

# The Impact of an E-Learning Strategy on Pedagogical Aspects

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**Abstract:** Planning and implementing courses – no matter whether done for face-to-face education or within e-learning environments – deal a lot with pedagogical issues. Learning is influenced by a couple of factors such as attention, motivation, emotions, etc. as well as by learner characteristics like prior knowledge, cognitive and learning styles, intellectual capabilities, constitutional states and the forth. This paper examines learner-centred aspects of e-learning by drawing conclusions from traditional learning in the classroom situation and outlining implications for the process of virtual learning. Furthermore, a case study carried out in the field of adult education tries to point out findings on the impact of different e-learning strategies on the factors influencing learning.

**Keywords:** pedagogical aspects of e-learning, factors influencing learning, learner characteristics, impact of an e-learning strategy on virtual learning, case study

## 1 Introduction

E-learning can be considered to be highly related to learning and teaching as stated in (Jain et al., 2002). Therefore, pedagogy and didactic are important aspects for all facets of e-learning, reaching from the creation of the courseware and the application of an e-learning system to the evaluation of the learning progress. Referring to (Mödritscher et al., 2006), it was already shown that an online course for a certain topic may be implemented in various ways and each method differs from each other with respect to aspects of the teaching process, such as the instructional design, the effort for the teacher, the effectiveness of the teaching strategy, or the applicability of an e-learning platform (in this case the platform used was Moodle).

In this paper, relevant factors of the learning process, e.g. attention, motivation, emotional aspects, students' characteristics, and the forth are examined according to different e-learning strategies. Therefore, section 2 derives relevant theoretical aspects for the virtual learning process by examining knowledge transfer within the classroom situation. In the following, section 3 describes the case study about implementing different e-learning strategies, which was carried out at the Graz University of Applied Sciences CAMPUS 02 (see Campus02, 2006). In section 4 findings on pedagogical aspects in relation with these e-learning strategies are highlighted.

## 2 Pedagogical Aspects of Learning and Implications for E-Learning

With respect to (Knowles et al., 1998), education can be understood as “*activity undertaken or initiated by one or more agents that is designed to effect changes in the knowledge, skill, and attitudes of individuals, groups, or communities*”. In contrary, the term “learning” emphasises the person in whom the change occurs or is expected to occur. Thus, learning comprises “*the act or process by which behavioural change, knowledge, skills, and attitudes are acquired*” (see Boyd et al., 1980). Tying up to this definition, the following subsections deal with the learner-centred aspects of the traditional learning process – such as relevant factors for learning, characteristics of learners, and further influences on learning – and examine them within the context of e-learning.

### 2.1 Factors relevant for the Learning Process

Drawing conclusions from (Bransford et al. 2000), four factors can be outlined as significantly important for the learning process: (1) attention, (2) motivation, (3) emotions, and (4) experiences of the learner.

First of all, the **focus of attention** determines if a student mentally follows a lecture and, therefore, if the intended behavioural change affects a learner at all. E-learning particularly requires a strategy for getting and keeping the learner's attention. Thus, it is necessary to consider cognitive processes such as the learner's selection of incoming data into the sensory memory, organising and integrating this information by building connections in short-term memory and encoding it by transferring it to long-term memory. Thus, it is recommended to apply certain principles for instructional design, e.g. the ones by (Fleming & Levie, 1993).

Secondly, the **motivational states** of students are of importance when questioning how the stimuli given by the teacher promotes the learning process. (Bransford et al., 2000) state that “*motivation affects the amount of time that people are willing to devote to learning*”. Yet, this willingness to learn is caused by different motives beginning with the intention of achieving something over competing against colleagues or helping other people up to emotional factors like anxiety. (Entwistle, 1981) classified three motivational orientation styles: (a) meaning-oriented, (b) reproducing-oriented, and (b) achieving-oriented motives. Considering motivational aspects for e-learning is mainly dependent on the learning content itself, e.g. by pointing out the relevance for an instruction or including interactive elements such as games and simulations. Furthermore, it is advantageous to create competition within a learner group and adapt to pre-knowledge in the subject domain to prevent the students from being unchallenged. For instance, (Astleitner & Keller, 1995) describe a framework for adapting instruction to the learner’s motivational state in computer-assisted instructional environments.

Thirdly, **emotions** have, similarly to motivation, a strong impact on the learning process. (Tobias, 1987) points out findings on students’ performance depending on anxiety, in particular test anxiety, and proposes special methods for dealing with such problems. On the other side, an emotion – no matter if a negative and positive one – may influence learning due to its special nature. With respect to (Paulsen, 2005), “*emotion is an unconscious arousal system that alerts us to potential danger and opportunities*”. Thus, addressing a learner’s emotional channel can be seen as a key cognitive process for transferring data into the short- or even long-time memory. Within the e-learning situation, the improvement of the learning process can be realised through emotions e.g. by storytelling, provocations, emotional figures and animations, group works, enabling confidence in the learning content, etc.

Fourthly, knowledge transfer can be improved if learners can **tie up to prior knowledge** either in the same domain or in a similar context. (Anderson, 1995) states that “*interference happens, when information gets mixed up with, or pushed aside by, other information*”. At the beginning, the degree of mastery of the original subject influences the learning process (see Bransford et al., 2000). In particular, an adequate level of initial learning is required. Then, learners can construct new understandings by tying up to previous experiences, which may not have been activated yet. In this way, learners become capable of understanding conceptual changes, adopt knowledge regarding their culture or everyday life, and even improve meta-cognitive abilities. Research findings have shown that the higher the level of prior achievement within a domain or a context, the less instructional support is required to accomplish a task (e.g. see Tobias & Ingber, 1976). Referring to (Tobias, 1994), prior knowledge strongly relates to interest in the subject. Considering prior knowledge within online courses, the macro-adaptive instructional approach described in (Park & Lee, 2004) deals with the necessity to determine learning objectives, define dependencies between instructional units and assess the students’ competencies to grant access to restricted instructions. These aspects are highly dependent on the learning content so that well-established e-learning standards – such as the specifications of SCORM (see ADL, 2004) – fulfil these requirements.

## 2.2 Learner Characteristics

Drawing conclusions from the last subsection, a strong impact on learning is given by the individual differences of learners as stated e.g. by (Cronbach, 1957). According to literature, each learner differs from each other by means of the following aspects, so-called learner characteristics:

- First of all, each learner has a unique profile of **intellectual capabilities**, which can be characterised i.e. by Gardner’s Multiple Intelligences (see Gardner, 1993) or various types of cognitive abilities described in (Snow, 1986). Education deals with the theory of multiple intelligences in two ways: On the one side, teachers devise curricula addressing different intellectual capabilities. On the other side, educators focus on the development of specific intelligences, e.g. like intra- or interpersonal skills. Although it is rather unmanageable to consider the learners’ intellectual abilities within the classroom or e-learning situation, (Kelly & Tangney, 2003) applied Gardner’s theory within an intelligent tutoring system named EDUCE.
- Secondly, **learning preferences** usually result from predispositions or orientations to learning and can be seen as influences by the context (see Jarvis & Woodrow, 2001). (Dunn et al., 1989) classify preferences by four different areas: (a) environmental, (b) emotional, (c) sociological, and (d) physical. Preferences are considered by many e-learning environments in various ways, e.g. by adapting the language or presentation of the learning content, group models, etc. Exemplary systems can be found i.e. in (Brusilovsky, 1996).
- Thirdly, researchers in the field of teaching and learning introduced so-called **cognitive and learning styles** which are somehow related to intellectual capabilities and preferences. Both kinds of styles try to provide more practical models for teachers. Cognitive styles, such as field-dependence, reflectivity versus impulsivity, haptic versus visual, and the forth, characterise modes of perceiving, remembering, thinking

and decision making. Learning styles like holist versus serialist, perception styles, concept formation approaches, etc. try to describe the connection between instructional presentation and materials with a student's preferences and needs (see Schmeck, 1988). Overall, a lot of practical models like the WAVI model by (Riding, 1991) – e.g. applied within the AdeLE project (see AdeLE, 2006) – or the learning styles by (Kolb, 1984) – e.g. realised in the AHA! System (see Stash et al., 2004) – have been developed in the last decades.

- Fourthly, (Mödrtscher et al., 2004) highlight **constitutional attributes and states** of learners, which may deal with physical properties of the body like disability, age, amblyopia, etc. as well as with short-term states of students, such as tiredness, concentration, emotional and motivational states and the like. Both directions are already well-examined, and various systems try to consider aspects of physical properties – for instance disabilities as stated in (Sánchez & Flores, 2004) – or constitutional states of learners such as the learner's attention (see Ueno, 2004).
- Fifthly, **self-efficacy and meta-cognition** influence the learner's achievement in the learning process (see Bandura, 1982). Self-efficacy comprises a student's evaluation of the ability to perform a given task through different senses. Furthermore, meta-cognition stands for the awareness of the process of learning and consists of two basic processes: (a) monitoring the learning process and (b) adapting the learning strategy (see Winn & Snyder, 1996). According to (Park & Lee, 2004), meta-cognitive abilities examined by various researchers within the area of aptitude-treatment interaction (ATI) are highly related to the learners' experiences and have an impact on different variables, such as the degree of feedback and tutoring, the locus of control, personality attributes, and the forth. In particular, various systems in the scope of adaptive hypermedia – e.g. by methods like adaptive navigation support (see Brusilovsky, 1996) – focus on learner control.
- Sixthly, the **background knowledge** of a learner comprising language and computer skills as well as experience on a related situation by means of a familiar context may also have an impact on learning. For example, (Campbell et al., 2004) report that students from abroad may have problems with understanding the language. (Felder & Henriques, 1995) examined learning styles within the scope of language education and found out connections with learning styles. Thus, (Mödrtscher et al., 2005) suggest providing translations for problematic phrases to support the learning process. Anyway, various approaches in the field of e-learning focus on experience of work in related areas, the user's profession, experience of using the platform (e.g. see Brusilovsky, 1996) as well as on foreign language students (e.g. see EPHRAS, 2005). Further, (Akhras & Self, 2000) introduce the INCENSE system offering the ability of identifying and analysing different learning situations and, if necessary, automatically switching among them.
- Finally, the last and most relevant characteristic of learners involves the user's **prior knowledge and experience** in the domain. (Vassileva, 1996) differentiates between experience and real knowledge about a topic, where experience determines the user's model of a knowledge space, the way of browsing through and mastering tasks in a domain, etc. Similarly, (Bransford et al., 2000) state that people having developed expertise in a particular area are able to think effectively about problems in this area and, therefore, differ from novices. Both factors are relevant for the learning process as shown in the last section. Thus, most theoretical models – e.g. the macro-adaptive instructional approach dealing with adaptation of the learning process according to the student's pre-knowledge and dependencies between instructional units (see Park & Lee, 2004) – and systems – like AHA, ELM-ART, INTERBOOK, KBS, PT, and the forth (see Henze, 2000) – focus on the prior knowledge of a learner. Experience is considered within the field of various research fields such as adaptive hypermedia, e.g. by methods like adaptive navigational support for browsing through a hyperspace (see Brusilovsky, 1996).

Concluding these seven classes of learner characteristics, it can be said that the result of learning is highly dependent of the learner itself. Therefore, teachers as well as e-learning content creators and online instructors have to know very much about pedagogical aspects and provide a large set of methods to support different kind of learners by means of the characteristics depicted above. Nevertheless, there are still more influences on learning as shown in the upcoming subsection.

### 2.3 Further Influences on Learning

While the last subsection dealt with learner-dependent attributes affecting the learning process, some further aspects – given by didactics or related with learner characteristics – may have an impact on learning. Therefore, the following paragraphs examine various factors influencing learning.

Referring to (Krapp et al., 1992), **interest** in a certain domain depends on aspects of prior knowledge, emotions, and motivation, all of them treated in the last two subsections. Thus, it can be assumed that interest results from expertise enhancing the degree of the learner's self-confidence as well as former positive experiences with the subject and can be modelled on bases of learner characteristics by means of inferring a certain amount of interest derived from these factors. As far as supported by the didactical strategy, e-learning may consider the factor interest by providing adaptability, e.g. by allowing the learner to choose preferred learning content, implementing statistical methods to determine instructions which are more interesting for the learner, or applying taxonomies and IR-based strategies to adapt the learning process on basis of the factor interest. Examples of platforms comprise a wide range of systems beginning with the ones focusing on motivation or prior knowledge, others dealing with self-organising hypertext maps like the KnowledgeSea (see Brusilovsky & Rizzo, 2002) or environments supporting constructivistic learning, e.g. the idea of navigating on basis of a course's concepts as mentioned in (Mödrtscher et al., 2005).

A didactical key issue is about people's **remembering and forgetting**. While these processes are highly related with intellectual capabilities, meta-cognition, prior knowledge and motivation of learners, a teacher might antagonise the forgetting curve, e.g. the one introduced in (Ebbinghaus, 1964), by regularly repeating relevant content. To define such key concepts within a course, teachers often use adequate learning objectives and choose appropriate teaching strategies. Such issues are considered within various e-learning environments or even specifications for learning content, e.g. by typical concepts of the macro-adaptive instructional approach examined in (Park & Lee, 2004), by competency-driven strategies realised in the study introduced in this paper or even by the possibilities of instructional sequencing within the specifications of SCORM (see ADL, 2004).

Another didactical aspect deals with the **time to learn** or the so-called time on-task. (Bransford et al., 2000) point out the necessity to give the student enough time to reach an appropriate level of experience within the scope of a certain domain, in particular for a complex subject matter. Nevertheless, learners are often faced with the situation in which a teacher tries to cover too many topics too quickly, which hinders an effective knowledge transfer for different reasons. On the other side, the time on-task should be limited, so that the learner is sufficiently challenged and self-efficiency is able to increase. Thus, it is particularly important for e-learning to plan the time allocated for learning and the time really spent on learning. As pointed out in (Dietinger, 2003), it is one of the advantages of e-learning that learners can go through the course materials at their own pace, deadlines must be set realistic in order to avoid frustration of the students. The possibility to define and manage deadlines for instructional units is provided by the commonly known specifications for e-learning content and nearly each learning management systems, even by open source solutions such as Moodle (see Moodle.org, 2006).

Depending on the given learning objectives, issues like **feedback and tutoring** might be of relevance for the learning process. In particular, if a course aims at mediating high-level objectives, skills or a certain behaviour, it is important for successful learning to give immediate feedback (e.g. see Thorndike, 1913). With respect to (Park & Lee, 2004), various research areas, such as aptitude-treatment interaction or the micro-adaptive instructional approach, deals with giving feedback and technical solutions like intelligent tutoring systems (ITS) or techniques for natural language dialogues. Furthermore, (Mödrtscher & Sindler, 2005) suggest to apply methods such as simulations, games, automatically essay grading, quizzes created with professional authoring software, and the forth.

Finally, learning is also affected by the **context** in which knowledge transfer takes place. According to (Bransford et al., 2000), learners might be able to learn in a certain context, but fail to learn in another one or to transfer the experiences gained to other contexts. Contextualised knowledge is regarded only by few e-learning environments – one of them is the INCENSE mentioned in the last subsection. As this issue is highly related with constructivistic theory, new paradigms are of importance nowadays. One idea in this scope is the application of a dynamic background library to support context-driven learning (see Mödrtscher et al., 2005).

Concluding this section, it has to be pointed out that the issues depicted so far comprise just the most relevant and learner-centred factors of the learning process. A full overview about the complexity of learning can be read somewhere else, e.g. in (Bransford et al., 2000). Nevertheless, it can be stated that the most critical factor for successful learning is the learner. The most important difference between the classroom situation and e-learning can be outlined with the statement that a teacher can adapt the learning process much more effectively by holding a lecture in the class, since communication in both directions – from the teacher to the learners and vice versa – is faster and more effective. In contrary, it is much harder to evaluate a factor of the learning process or learner characteristic and react to it via e-learning platform. Nevertheless, research mainstreams such as adaptive instructional systems or adaptive e-learning (e.g. see Park & Lee, 2004) deal with aspects of adaptation in e-learning environments to improve the learning process.

To examine pedagogical issues within the e-learning situation, the next two sections report about a case study implementing different e-learning strategies and examine their impact on the learning process.

### 3 Setup of the E-Learning Study

After identifying the need for realising e-learning phases within its educational concept at the Graz University of Applied Sciences CAMPUS 02 (see Campus02, 2006), an internal project was initiated with the aim to support lecturers to implement their e-learning strategy within the area of adult education. The study introduced in this section is one of the project's outcomes and describes an online course about the topic "document formats". The course was carried out over a period of two month and realised according to a full virtual concept using a customised version of the e-learning platform Moodle.

Although the course can be considered as lecture on the basics of information technology, attempts were made towards reaching the whole set of competencies and even some higher levels of objectives. Characterising the e-learning course with respect to (Bloom, 1956), the learning objectives comprise five "Level I", four "Level II", and two "Level III" objectives of the cognitive domain, two "Level III" objectives of the psychomotor domain as well as one "Level III" objective of the affective domain. To realise different e-learning strategies, three courses were implemented and each of the 38 students was assigned to one of these courses according to the achievement levels of a prior topic-related lecture. Referring to (Mödritscher et al., 2006), the three courses can be characterised in the following ways:

- Course A was planned with respect to **Behaviourism**, whereat the teacher portioned the learning objectives and the material into three modules, each of the 14 students assigned by the teacher had to study each module and finished with an online examination to measure the achievement levels. Furthermore, this course included some playful activities, such as several attempts in the exam, an increasing difficulty level, a task to gain a bonus, etc., to keep the learners motivated. The learning process was assessed by typical behaviouristic elements like multiple-choice questions, assignment tasks or short answers. To examine the high-level objectives of the psychomotor and affective domain, ITS methods were simulated by the teacher.
- Course B was implemented according to the ideas of **Cognitivism**. Therefore, the tasks could be characterised by classical cognitive elements, for instance repeating learning content in different ways, working out parts of the course within a group work or re-structuring the content. This course was divided into two phases: Firstly, three groups consisting of four students each had to work out a part of the overall objectives. In the second phase, the groups were reassembled to four groups with three members, while each group had to restructure the results of the first phase using a WIKI environment. To motivate the groups, the best work of the second phase was awarded with a bonus. To assess the learning process, the results of each phase were graded by the teacher based on the quality and quantity of the students' work within the group. The WIKI environment allowed reproducing the student's effort within the group.
- Course C comprises the idea of **constructivistic learning** and was realised by simply providing the four groups consisting of three students with all the materials and the task to create a manuscript for mediating all the learning objectives of the course. In the second phase, the three members of each group had to compare the works of the other groups and evaluate them by distributing a certain amount of points and reasoning this distribution. Again, the group with the best work received a bonus. The group works were graded by the teacher on basis of the students' peer reviews.

While the e-learning phase was in progress, students were instructed to document certain aspects, such as the effort for learning, a self-assessment on reaching the objectives, the learning materials used, etc. Furthermore, an unannounced and challenging examination as well as a post-questionnaire was carried out in the lecture held after the e-learning experiment. Based on the whole amount of data retrieved from this e-learning experiment, the next section examines the impact of the e-learning strategy on pedagogical issues.

### 4 Findings on pedagogical Aspects

In accordance with section 2, this section deals with two issues of evaluating the e-learning study. On the one hand, selective learner characteristics are examined in two ways, for all participants and for the students of each course. On the other hand, the factors relevant for the learning process are analysed for each e-learning strategy. For both approaches, all data collected during and after the e-learning phase is exploited.

#### 4.1 Assessing the Learner Characteristics

The following findings on the learner characteristics are mainly deduced from the post-questionnaire, where the students had to evaluate and rate certain statements. As the literature manifests that the students' self-assessment of learning behaviour is often wrong and psychological tests are more reliable, it has to be said that the statements of this questionnaire are easy to understand and formulated in the way that the students hardly can infer one of the learner characteristics. Furthermore, the questionnaire was performed right after the end of the e-learning phase, so that significant differences between the courses might be found. After all, the results of the post-questionnaire concerning typical learner characteristics are summarised in Table 1.

Self-assessment of Learner Characteristics	Overall ( $\bar{x}/\sigma$ )	Course A ( $\bar{x}/\sigma$ )	Course B ( $\bar{x}/\sigma$ )	Course C ( $\bar{x}/\sigma$ )
1. Extensive prior knowledge about topic	3.7/1.0	3.7/0.9	3.6/1.3	3.8/0.9
2. Interest in the course's topic	3.1/1.2	2.8/1.3	3.2/0.9	3.3/1.2
3a. Preferring online learning to reading printouts	1.8/0.9	1.8/1.0	1.9/1.1	1.7/0.9
3b. Preferring online tests to written exams	2.9/1.2	2.8/1.4	2.5/1.2	3.3/1.1
3c. Preferring open-ended to closed questions	3.5/1.1	3.5/1.3	3.2/1.1	3.8/0.9
3d. Preferring learning within a group	3.1/1.1	2.8/1.1	3.5/1.0	3.1/1.0
3e. Preferring interactive elements	3.0/1.1	2.8/1.2	3.2/0.8	2.9/1.3
4a. Acquiring knowledge by typical cognitive processes (structuring, summarising)	4.0/1.0	4.2/0.7	3.8/1.3	4.0/1.0
4b. Intensively studying complex content	4.2/0.9	4.5/0.7	4.1/1.0	4.0/1.1
4c. Need to practice new skills	3.9/0.9	4.2/0.9	3.9/0.6	3.7/1.0
4d. More wholist than analyser	3.5/1.2	3.7/1.3	4.1/0.9	2.8/1.2
4e. More imager than verbaliser	3.5/1.1	3.7/1.0	3.3/0.8	3.5/1.0
5a. Understanding background by research or questions (related to Kolb's "converger")	2.9/1.0	3.3/1.0	2.7/0.9	2.6/1.1
5b. Meaning-oriented learning of important concepts (related to Kolb's "assimilator")	4.4/0.7	4.5/0.8	4.6/0.5	4.2/0.7
5c. Tying up to own experiences (related to Kolb's "diverger")	3.9/0.9	4.2/0.7	3.7/0.9	3.8/1.1
5d. Finding practical examples for theoretical content (related to Kolb's "accommodator")	4.1/0.8	4.4/0.7	4.2/0.6	3.7/1.0
6. Easy to be motivated by game-based elements or competitions	3.3/1.3	3.5/1.3	2.9/1.3	3.6/1.2
7. Preferring autonomous to teacher-driven learning	3.1/1.1	3.2/1.2	3.3/0.9	2.7/1.2

**Table 1: Results of the Post-questionnaire concerning the Learner Characteristics (each statement rated with a number between 1 and 5 comprising the range from "absolute disagreement" to "strong agreement")**

Considering prior knowledge (1) about the course's topic, most students agreed with this statement and meant to have good experiences and knowledge within the course's domain. This can be reasoned due to the students' experiences from their jobs as well as to former lectures dealing with a few parts of the learning content. The even distribution across the three courses may be a result of the students' assignment to the courses described in section 3. While the overall interest on the online course (2) is rather average, students of behaviourist e-learning strategy seem to be less interested in the topic than the other students that mastered the course with group tasks.

The students' preferences (3a-e) underlie some surprises. First of all, students through all courses strongly dislike learning on the screen. Secondly, their attitudes towards preferring online tests to written exams differ from disagreement in course B to a slight agreement in course C. Similarly, students of course C more strongly agree on preferring open-ended to closed questions than students of course B. Furthermore, students of the behaviourist approach are slightly negative about learning in a group, while the students of the other courses are positive about it. Applying interactive elements seems to be neutral and evenly distributed amongst the students of all courses.

Summarising the findings on cognitive styles (4a-e), the students' ratings for the statements were rather high, which means they agreed about acquiring knowledge by typical processes or the need to practice new skills. The self-assessment of the so-called WAVI-factors outlines that students consider themselves to be more wholist

and visualiser. Particularly, the wholist factor shows strong differences between course A and B to course C. Nevertheless (Phillips, 2005) states that learners are – for different reasons – not good judges of their style and that even psychological tests are not fully reliable in assessing cognitive styles.

Referring to Kolb’s learning style inventory, four questions (5a-d) focussed on evaluating the students’ learning behaviour by means of being more active or reflective in the learning process as well as thinking in a more abstract or pragmatic way. Overall, the students participating in the three courses see themselves as rather reflective learners, while there is no clear tendency for abstract or pragmatic thinking. Analysing the groups of the three courses, students of course A seem to rate their attitudes towards diverging and converging higher than the participants of the other courses. In contrary, students in course C do not consider themselves being as good accommodators as in the other courses. Generally, these results of the students’ self-assessment are unreliable due to the reasons stated above for the ratings of the WAVI-factors.

Concluding the results of the post-questionnaire, both game-based elements (6) as well as autonomous learning (7) are rated neutral by the overall class. Hence, students of course A and C are more convinced of the fact that game-based elements improve their motivational states slightly. On the other side, self-directed learning is seen much more positive in course A and B – the two courses mainly driven by the teacher – than in course C, which implemented a constructivistic approach.

Finally, it has to be stated that background knowledge was considered by the teacher in three ways: Firstly, the course was given in German, the students’ mother language. Secondly, the teacher introduced the students to the Moodle platform in the lecture, before the e-learning phase was started. Thirdly, the students attended a technology-focused study for two and a half year. Overall, the students should not have had problems with the course’s language as well as with the usage of the system. Analysing the questions about the system’s usability and the quality of the learning material, these two aspects were – excluding some problems about using the WIKI module in course B – not mentioned at all by the participants. In contrary, students stated that the Moodle platform can easily and intuitively be used.

#### 4.2 Analysing the Factors of Learning

Considering the factors influencing the learning process (see subsections 2.1 and 2.3), two sources are of relevance for the findings of this analysis: (a) the distribution of the students’ activities, and (b) the students’ ratings of the statements of the post-questionnaire.

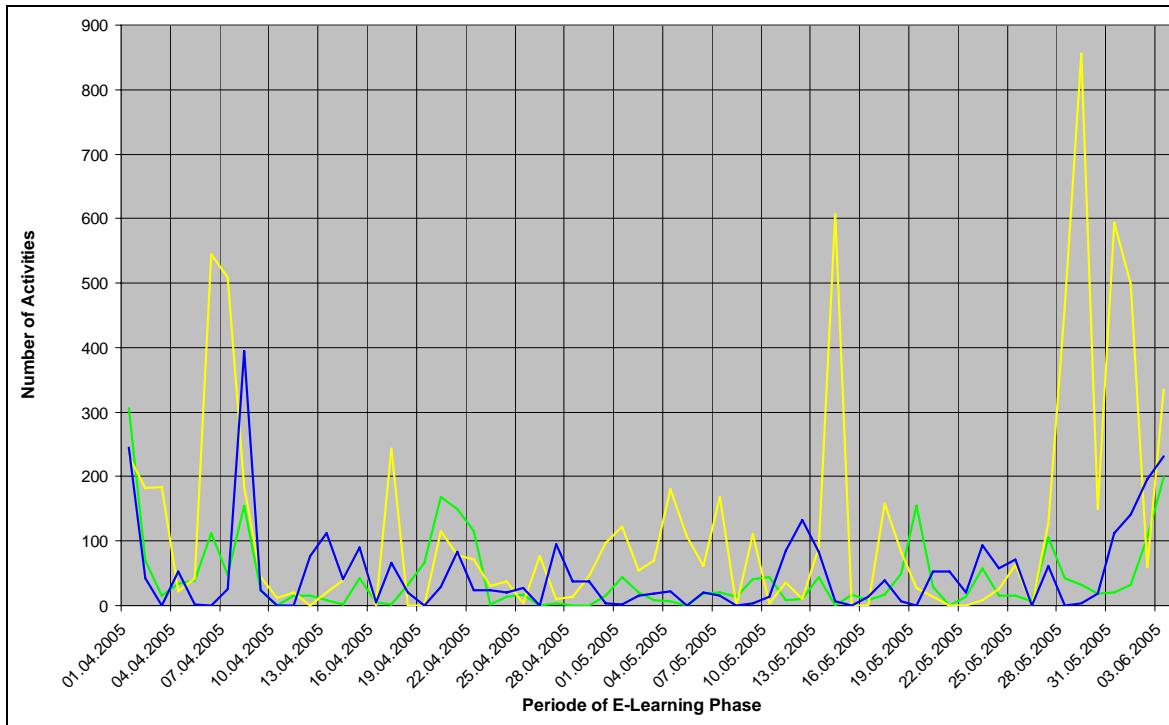
Characteristic	Course A	Course B	Course C
Students’ self-assessment of average effort [in h]	12.2	9.4	7.6
Students’ self-assessment of mastering objectives	92.9%	46.8%	74.3%
Students’ self-assessment of the necessity for the lecturers notes	68.8%	31.3%	62.1%
Students’ self-assessment of using external material	14.3%	43.3%	29%
Students’ self-assessment of learning alone rather than in a group	96.9%	69.2%	98.8%
Results of the concluding exam	54.8%	37.4%	43.2%
Overall number of the students’ activities	2696	8037	3162

**Table 2: Characteristics of the three Courses based on the Students’ ongoing Documentation about Learning and raw Database Queries within the Moodle System**

Analysing the **students’ attention** within the online courses, the distribution of the course activities and certain characteristics is useful, but does not cover all findings concerning attention. Particularly, it is not possible to infer something about the students’ behaviour while learning offline. Nevertheless, Table 2 (the courses’ characteristics) as well as Figure 1 (overall number of students’ activities) document that students of course B had to work much more with the Moodle system than the participants of the other courses. Interpreting the results of the concluding examination in this context, the high degree of learning within the Moodle platform does not really imply a high degree of attention, because students of course B performed worse than others. Further, several students of this course stated that the WIKI module lacks of good usability and they had to concentrate more on the tool than on the learning content. Thus, good usability of a learning management system is an important factor for a high degree of the students’ attention and adequate results in learning.

**Emotional states** of the students can be summaries by three observations: Firstly, the instruction to upload a photo of each student as profile avatar causes a lot of activities in the discussion groups of all three courses (see

lines in Figure 1 around the 5<sup>th</sup> of April). Students considered this to hurt their privacy; some started emotionally driven discussion threads, while others refused to upload a valid photo. Secondly, the evaluation of course B was worse than the one of the other courses due to the usability problems and the higher effort resulting already depicted. Thus, several rather emotional comments such as “I hate e-learning”, “The task is senseless”, etc. were written down in the post-questionnaire, while students in the other two courses were not that offensive and negative. Further, the higher effort compared with the other courses was criticised (see Table 2). Thirdly, the curiosity about the learning content was rather neutral and evenly distributed over the three courses (see statement 1 in Table 3).



**Figure 1: Distribution of the students' activities for the courses A (green), B (yellow), and C (blue)**

The students' **motivation** for learning is examined by the following three findings: Firstly, in course A the deadlines (see the green line in Figure 1 around the 21<sup>st</sup> April, the 19<sup>th</sup> May, and the 2<sup>nd</sup> June) are more obvious than in the courses implementing group works (see the yellow line around the 6<sup>th</sup> May and the 2<sup>nd</sup> June as well as the blue line around the 13<sup>th</sup> May and the 2<sup>nd</sup> June). Due to the increasing activities ahead of the deadlines, it seems that a behaviouristic approach enforces students to accomplish the examination right before the module ends. Secondly, each course included some motivational elements as stated in section 3 as well as some statements about the necessity to reach the objectives. Yet, students of the courses A and C meant to master the objectives better than the participants of course B, which highly correlates with the results of the concluding exam (see Table 2). Thirdly, the motivation to complete the tasks was, according to the questionnaire's statement 2 (see Table 3), average in course A and slightly negative in the courses B and C.

Self-assessment of Learner Characteristics	Overall ( $\bar{x}$ / $\sigma$ )	Course A ( $\bar{x}$ / $\sigma$ )	Course B ( $\bar{x}$ / $\sigma$ )	Course C ( $\bar{x}$ / $\sigma$ )
1. Curiosity about learning content	3.1/1.1	3.2/1.3	3.0/1.2	3.2/1.0
2. Strong motivation to accomplish the tasks	2.6/1.0	2.9/1.0	2.5/1.0	2.4/1.1

**Table 3: Results of the Post-questionnaire concerning the Factors relevant for Learning (each statement rated with a number between 1 and 5 comprising the range from “absolute disagreement” to “strong agreement”)**

Aspects of prior knowledge were already examined in the last subsection. Moreover, the teacher considered the **tying up to prior knowledge** by giving practical and well-known examples for theoretical learning content as

well as cross-references to other lecturers. According to cognitivism, issues concerning **remembering and forgetting** were realised only in course B. Yet, these considerations seemed to have failed due to the bad learning results of this course. Finally, **feedback and tutoring** for each course differed depending on the three learning theories: While it was necessary to actively stimulate the participants' learning in course A, students of course B required immediate feedback about the completed tasks. In course C, the teacher had to suppress any comment on the works submitted. Overall, the three courses as well as the learning outcomes differed in several aspects of the learning process as shown in this section.

## 5 Conclusions and Recommendations

To conclude this paper, I have to outline that learning is a very complex process depending of various factors and influences with each of them concerning especially the learners themselves. Thus, an instruction implementing online courses has to consider two relevant aspects: On the one side, the target group of a course needs to be analysed by means of the learner characteristics. If required, the teacher might also apply some classroom assessment methods to assess certain information about the learner within the learning process. On the other side, it is necessary to adapt the learning process towards the findings about the learners. Yet, it is not worth evaluating all characteristics, whether the effort to assess one is too high or the relevance or applicability to serve as a basis for adapting of the learning process is missing.

Summarising the study, it was shown that each e-learning strategy following one of the commonly known learning theories – the Behaviourism, the Cognitivism, and the Constructivism – is realisable for an online course within the scope of adult education. Further, each didactical strategy has a more or less strong impact on the factors influencing the learning process and the self-assessing of learner characteristics. For applying one of the e-learning strategies, it is recommended to analyse certain learner characteristics, particularly prior knowledge and motivation, to prevent the learners from failing to finish the course and to assess various characteristics to optimise the learning process. Nevertheless, there are also some didactical aspects to be considered for realising an e-learning strategy. Issues such as the impact of the learning objectives determined or the assessment strategy implemented have to be examined as part of my future work.

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