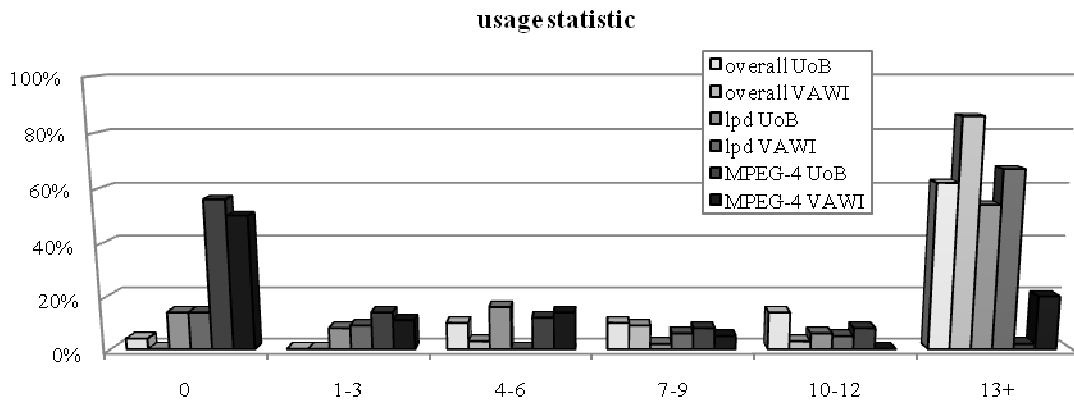
**usage statistic**



Figure 2. Number of recordings used overall, by file type, and student groups

Being asked on the purpose of using recordings, it comes with no surprise that VAWI students use recordings as lecture substitute—78% for lpd, 31% for MPEG-4 recordings which is more than twice the number as for UoB students. Looking at the overall application of lecture recordings, scenarios are widespread and almost uniformly distributed. Recordings are, therefore, also used for subsequent studying of the lecture, review of single aspects, and repetition for the final exam.

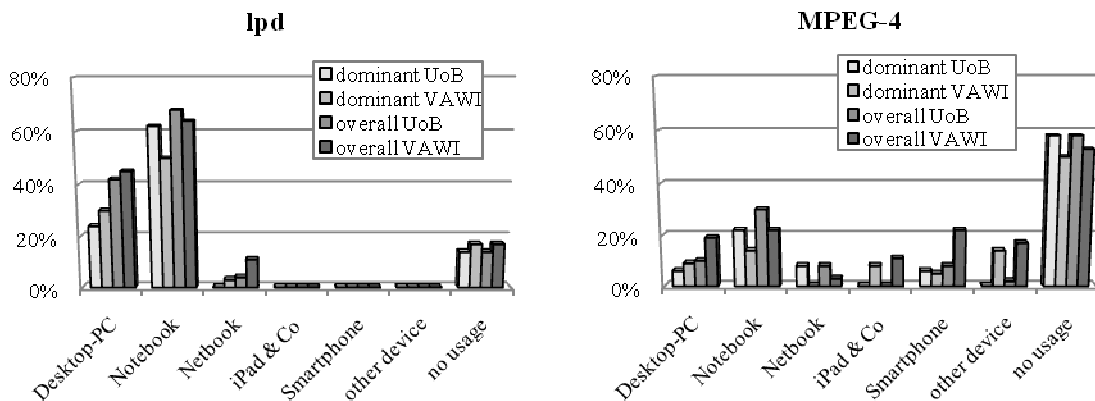## 4.2 Devices of Mobile Learning



Figure 3. Devices used to view recordings in primary model and overall situation—lpd (left) and MPEG-4 (right)

Firstly, students were asked to name devices they own. Potential answers and the distribution of responses are shown in Table 4. Although all of the students are equipped quite good, there is a notable difference between UoB and VAWI students. While VAWI students own 2.48 devices on average, UoB students can only draw on 2.1 devices on average. Especially the percentage of smartphone owners is remarkably higher—compared to UoB students, almost twice as many VAWI students are in possession of a smartphone. This difference can be explained due to the fact that VAWI students are working professionals and therefore likely to have a more settled financial position. However, the ability to actually learn mobile is significantly influenced by this fact and has to be considered when developing strategies for mobile learning.

Of course, pure ownership of devices is not meaningful. Therefore, the specific usage of recordings assigned to devices is shown in Figure 3—students' preferred option and the overall situation—where the chart on the left points out the usage of lpd files and the chart on the right depicts statistics for MPEG-4. Interestingly, notebooks are the most dominant device—no matter what file type is used—for the preferred as well as overall situation. At first sight, lpd seems to be the dominant choice regardless of devices.

However—as mentioned in section 2.1—lpd files cannot be displayed on smartphones, iPad, and similar devices. Nevertheless the usage of those devices for mobile learning is notable due to the availability of MPEG-4 recordings. A third of all VAWI students and about 10% of UoB students use those recordings on mobile devices within their overall setting, 13% of VAWI students and 6% of UoB students even claim those devices to be their preferred option.

Table 4. Devices in student ownership

| Devices | UoB students | VAWI students |
|---|---|---|
| Desktop-PC | 0.62 | 0.67 |
| Notebook | 0.76 | 0.89 |
| Netbook | 0.34 | 0.17 |
| iPad & Co | 0.02 | 0.14 |
| Smartphone | 0.36 | 0.61 |

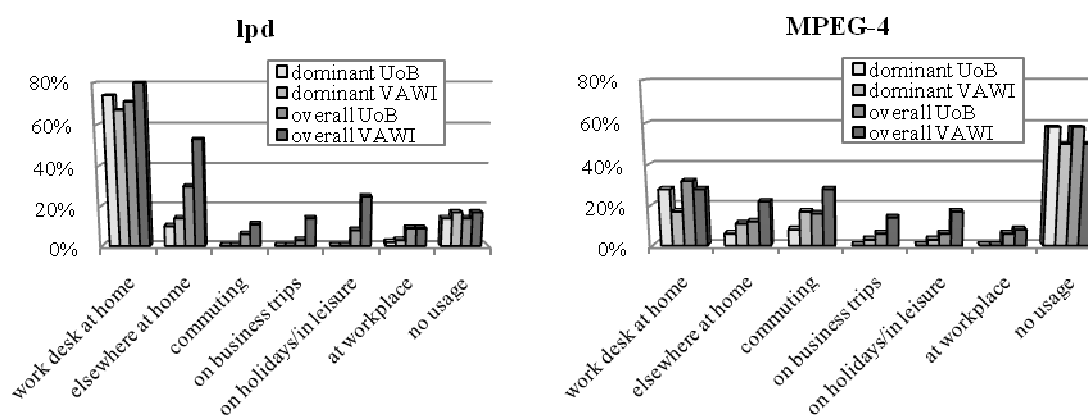## 4.3 Locations and Auxiliary Means of Mobile Learning



Figure 4. Locations of mobile learning in primary model and overall situation—lpd (left) and MPEG-4 (right)

After learning about devices of mobile learning, the question for locations where these devices are employed arises. Figure 4 shows the range of possible answers—separated by file type—and confirms the previous assumptions to some degree. The lpd recordings seem to be most comfortable for stationary learning while MPEG-4 is also used for mobile learning. Combining the options for mobile learning—learning while commuting, on business trips, and on holidays/in leisure—more than half of VAWI students and almost a third of UoB students use MPEG-4 within their overall setting. For 23% of VAWI students and 8% of UoB students mobile learning with MPEG-4 is even the primary learning method.

Examining the learning situation in detail, it was revealed that learners still rely on paper-based support for learning. Asked on their personal habits while learning with recordings, 89% of VAWI students and 64% of UoB students either create handwritten records or add handwritten notes to a printed copy of the lecture slides whereas only 6% and 18% prefer digital notes.

## 4.4 Evaluating the Future Capabilities of Mobile Learning

Finally, all students were asked to rate the potential benefit that can be assigned to mobile learning according to their opinion. As shown in Figure 5, the majority of students—46% of UoB students and 53% of VAWI students—view mobile learning as occasional supplement within their learning situation. In addition, about one third of each group grants mobile learning the potential to be an integral part of their learning.

However, by now, more than half of both groups name the lacking ease of use as current obstacle for mobile learning. Of course, this obstacle might be obsolete in near future. Nevertheless, the same number of students claims the inconvenient circumstances mobile learning is situated in to be an argument against mobile learning. This impression is also supported by the students' free text comments on mobile learning.
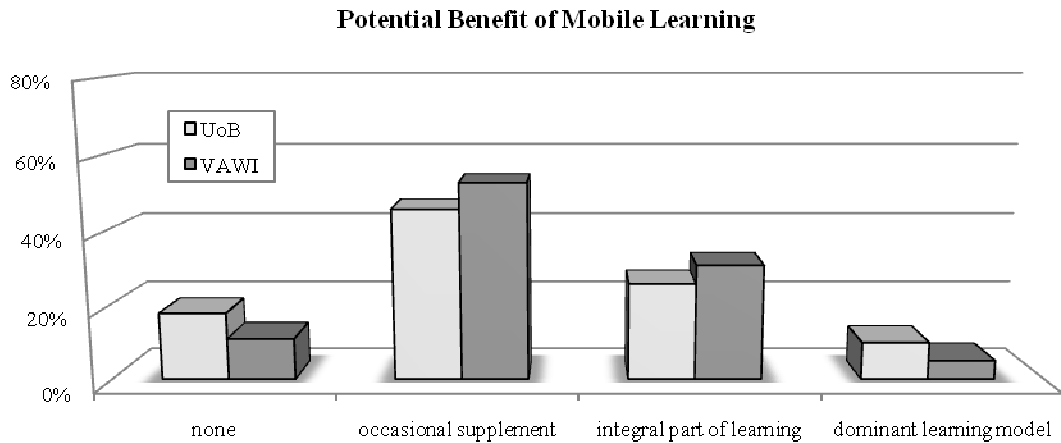
**Potential Benefit of Mobile Learning**



Figure 5. Potential benefit of mobile learning

## 5. CONCLUSION

Overall, the evaluation and particularly the analysis of the free text comments have shown that due to lots of different factors the role of mobile learning needs to be reconsidered. First of all, devices for mobile learning are not affordable for everyone and not everyone is satisfied with the capabilities of learning on mobiles devices, such as a small display and the often necessary, uncomfortable personal position for example while learning on board a train. Also, the disturbing surrounding in which mobile learning is typically achieved has been proven to be an argument against it. Lots of students prefer to study in private without interruptions and annoying sounds. In addition, lots of people are commuting on a daily basis but not necessarily by using public transportation so that there is no possibility for mobile learning at all.

A complete shift from traditional learning to mobile learning seems to be inadequate for lots of learning situations. However, some interesting ideas for combining mobile and other options of learning have been revealed. One student, for example, uses the MPEG-4 recordings to get a preliminary insight on the topic of the lecture, before actually working through the lecture in detail at home. Another student streams the MPEG-4 recordings to his TV via DLNA, simultaneously using his notebook to research single aspects and make digital notes.

Therefore, ubiquitous learning seems to be worth considering. According to Ogata and Yano (2004), ubiquitous learning is characterised by permanency, accessibility, immediacy, interactivity, and embedding learning into daily life such that mobile learning can be a valuable contribution.

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