Knowledge-enhancing Helix:
An Approach for Developing Key Academic Skills at Universities. A Case Study

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ABSTRACT

In an increasingly e-literate society, new and media technologies are proliferating and traditional teaching approaches are challenged to meet new requirements. Other aspects such as teamwork and knowledge exchange are also becoming more important. Collaborative working methods are more dominant in the networked business environment. The vocational training at universities is therefore continuously facing with new challenges.
The objective of this paper is to show how the implementation of a holistic teaching approach including the idea of blended learning can be an effective way to train students in collaborative and academic working skills, methodological expertise, information literacy, as well as making students aware of new developments in media literacy.
This approach follows our proposed concept DIAMOND (Didactical Approach for Media Competence Development) with a main focus on the implementation of the "knowledge-enhancing helix." This pedagogical concept was developed corresponding the requirements for "good online learning." The paper accordingly discusses the theoretical framework and presents a case study where the concept was implemented in practice.

Keywords: teaching-approach, good learning, education, collaboration, key competencies, information literacy, media literacy.

1. INTRODUCTION

Today's information society is increasingly influenced by media and new technologies, now more than ever. Teamwork, networking and knowledge exchange have gained an important role in professional life. Collaborative working patterns are becoming the norm. Information and media competencies are emerging skills that need to be taught in higher education. They need to be learned by students graduating into an increasingly e-literate society.
Traditional teaching methods alone such as lectures and writing assignments can no longer meet the requirements of a successful vocational qualification. Universities have to meet these new challenges - key competencies need to be developed at an early stage in academic education in order to provide successful conditions for learning and to set the base for future careers. Criteria for good learning conditions help to meet these demands and will be explained in the next part of this paper. Key competencies are derived out of these, which will be described further in the following chapter.
In order to meet the requirements for successful learning and to develop key competencies, the concept of "DIAMOND" (Didactical Approach for Media Competence Development) was developed as a teaching framework and will be described in chapter 4. This concept is integrated in the learning environment of the curriculum of Information Science education at the University of Applied Sciences in Chur, Switzerland.
The emphasis of the teaching method for the development of these key competencies mentioned above lies in encouraging collaborative working methods. This didactical approach is based on the principles of the knowledge-enhancing helix. It is a comprehensive approach that comprises six steps which strongly focus on collaborative learning by using Wiki software and will be described in the next part.
To conclude, we validate and discuss the success of our approach, by measuring the insights gained using the guidelines for good learning and therefore on successfully developing the key competencies.

2. CRITERIA FOR GOOD LEARNING

Learning approaches and theories have changed in the last decades [12] [16]. Especially since e-learning and blended learning has spread more widely, the students' learning abilities need to be considered more thoroughly [19].
Teaching therefore must not just deliver new knowledge or information, but also needs to enable good learning that helps creating knowledge structures and regarding individuality as well as students strengths and weaknesses.
Thus, it is crucial to set up a teaching and learning environment that really is successful in meeting those requirements.

Principles for „Good Learning"
Several authors have explored the factors supporting "good" and "successful learning" [9, 15]. Summarizing and following the work of Chickering/Gamson [6], Alley/Jansak [2] deducted the following „Ten Keys to Quality Assurance for Online Learning":

1. Knowledge is constructed.
2. Learning is more effective if the students can take responsibility for their own learning.
3. Student motivation is a strong determinant of the outcomes and success of learning.
4. Higher-order learning requires reflection.
5. Learning is unique to the individual.
6. Learning is experiential.
7. Learning is both social and private.
8. Inexorable epistemological presumptions can misdirect higher-order thinking.
9. Learning is spiral.
10. Learning is "messy."

These 10 principles are based on various learning theories and paradigms: Principles 1, 4 and 7 emphasize the importance of collaboration and feedback in the learning process in order to enable higher-order thinking (Key 4) as stated by Collins, Brown and Newman [9] with their cognitive apprenticeship theory.
Principles 1, 2, 3, 5, 6 and 10 are based on a moderate constructivist learning approach [15], concentrating on a learner-sided knowledge construction with a personal and individual learning process. The theory of situated learning [13] also has an influence on those four principles, since it states that learning is dependent on the individual learners' situation. It also forms the basis for contextual learning as stated in principle number 10.

Guideline for creating a good eLearning environment

As a guideline for the tangible implementation of an eLearning environment, Fresen and Boyd [11] have identified six categories with between 4 and 15 criteria which need to be considered when aiming to meet the actual challenges. Those criteria are elaborated in detail and provide guidance when developing an eLearning framework:

1. Institutional Criteria
- Technology Plan
- Infrastructure / adequate resources for web-supported learning
- Student advice and guidance (with respect to courses, careers, bursaries etc.)
- Institutional evaluation of program effectiveness

2. Technology Criteria
- Reliability / robustness
- Accessibility / 24-7 availability
- Technical support for lecturers and students
- System training for lecturers and students
- Appropriate use of technology
- Accurate management of student records/data

3. Lecturer Criteria
- Interaction with students / facilitation of web-supported learning
- Frequent and constructive feedback to students
- Academic background / qualifications
- Professional training in education / professional development
- Regular evaluation of lecturer competence

4. Student Criteria
- Communication with fellow students
- Time management / time on task
- Learner control over time, place, pace of learning
- Expectations of efficiency and effectiveness with respect to web-supported learning
- Employ critical thinking strategies
- Motivation / commitment / self-esteem
- Improve problem-solving abilities
- Return on client's investment – client satisfaction, cost/benefit

5. Instructional Design Criteria
- Co-operative / group learning / team work / reciprocity
- Student engagement in higher cognitive levels / knowledge construction / challenges
- Rich learning resources / sound learning materials
- Interactivity / active learning / learning activities
- Enhanced student motivation / responsibility for own learning
- Design standards / guidelines / minimum requirements
- Manageable segments / modular / chunking
- Inclusivity: social, cultural, gender, disabilities
- Routine review and evaluation of courses / products
- Purposeful use of learning media
- Usability / Minimize student frustration / appealing
- Appropriate use of images, graphics
- Offer a complete learning package
- Appropriate layout and presentation
- Appropriate bandwidth and download demands / speed

6. Pedagogical Criteria
- Learning outcomes / objectives are clearly stated
- Optimal assessment strategies / authentic tasks
- Respect diverse talents and learning styles
- Clearly stated expectations re: minimum levels of participation, assignment completion
- Communicate high expectations
- Provide time for students' self-reflection
- Provide a non-threatening, comfortable environment
- Offer multiple paths for recursive learning
- Provide a learner-centered environment
- Students instructed in proper research methodology
- Relevance and accuracy of content
- Currency of learning resources and content
- Research and continuous improvement.

In Chapter 4, we suggest an eLearning environment which enables the development of key qualifications considering these recommendations.

3. KEY QUALIFICATIONS

Various qualifications are necessary to successfully fulfill the criteria mentioned above. Key competencies in this context are meant to consist of interplay of various skills, abilities and attitudes [17]. Furthermore, in a study on the topic of key competencies OECD refers to the globalization and modernization of our society as the reasons behind a networked world which have led to the development of new challenges for individuals in terms of dealing with a wide range of different media and tools [18]. Individuals need to understand the use of such tools for their own purpose and to interact with heterogeneous groups in a broader social context.

Therefore, the development of competencies is a crucial requirement for being able to take part in the scholarly communication as well as a precondition for a successful future working life [20]. A theoretical introduction to the subject is often not very successful as students at this early stage in their studies often cannot independently identify the need for and relevance of obtaining these key competencies to enable good learning. Hence, this process has to be taught and applied from the very beginning of academic studies. In the following chapters, there is a closer description of the importance of these key competencies as part of university studies.

3.1 Information literacy

During the last decades, several different definitions, models and standards for information literacy (IL) have been proposed and discussed controversially [3, 5, and 7]. In the context of university studies, the following definition by Catts & Lau seems appropriate very well: "Information Literacy is the capacity of people to: Recognize their information needs; locate and evaluate the quality of Information; store and retrieve information; make effective and ethical use of information, and apply information to create and communicate knowledge." [8]

Similarly, the majority of the diverse definitions and models on information literacy, IL here is understood as the combination of different sub-competencies:

1. Recognize information need
2. Locate information
3. Evaluate quality of information
4. Store information
5. Retrieve information
6. Use information effectively and ethically
7. Apply information for creating knowledge
8. Apply information for communicating knowledge

This perception contains both the (mostly iterative) process of working with information, as it applies to the everyday life of a university student, but also names the crucial creative aspect of creating new knowledge and communicating it.

3.2 Media literacy

Handling data, knowledge and information is increasingly important in an information society that is governed by new technologies and media. In order to understand and manage all the complexities of a subject area, one has to be able to meaningfully and professionally handle media and media related matters. Keeping a distance and attitude toward media that allows for criticism and reflection is also necessary. Media use is practiced and consolidated with various technologies.

In literature, there is a long-lasting discussion whether media literacy (ML) is part / precondition for information literacy or vice versa [14]. According to our understanding, this question does not matter too much, when focusing on the aspect of teaching and active development of key qualifications, as long as IL and ML are developed together. This for example encompasses the deliberate use of new tools as support for the information process, where students get forced into becoming media literate in order to complete their studies.

3.3 Personal information and knowledge management

The times have changed: not the shortage or lack of information creates problems but the abundance of information. The so called information overload is currently regarded as being a major obstacle in decision making and productive working. Methods for personal information and personal knowledge management are becoming increasingly important. The process of acquisition, organization and retrieval of information and knowledge is to be supported by methods and tools which are based on information and media literacy skills but require individual/personal competencies.

3.4 Social skills

Social skills are characterized by the fact that an individual is able to take responsibility for him- or herself by interacting with the environment. This demands high levels of reflectiveness that lead to social maturity [18]. Collaboration and communication skills play a central role in acquiring social skills [17]. This means that an individual needs to show open and clear communication behavior by giving adequate feedback, especially in conflict situations. By actively collaborating and discussing certain topics of their work, the students learn to give and accept constructive criticism.

In the overall context, social competence is a key to successful learning and managing increasingly complex problems. Focus is the personal development of each student. This provides an important incentive for life-long learning. Each individual competence therefore is an important contribution to the professionalization and strengthening of the student's social skills.

3.5 Methodological expertise

Handling different learning and working methods requires the ability to apply methods and tools for their specific purpose in a certain knowledge domain or subject field. These methods and tools should be adapted according to the actual requirements.

The students are taught a selection of methods, strategies and skills that help them to acquire an effective set of scientific working methods. Methods such as efficiently reading and summarizing a text, writing abstracts, formulating and discussing a thesis, discourse techniques for argumentation, writing a scientific paper using the correct quotation style, as well as processing information and goal-oriented presentation techniques are actively practiced by using exercises and examples.

3.6 Professional competence

Imparting knowledge of the subject area is an important aspect of university studies. Understanding and addressing principal problems in the subject area is the key to acquiring professional competence. Independently developing problem-solving strategies is another important aspect. The subject matter has to be communicated by actively involving the students. This enables them to utilize knowledge gained and also allows them to apply the problem-solving strategies to specific problems arising in real-world work situations.

3.7. Personal empowerment

All the described key competencies finally focus the further personal development of each individual. Thus, students need to develop their own decision-making ability and capacity to act. Furthermore, they establish their own ideals and moral concepts as well as acting autonomously by embedding learned knowledge into practice and life plans [18].

4. CONTEXT OF "DIAMOND"

In order to reach the paradigms we described above, and thereby to ensure good quality in online learning, new forms of

computer-supported teaching must be applied. Accordingly, we have developed the DIAMOND concept considering these principles as well as utilizing supporting tools like e-learning platforms and Wiki software.
The aim of this concept is to teach social, professional, media and information skills and methods as part of the curriculum. This integrated approach has been applied for years and is continuously being developed further. The students have to actively acquire these skills in the first semester as they are a module requirement.
The framework is built on a comprehensive learning environment that integrates various teaching methods and learning possibilities following the concept of blended learning. Mainly it is a computer-supported environment, where students are introduced to new media and activated for purposeful learning.

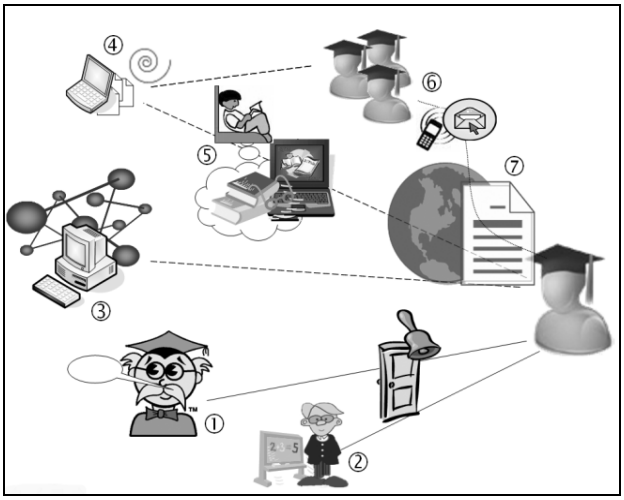

Figure 1: Learning Environment

Figure 1 shows the whole learning environment with its seven different perspectives of teaching and learning. The steps are explained in detail in the following:

1. The weekly face-to-face lectures serve as a classical method of knowledge dissemination. The students attend to the professors' lectures and can solve exercises both alone and in small teams. Teaching material is provided as printed slide-shows or can be accessed electronically on the eLearning website (3). Furthermore, the students are advised to take additional notes on their notebooks or by hand.

2. Tutorials for extending knowledge on particular and especially complex topics are accompanied by an assistant lecturer. Furthermore, the students are trained in using all provided resources and receive introductions to online retrieval and develop and exercise academic writing skills. The tutorials also give room for practice exercises, discussing texts and actively practicing skills to reach information literacy.

3. On an eLearning website material for all covered and discusses topics is accessible. Following various didactical approaches, the material is formatted for online access. For each lecture the same type of content is provided: abstract and learning goals, keywords and definitions, introductions and material for deepening on close-by topics, continuative reading material and links as well as exercise material. In order to provide a strongly learning-centered and recipient-oriented environment, various topic maps have been implemented as browsing interfaces. Via the cross linked design, the topic maps enable very individual access considering the workface diversity of different students (culture, learning types, languages, gender etc.).
4. The process of collaborative writing takes place in a local installation of Wiki software. Students read and comment on the papers of their fellow students according to the knowledge-enhancing helix model (as described in detail in chapter 5). Through this collaborative approach students expand their knowledge and learn to form their own theoretically grounded opinions.

5. The continuative reading material is organized in digital libraries. Various e-print servers, subject databases, online repositories, library catalogues, online glossaries and encyclopedias are included and cross-linked. During tutorials, the students are introduced to those sources and learn how to access them effectively and retrieve information.

6. Within the learning platform a basis for synchronous and asynchronous communication like chat and discussion forum is given. Those communication technologies are web based and allow the supervision and support by teaching assistants. Students can exchange views and discuss questions on a learning platform by using chat and forum functionalities. Special emphasis is placed on that kind of communication in our general conditions, due to the fact that we have both full-time students and part-time students living and working in different locations. Communication between those two groups of students is facilitated by new supporting software and tools.

7. The open source eLearning platform Claroline (claroline.fh-htwchur.ch) serves as starting point with all background information to the respective course. All other media and programs of the learning environment are linked in this system in order to provide easy access and a single point of access for the students. The web-based and interoperable platform of Claroline provides an intuitive user interface that covers all organizational aspects for course management purposes. Different modules allow the management both of a course agenda, announcements, mailings and document spaces.

This whole blended learning framework allows a holistic and integral teaching approach that offers students different learning concepts. It enables them to both self-direct and supervised learning by using social teaching methods.
In the following model, all contextual, technological, methodological, didactical, pedagogical and content-related correlations of the DIAMOND concept are displayed.
This approach is based on a strong process orientation which supports the continuous further development of students, their increasing competency, their knowledge enhancement, as well the optimization of the course framework itself. Overall, a social and multiple teaching learning environment should support self-study and tutored learning in equal measure.

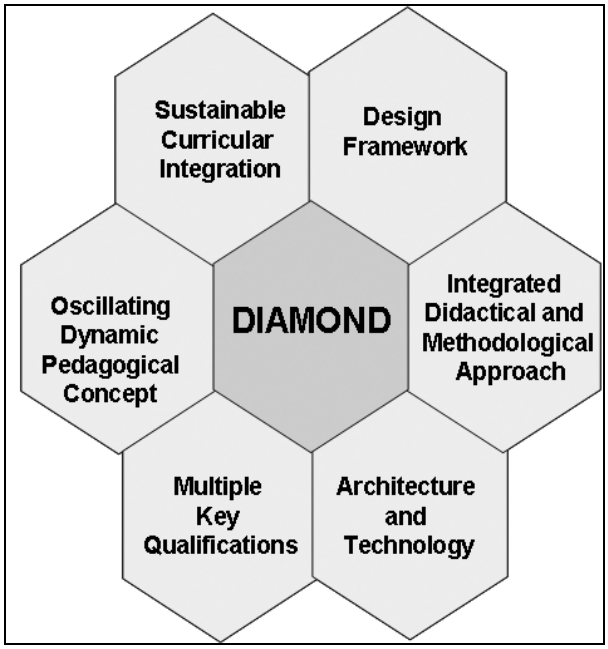

Figure 2: General view DIAMOND

The development and formation of the key competencies are the basis for the DIAMOND concept. From a pedagogical perspective, working collaboratively, writing and discussing are especially important. The module "Oscillating dynamic pedagogical concept" describes an educational approach that includes six steps that together lead to increasing knowledge and developing key competencies. The embedded knowledge-enhancing helix model illustrates this process and is explained in detail in the following chapter.

The specific characteristics of the DIAMOND model are documented in detail in Boeller, Herget & Hierl [4].

5. KNOWLEDGE-ENHANCING HELIX

This chapter goes into the theoretical framework of a knowledge-enhancing helix that was developed to clarify the pedagogical approach in the DIAMOND concept. The helix enables good online learning following the principles of learner-centered knowledge construction in a collaborative setting.

Approach

Students get a lot of practice in academic writing during their university courses as one of the most common ways of teaching them is through exercises in which the students have to compose a paper on a specific topic.
Several problems, however, may occur when this form is applied in the traditional way:

- Many students just concentrate on the topic of their own papers and thus do not learn anything about the topics dealt with by their fellow students.
- These papers are often discussed and written – at best – in small groups, reviewed and corrected only by the lecturer.

Accordingly, the students do not learn anything about critical reviewing, discussion of different topics or academic collaboration during the process of writing their papers.

Besides conveying knowledge and information, the ability to undertake independent reflection and enhance literacy and the ability to form one's own opinion and judgment on a topic is a central objective in academic education. Our hypothesis indicates that these skills can be developed exceptionally well in a collaborative environment.
If we now apply these objectives on academic writing, the approach comprises six steps, as shown in the following figure:

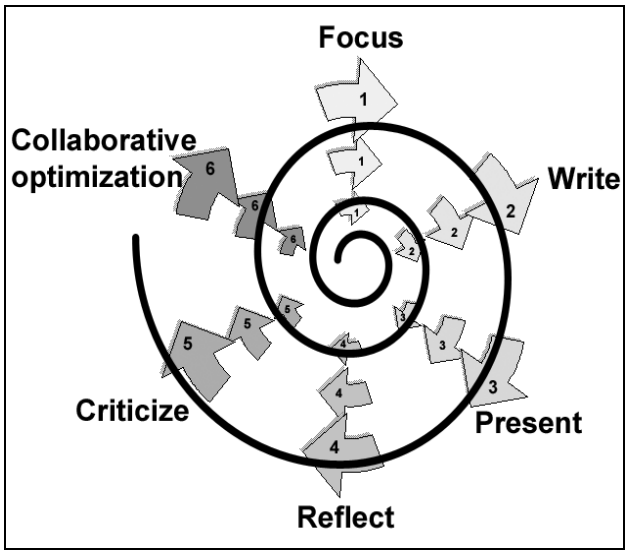

Figure 3: Knowledge-enhancing helix

Preparation

Before the students start writing a term paper, the main goals of this task is discussed and the students are introduced to the whole process and all requirements.

1. Focus

Students proactively gather information on a chosen topic by identifying problems and open questions. They learn about methodical information retrieval on the internet, in (digital) libraries and databases. Students discuss their chosen topic with their fellow students by giving reasons why their topic is worth being elaborated on.

2. Write

Students write their paper individually and deal with current research questions of their topic and learn how to write papers following academic guidelines.

3. Present your ideas

All papers are made accessible to the fellow students. The students thus have to develop their courage and self-confidence in presenting their own work to their fellow students.

4. Reflect on the fellow students' papers

Students take an active part by reading a number of chosen papers of their fellow students analytically and critically. They have to reflect on topics by raising questions and going into deeper research.

5. Criticize constructively

Students can earn extra credits for commenting on and discussing their fellow students' work in a constructive way.

6. Accept criticism and optimize your work

Well-founded comments posted on ones' article can afterwards be included in the paper by the author. The student has to learn how to deal with positive and negative feedback by actively reflecting, sorting, rethinking and recontextualizing their own work and developing appropriate troubleshooting.

In order to apply the teaching method as explained, a collaborative environment with possibilities of online communication is required. Compared to meanwhile traditional forms like email or forum, Wiki software has evident benefits in online communication and online collaboration [1]. Furthermore, operating a Wiki web is easy to learn and no special client software is required. By focusing our main objectives, we have adapted the six above-mentioned steps into the working process by using a local implementation of Media Wiki (www.iud.tlab.ch/wiki).

Illustration of the model:

Every step in this enhancing process integrates the findings of the previous phases and leads to continuous improvement as illustrated in figure 1.

On one hand, by applying our approach in a Wiki web, a knowledge base is constructed and accessible for a long time. On the other hand, students are sensitized to new developments and methodological expertise and are taught in collective learning, as well as being trained in academic working skills and the development of information and media literacy.

During the whole process, the students are supported and instructed by a tutor or a librarian in order to achieve the respective skills. Thus, in order to be able to fulfill the task of writing their term paper according to the helix process, the students must both deal with and actively use the indicated skills and competencies:

Relevant skills and competencies for the individual steps

When mapping the different required skills we identified in chapter 3 on the single steps of the knowledge-enhancing helix, it becomes obvious that this learning process reaches much further than just to learning how to write a term paper. In each step of the process, different tasks have to be solved which in consequence requires the development of the respective skills. It often happens that the same skills are needed several times in different steps – and thus in different contexts for different tasks aiming at different goals. This repetition and varying approach to competencies is another factor that supports the students getting a practical and realistic feeling for the different skills. In the following, we highlight the respective competencies needed in each step of the knowledge-enhancing helix:

1. Focus:

- Recognize information need
- Locate information
- Retrieve information
- Organize information
- Structure information and knowledge
- Apply information for creating knowledge
- Effective reading
- Goal-oriented presentation of information
- Identify and address problems
- Develop problem-solving strategies

2. Write:

- Evaluate quality of information
- Use information effectively and ethically
- Apply information for creating knowledge
- Handle media professionally
- Deliberately use new tools and media for supporting working process
- Handle different working methods
- Effective reading
- Summarizing a text
- Write abstracts
- Use correct quotation style
- Identify and address problems
- Develop problem-solving strategies

3. Present

- Take responsibility for yourself and your work
- Apply information for communicating knowledge
- Keep a critical distance and attitude toward media
- Goal-oriented presentation of information

4. Reflect

- Recognize information need
- Locate information
- Evaluate quality of information
- Apply information for creating knowledge
- Adapt to new requirements
- Effective reading
- Identify and address problems
- Develop problem-solving strategies

5. Criticize

- Give and take feedback
- Self-reflection
- Identify and address problems
- Develop problem-solving strategies
- Decision-making
- Develop personal ideals and moral concepts
- Apply information for communicating knowledge
- Keep a critical distance and attitude toward media

6. Collaborative optimization

- Take responsibility for yourself and your work
- Give and take feedback
- Self reflection
- Develop problem-solving strategies
- Decision-making
- Develop personal ideals and moral concepts
- Accept constructive criticism
- Evaluate quality of information
- Use information effectively and ethically

Thus, the six steps lead to continuous improvement in developing critical abilities and acquiring social skills as well as communicative competencies. Furthermore, students of course increase their knowledge on different topics.

In terms of a model, this process of knowledge acquisition is being represented in a helix. The spiral and staircase-like structure shows the continuous process that step by step leads to knowledge enhancement. The helix becomes larger as it moves up leading continuous improvement and can create new spirals of enhancement.

6. CASE STUDY

The DIAMOND concept and the pedagogic approach of the knowledge-enhancing helix have been implemented in the curriculum for the last four years at the University of Applied Sciences in Chur (Switzerland). This longtime experience has resulted in a case study showing the successful integration of this concept.

Curricular Implementation
Particularly in the first year of a university education, the conveyance of basic competencies and skills takes a very important role for further successful achievements [20].
Therefore the teaching method of DIAMOND with the knowledge-enhancing helix is implemented already in first-year student classes at the Faculty of Information Science.

Evaluation
The helix approach of the DIAMOND concept is already applied in first study phase to enable students to form a firm basis on which to build the skills and competencies required. The implementation can be regarded as successful.

Within the short period of three months, the first-year students were, on the one hand, able to learn all the important aspects of academic writing on an electronic platform. On the other hand, they gained the ability to implement different aspects in collaboration with other students. At the beginning, the students were rather skeptical of making comments on other students' papers and thus criticizing them. However, after a short while, they saw the advantages, such as the chance to improve their own work, and the opportunity to learn more about other topics by reading their fellow students' papers critically. They also realized that it is not necessary to know all the details of a topic in order to be able to make helpful comments and suggestions for improvement.

Students start to develop the key competencies for successful academic education as mentioned above. Particular emphasis should be given to the opportunity to publish and access all the papers on one electronic platform. The papers do not have to be printed out to review them and they remain accessible to other students for a long time. Meanwhile, a knowledge base is build up with the term papers on various topics.

Lessons Learned?
This teaching method was not only appreciated by the first-year students, but was even suggested by them in several courses after reaching the second and third year of their studies. In effect, they asked for the method to be implemented in order to improve the quality of learning in other classes as well.

7. CONCLUSIONS

The DIAMOND concept and the integrated knowledge-enhancing helix aim to actively teach the necessary key competencies. The focus is on a learning-centered approach that incorporates the current development in blended learning.
In order to validate the success of our proposed framework, we discuss whether our approach of the knowledge-enhancing helix corresponds to the 10 keys for assuring good online learning, by successfully developing the key competencies:.

- Students are encouraged to form their own opinions when focusing on a topic for a paper. Therefore, it enables knowledge construction (key nr. 1) and makes the students take responsibility for their own results (key nr. 2).
- Students gain the ability to read critically and consciously which definitely leads to reflection (key nr. 4). Traditional assumptions and approaches are deliberately questioned (key nr. 8).
- By providing a flexible learning environment, explorative learning is encouraged. This encourages the individual learning process (key nr. 5).
- Students present their own ideas to fellow students which is the basis for a strong motivation for good and successful outcome (key nr. 3), since no one wants to embarrass themselves through weak results. Besides, it brings in the aspects of both social and self-study learning (key nr. 7).
- Students develop the ability to judge and formulate criticism constructively and learn to accept and understand criticism by fellow students. Furthermore, our approach enables one to include constructive criticism and thus increases the quality of one's' own work. This aspect emphasizes the spiral and "messy" learning (as stated in keys nr. 9 and 10) but also the experiential learning approach (key nr. 6).

Hence, we assume that using Wiki and following the helix-concept successfully enables good learning. Furthermore, the evaluation has shown that students have developed key competencies when going through the process of writing a term paper with these prerequisites.
Many of the advantages described above were confirmed by applying this teaching method. The good adaptability and ease of learning have lead to great acceptance by the students. With the application of the Wiki software, already known to most students by the Wikipedia concept, the entry barriers are quite low and the required collaborative working style is evident.
Furthermore, a knowledge base on different topics is built up when term papers are written and being made available in Wiki. By steadily improving and updating the articles an up-to-date knowledge pool is created as a nice add-on to the advantages discussed above.

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