Semi-automatic generation of multilingual lecture notes - Wikipedia books on different subjects in various languages for blended learning applications

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Abstract

The aim of this paper is to describe the process of semi-automatic generation of multilingual lecture notes in form of Wikipedia books. In particular, we study the case of the generation of lecture notes for undergraduate courses on Algorithms and Data Structures in different languages: German, English, Spanish. The benefit and support of Wikipedia books and multimedia-based teaching in a course on Algorithms and Data Structures was described in an earlier paper. Furthermore, we explain the advantage of Wikipedia books to support the blended learning process using modern mobile devices in multicultural and multilingual environments. We will describe the multilingual production, benefits, form, style and contents of those Wikipedia books. Planned languages of Wikipedia Books for Algorithms and Data Structures:

- *German, English, Spanish, French, Italian, Portuguese, Chinese, ...*

Planned topics of further Wikipedia Books:

- *Algorithms and Data Structures*
- *Computer Graphics*
- *Multimedia Technology*
- *Image Processing*
- *Smart Graphics*
- *Computer and Network Forensics*

Introduction

Nowadays, small- and medium-sized enterprises (SME) have to deal more and more with the issue of IT security. Due to the ever-growing popularity of mobile devices, but also by the general acceptance of IT technology in everyday life, new security threats to corporate data occur every day [1-13].

Due to different terms and conditions within a company, there is no single security solution to counter all different threats.

In addition, dependent on the experience of the administrators, devices and services may be misconfigured and thus open security vulnerabilities.

Companies can protect themselves against such risks by assessing using penetration testing to get an accurate analysis of the threats and develop individual security concepts. However, there are two major challenges. How can companies be aware of the importance of security inspections? How can a check be offered so inexpensive that even in the face of SMEs regular checks are made possible?

One solution is to completely automate the vulnerability and penetration tests and to reduce the necessary oral audits to an essential minimum. With this approach, security audits could be carried out efficiently and with reduced effort and businesses are encouraged to perform these important checks regularly.

Introduction - Virtual University and Blended Learning

Nowadays, traditional educational institutions, such as public schools, colleges and universities and business organizations, use more and more the possibilities of electronic on-line training, the so-called "e-Learning" [4]. Due to the growing worldwide development of information, communication and computer technologies one can observe more and more acceptance of this kind of training opportunities in our society [1],[3],[7-21]. Not only is the global network of computers over the Internet and the versatility of digital media and products involved in the rise, but also the changing social conditions. Multimedia learning environments are independent of space and time (see figures 1-5). Thus, learners can decide flexibly despite their private, social and professional obligations on their learning processes. One can increasingly observe that colleges and universities more and more have to adjust to this present generation of students and respond by increasing the flexibility of the courses. For this reason, online degree programs, or suitable combinations of classroom and online studies (blended learning) are increasingly offered. It is well-known that man learns about 80% of its knowledge and skills by informal learning compared to learning from formal learning. Unfortunately, often this fact is not taken into account by planners and decision-makers from school, university and companies. A well-known example is the now already for 10 years successfully operating "Virtuelle Fachhochschule (Virtual University)", an association of 10 established Universities of Applied Sciences in Germany and Switzerland [2]. A special feature applies to new students, who often have to start and face various "entry level" difficulties in a higher education experience. This can have various causes (e.g. of a longer working period after high school, army and civilian activities, family situation, social status, career changers, migration background, additional employment to earn

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money while studying, lack of student loan assistance, etc.).

In order to help these students and to ease the entry to facilitate study and the associated intensive teaching and learning process, the following two projects were carried out [1].

Virtual Tutorials

In this project not already well-known facts about online teaching should be explored, but rather are demonstrated, as additional virtual online tutorials are successfully introduced into the undergraduate course Algorithms and Data Structures of the Department of Informatics and Media of Applied Sciences Brandenburg in order to give the opportunity to all students to better understand the educational content of this course through a variety of complementary tools to deepen their knowledge and practice with exercises. Nowadays there is a variety of virtual learning spaces, such as Adobe Connect, TeamViewer or iLinc [5]. The University of Applied Sciences Brandenburg uses mainly the iLinc software offered by the company netucate systems GmbH [3]. This tool offers a number of opportunities to use learning materials and to interact with the students. The network performance and stability clearly showed that the use of virtual learning spaces of Netucate with the iLinc software for online virtual tutorials is well suited and the performance is very good. The netucate system allows the effective use of whiteboards, application sharing, integrated browser and other features. We have introduced in the undergraduate course on Algorithms and Data Structures a combination of classroom study and e-learning as a typical blended learning scenario. It is important to mention here that the online tutorial will not replace your presence time in the university, but an additional structural support to individual learning processes. It allows students great flexibility, regardless of time and place they can deepen their thematic knowledge and their priorities. Additionally, several Wikipedia books on specific topics on Algorithms and Data Structures were created and corresponding annotated link lists for multimedia animations were added in the course site of the Moodle server (see Chapter 3).

Additionally, for the digital recording of handwriting in the virtual learning space, a novel Bluetooth pen of the company Papershow [6] was available. This pen enables a vibrant design of presentations, as handwritten notes, sketches or drawings are transmitted in real time and significantly "softer, smoother and more fluid handwriting" on the monitor screen in the virtual learning space and works much better than conventional graphics tablets (digitizers, pen tablets) for writing. In addition, all tutorials are recorded and made available free to all students at any time. Despite progressive developments in the electronic communications students always should feel that the teacher is present during the entire virtual lecture and are accessible through interaction.

Creation of a Multimedia Repository

As part of this project, several multimedia repositories were made on the individual topics of Algorithms and Data Structures and made available to students online. These multimedia repositories consist of both new and custom-made Wikipedia books, Wikipedia links and on the other hand, of annotated list of links to selected interesting multimedia elements on the web. Wikipedia books have the advantage that they allow a skillful selection of available Wikipedia article in the Internet in a clever saved form in

a book structure, without copyright restrictions. These Wikipedia books are available at any time, are easily accessible, and can be updated on the web easily by recompiling (since the basic structure is stored by the teacher at the Wikipedia website).

Moreover, Wikipedia books can be easily produced in different languages. Thus, it is unproblematic for each new semester to produce practically "at your fingertips" updated editions of teaching materials in a nice Wikipedia book form, allowing a supplementary self-study for the students [1]. The Wikipedia books can be created in various formats including PDF, Open Office, ePub, etc. Particularly, with regard to the use of smartphones and tablet PCs, the format ePub is very suitable since the font size can be adapted by the user to the visible display size itself, which is in contrast to the rather rigid and inflexible PDF format easier for reading. Mostly all e-book readers including Amazon's Kindle Reader are compatible with a variety of formats including the new ePub format. This new open file format was developed specifically for use on mobile readers and is regarded by the international publishing industry as the de facto standard format for e-books. Furthermore, for all mobile devices some free applications are available that allow the easy use of ePub files. Students often face some troubles with loan periods and overdue fines in conventional media in the standard university libraries. This can be generally avoided by the use of Wikipedia books in the Internet. In summary, the following 7 Wikipedia books were produced for the subject Algorithms and Data Structures and are available for display and free download for the students on the Moodle server of FH Brandenburg and in the Internet on researchgate.net [16],[18]:

Algorithms and Data Structures - Part 1 : Introduction and Basic Concepts (83 pages),

Algorithms and Data Structures - Part 2: Basic Mathematics, geometry and mean values (137 pages),

Algorithms and Data Structures - Part 3: Complexity and Computability (51 pages),

Algorithms and Data Structures - Part 4: Searching and Sorting (52 pages),

Algorithms and Data Structures - Part 5: Pattern Recognition - string matching (29 pages),

Algorithms and Data Structures - Part 6: Recursion (82 pages),

Algorithms and Data Structures - Part 7: Trees and Graphs (142 pages).

This 7 Wikipedia books were converted to PDF format and are available in ePub format. They were all tested for use on various mobile devices (smartphones, tablets, ...). The in-house production of the Wikipedia books in the framework of this project was a very well accepted work by the students since the easy reading of the ready materials on various mobile devices allows a much deeper understanding of the sometimes difficult matter in the subject Algorithms and Data Structures. According to the ancient Chinese wisdom "A picture says more than 1000 words" an extensive collection of various Flash animations, Java applets, educational films and video clips from Youtube etc. in 7 parts (corresponding to the 7 Wikipedia books and lecture parts) was prepared and set on the Moodle server of FH Brandenburg.

Evaluation

It is well-known that everyone learns differently. One can make a division into the following four types of learning by Vester
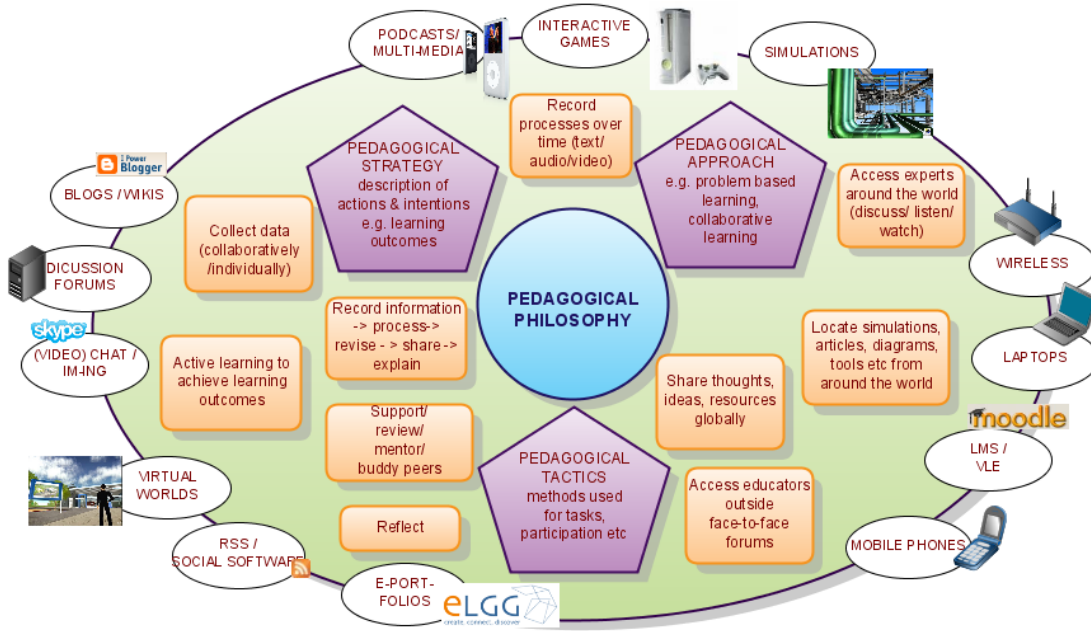
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Figure 1. *Illustration of pedagogical philosophy concepts [??]*
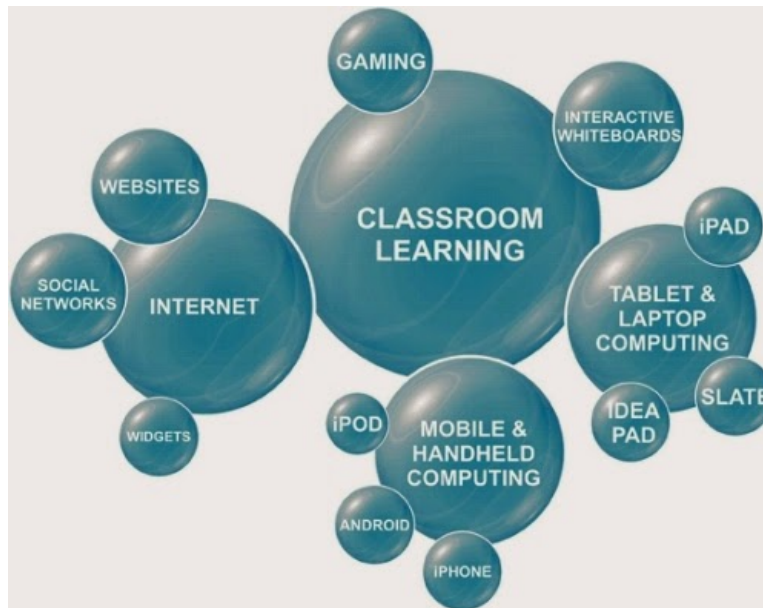
Figure 2. *Platforms of blended learning and 21st Century Learning [??]*

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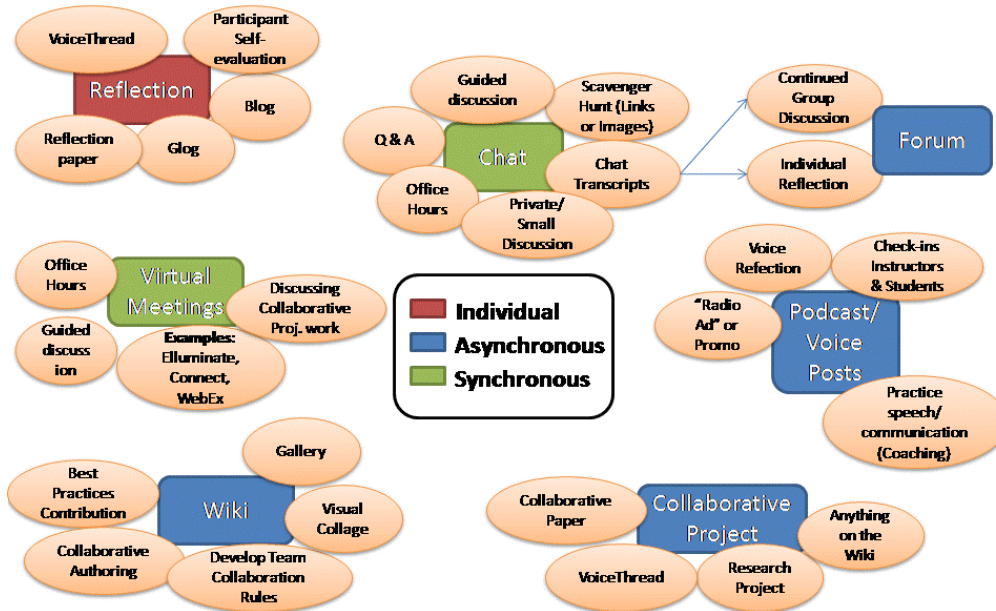# Possible Learning Activities for an Online Course

Figure 3. *Illustration of possible learning activities for an online course [??]*

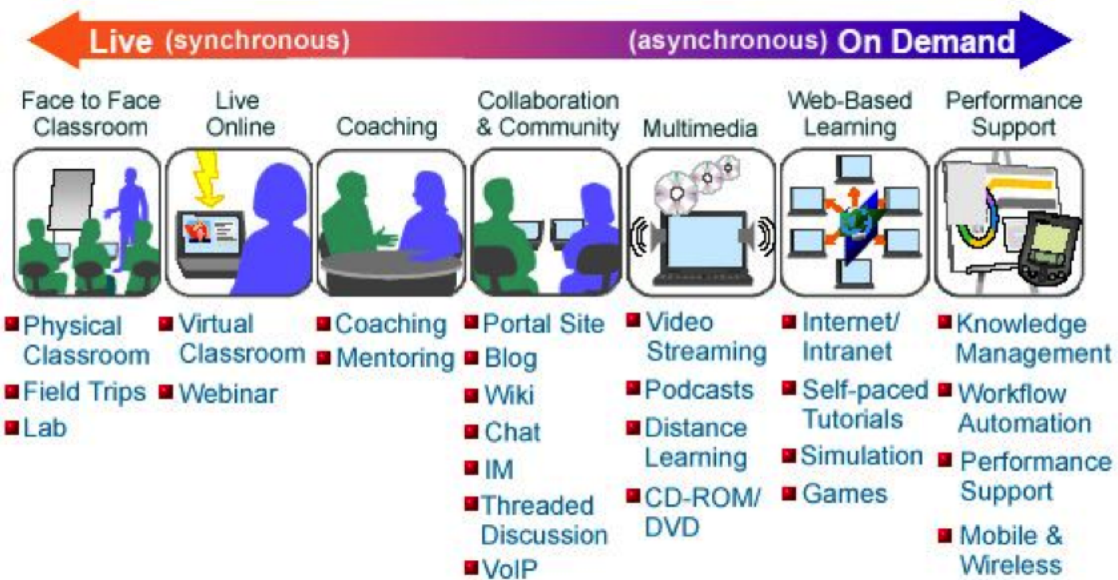**Figure 4.** *Variety of E-Learning instructional methods and activities [??]*

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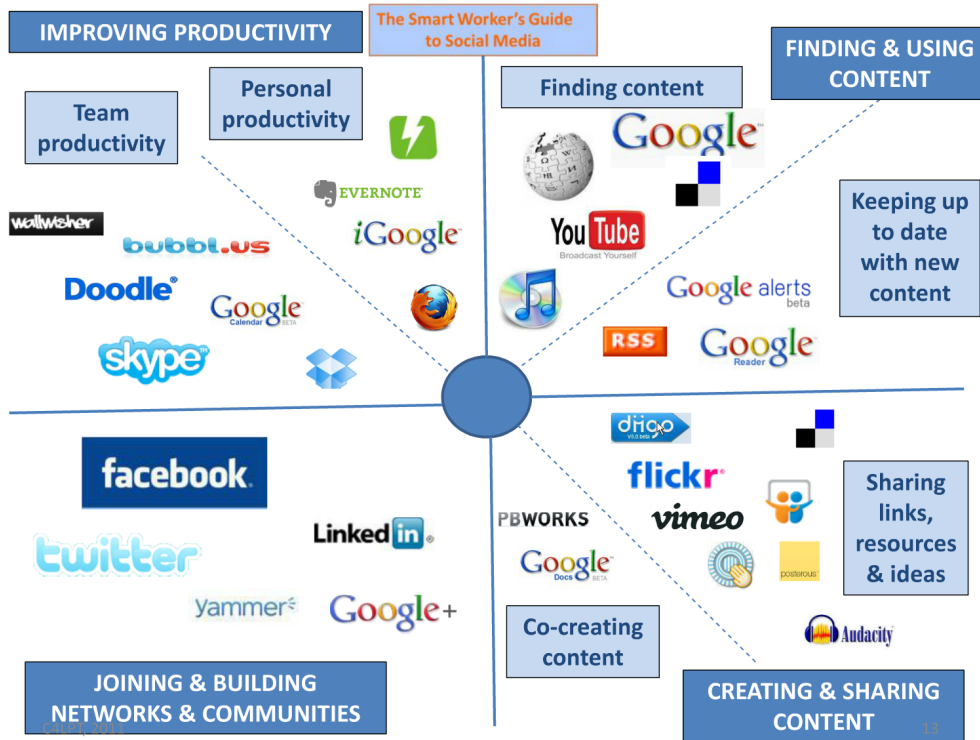Mobile Devices and Multimedia: Enabling Technologies, Algorithms, and Applications 2017

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Figure 5. *Components in modern social learning [??]*
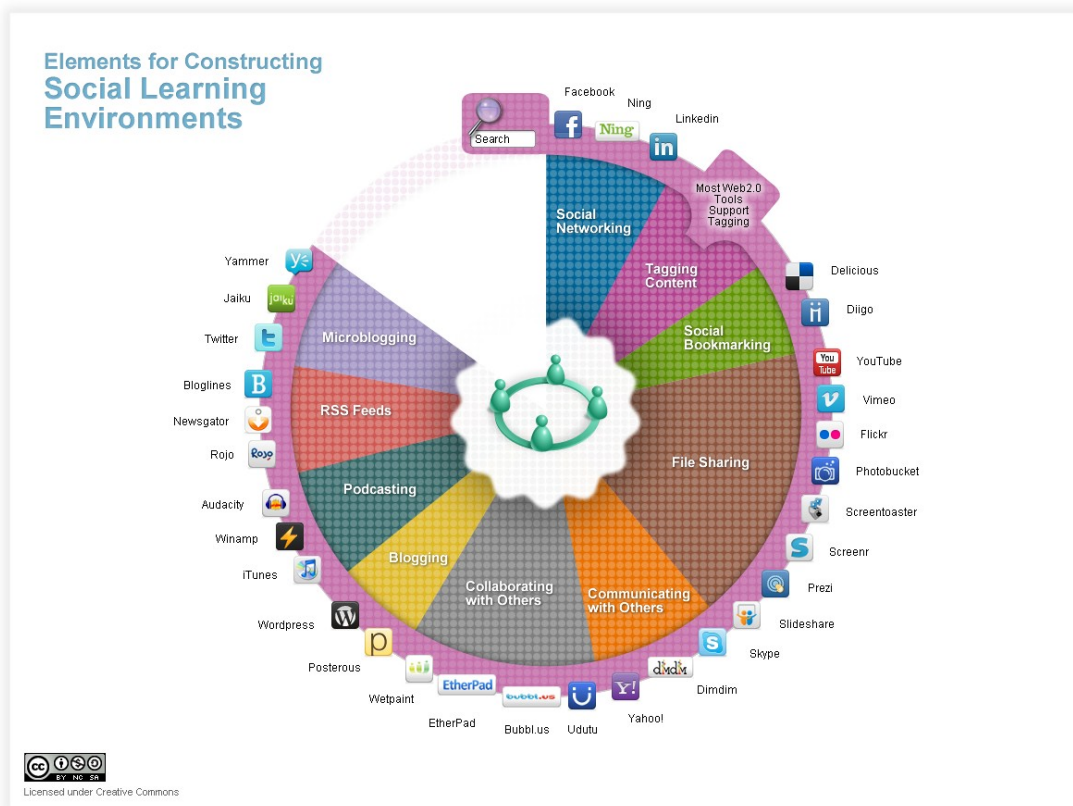
Figure 6. *Elements-for-constructing-social-learning-environments.*

Algorithmen und
Datenstrukturen
Wikipedia-Buch 2013

By Wikipedians

Algorithmen und
Datenstrukturen
Wikipedia-Buch 2013

By Wikipedians

Algorithmen und
Datenstrukturen
Wikipedia-Buch 2013

By Wikipedians

Teil I:
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Komplexität und
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Figure 10: Illustration of title pages of German Wikipedia books, part I - III

**Algorithms and Data
Structures**
Part 1: Introduction (Wikipedia Book 2014)

By Wikipedians

Editors: Reiner Creutzburg, Jenny Knackmuß

**Algorithms and Data
Structures**
Part 2: Basic Mathematics and Geometry
Basics (Wikipedia Book 2014)

By Wikipedians

Editors: Reiner Creutzburg, Jenny Knackmuß

**Algorithms and Data
Structures**
Part 3: Computational Complexity and
Computability (Wikipedia Book 2014)

By Wikipedians

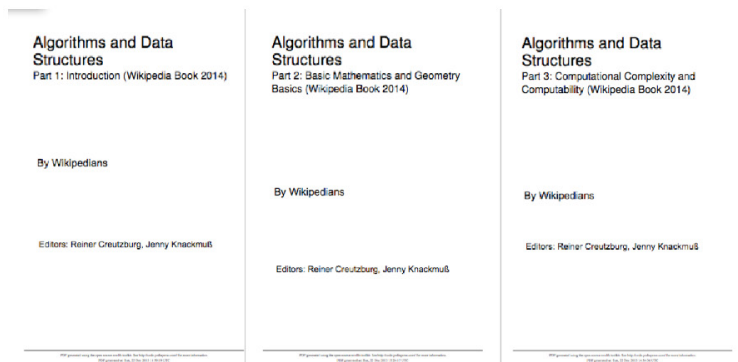Editors: Reiner Creutzburg, Jenny Knackmuß

Figure 11: Illustration of title pages of English Wikipedia books, part I - III

Figure 7.   *Example of Wikipedia books on Algorithms and Data Structures.*

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[17], who addressed that the learning effectiveness can be increased by proper perception of each channel (optical / visual, auditory, tactile, cognitive). The project described here supports especially the case, the perception of visual / visual and auditory learning styles and supplemented by the Wikipedia books and annotated Internet link lists the collection of material for the classical theory in didactic teaching. In particular, this collection of animations on various topics (as for example searching, sorting, pattern recognition, tree and graph algorithms) found the students' interest and increased significantly the motivation for further study of the course material. The project of virtual tutorial was evaluated for the time of December 2012 until August 2013. The success was clearly measurable. A detailed review of the study results based on the rating lists on the subject Algorithms and Data Structures for the last 2 years in the tests and repeated tests yielded the following results: The failure rate in the tests was in the academic year 2012/2013 has reduced to 10,2The overall average of the examination mark in all three undergraduate programs in Computer Science, Medical Informatics, and Applied Computer Science (ACS) has been slightly improved from 2.9 to 2.6. The average grade of foreign students and students with an immigrant background significantly improved from 3.3 to 2.8. Particularly noteworthy is the improvement of the examination results of female students in this group by more than one grade from 3.4 to 2.2, which was apparently caused by the use of a female student as a tutor that had an extremely positive impact on the working atmosphere within the tutorials and virtual tutorials. Conducted evaluation of the course based on the evaluation forms of this form of learning revealed an overall rating of 1.7. Through the creation of lists of links, and appropriate integration of multimedia repository into Moodle pages FH Brandenburg and the Virtual High School, the sustainability of the project is saved. Therefore the project can "live" forever and must be kept up to date only with minimal effort from the teachers themselves. It is important to mention that it does not create any further costs. Since the developed learning content is based on Wikipedia or free Internet content, now and in the future basically no copyright issues will arise [1].

Summary

In this paper we have described our experiences by using virtual tutorials, Wikipedia books and multimedia-based teaching in a course on Algorithms and Data Structures. We describe our work, the benefits and success we gained from using virtual tutorials held in Netucate iLinc sessions and the use of various multimedia and animation elements for the support of deeper understanding of the ordinary lectures held in the standard classroom on Algorithms and Data Structures for undergraduate computer sciences students. The advantage of the use of Wikipedia books to support the blended learning process using modern mobile devices is clearly documented. Finally, some first statistical measures of improved student's scores after introducing this new form of teaching support are documented.

Acknowledgments

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List of Wikipedia books on Algorithms and Data Structures
🇬🇧 **English version**
Title: Lecture Notes - Algorithms and Data Structures - Part 1: Introduction `https://www.researchgate.net/publication/259397239_Lecture_Notes_-_Algorithms_and_Data_Structures_-_Part_1_Introduction`
Title: Lecture Notes - Algorithms and Data Structures - Part 2: Basic Mathematics and Geometry Basics `https://www.researchgate.net/publication/259397614_Lecture_Notes_-_Algorithms_and_Data_Structures_-_Part_2_Basic_Mathematics_and_Geometry_Basics`
Title: Lecture Notes - Algorithms and Data Structures - Part 3: Computational Complexity and Computability `https://www.researchgate.net/publication/259397742_Lecture_Notes_-_Algorithms_and_Data_Structures_-Part_3_Computational_Complexity_and_Computability`
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