

(DIS-) SATISFIERS FOR E-LEARNING USER INTERFACES

Completed Research Paper

Margit Kastner

WU Vienna

Institute for Tourism
and Leisure Studies

Augasse 2-6, 1090 Vienna
Austria

margit.kastner@wu.ac.at

Brigitte Stangl

HTW Chur

Institute for Tourism
and Leisure Research

Commercialstrasse 22, 7000 Chur
Switzerland

brigitte.stangl@htwchur.ch

Abstract

With the growing importance of e-learning and increased competition among e-learning providers, website designers must cater to users' needs more accurately. Interfaces need to provide the features users demand to experience an optimal learning environment. This empirical research investigates whether the function of specific e-learning features are either basic, performance related, indifferent, or attractive. The Kano model is applied to examine the impact of 73 e-learning features on satisfaction. 1,034 completed questionnaires from an online survey distributed to economics and business students are the basis for the assignment to the Kano factors. Results show that among others, basic features include learning statistics, sample exams, and video-taped lectures. Educational videos are seen as an attractive factor. In terms of different groups of learners, findings confirm that Bachelor students are more demanding than Master and Doctoral students. Additionally, importance ratings allow recommendations for an implementation sequence for the features examined.

Keywords: Interface design, e-learning features, Kano model

Introduction

Knowledge and skills of citizens are seen to be essential for the strength and growth of an economy, its productivity, growth of jobs (Bell 1973), social cohesion, and quality of life (Sampson et al. 2002). In knowledge-based economies it is not surprising that education, continuous training, and updating of skills are perceived to be imperative (Advisory Committee for Online Learning 2001). This fact is reflected in expenditures of more than two trillion dollars worldwide for all forms of education (Clarke and Hermens 2001). E-learning represents the fastest growing sector (Hezel Associates 2005) as it is an integrated part of life-long learning and the reduction of time and space barriers (Poehlein 1996). Consequently, e-learning is an important tool in many organizations and companies (Hoppe and Breitner 2003). Unfortunately, schools and universities often take less advantage of e-learning than enterprises such as financial service providers, the automobile industry, and retailers (Payome 2002); until the early 1990s there were only 20 universities worldwide that used e-learning technologies (Huynh et al. 2003). However, cheaper computers, email, the Internet, and widespread Internet-access have changed the pedagogical structure of universities (Parker and Gemino 2001). E-learning has become more and more an alternative to face-to-face education (Huynh et al. 2003) such that the percentage of universities offering online courses increased from one third in 1995 (National Center for Educational Statistics 1997) to two thirds in 2005. In 2005 higher academic institutions educated about 2.35 million undergraduate and graduate students via e-learning (Allen and Seaman 2005).

A prerequisite for the success of e-learning courses are well-designed system interfaces providing pedagogically valuable features. In order to avoid unprofitable investments through the implementation of features not demanded by learners, interface designers need to have an understanding of the basic components or frameworks which constitute an e-learning system (Hoppe and Breitner 2003; Huynh et al. 2003). Knowing what learners want and need from a learning system is essential to successful implementation and such knowledge must be regularly updated because these requirements change over time; e-learning systems, like other computer systems, must adapt to technological advances (Ismail 2001).

In terms of the development of e-learning systems, the first generation more or less focused on the allocation of content; in contrast, contemporary systems are forced to be service-oriented, dynamic, and interactive (Dagger et al. 2007). Thus, e-learning system designers must decide which of the numerous available features (e.g., Brasher et al. 2008; C4LPT 2010; Clarebout and Elen 2006; Conole 2007; De Corte 2001; Hannafin et al. 1999; Jonassen 1999; Rist and Hewer 1996; Seufert and Euler 2005; Wouters et al. 2008; Zhang and Dran 2001) should be implemented for which target groups. Due to the large amount of existing features it is essential to choose features (e.g., tools to control the learning progress, collaboration, and communication) that optimally assist learners (Ardito et al. 2006). So far there are only very few e-learning system suppliers tapping the possibilities that the Internet provides with respect to delivering such features (Sigala and Christou 2002). In fact, we are still in a phase of experimentation concerning the design of successful e-learning interfaces and environments; a circumstance that is arguably reflected in the high drop-out rates of people attending online courses (Barolli et al. 2006; Carr 2000; Frankola 2001). In the light of the dynamic development of technology and features respectively, only theory-driven and user-based development of e-learning systems secure effective learning environments that result in high participation and graduation rates (Zhang and von Dran 2000).

All of these reasons call for more knowledge regarding successful interface design of e-learning systems. Well-designed interfaces differ in terms of the technical, pedagogical, and individual needs of their learners (Sigala 2001; 2002). As users' computer, Internet, and e-learning experience and skills increase, expectations pertaining to system functionality are raised (De Marsico & Leviardi, 2004). There is also evidence that features provided by e-learning systems need to be chosen carefully because offering all available features on one single site overtaxes the user, which can in turn result in dissatisfaction (Perfetti 2001). Thoughtless and unplanned implementations, without consideration of user characteristics and learning processes, cause information overload and system failure (Bondarouk and Ruël 2010). The design, as well as the features provided, must be customized based on the requirements and needs of target users (Visciola 2003).

Many studies deal with the design and usability aspects of e-learning systems (Norman 2002; Shneiderman 2003), but designers get no scientific advice in regard to which features are standard, which

trigger satisfaction, and which result in the dissatisfaction of users. Generally, e-learning system designers provide a selection of features without knowing the impact of these features on learners' satisfaction. With the vast variety of available features it is like a never-ending trial and error procedure trying to find the most appropriate interface design (Zhang and Dran 2001; Zhang and von Dran 2000). While some features may not be used and only clutter user interfaces, there may be unimplemented features that would significantly contribute to learners' satisfaction. Consequently, the aim of the present project is to reveal the perceived importance of certain e-learning features in the e-learning context of social science, more precisely, of economics and business. The contribution of the study is manifold: i) 73 e-learning features are classified into "basic", "performance", "surprise", and "indifferent" factors; ii) contributions of each feature to satisfaction and dissatisfaction, in cases of availability and non-availability respectively, are presented; iii) importance ratings are obtained that may guide managerial decisions on the sequence of feature implementation, particularly for the social sciences; iv) the usefulness of the Kano model for examining the relevance of system features is debated.

The remainder of the article starts with a review of existing literature on interface design for e-learning systems and an introduction to the Kano model. Next the methodology is described, followed by the procedure of data analysis. The results section includes a sample description, the assignment of features to basic, performance, surprise, and indifferent factors, aggregated results based on Better-Worse ratios, and importance ratings. Additionally, differences between user groups (i.e., Bachelor, Master, and Doctoral students) are highlighted, taking into account the time of a feature's implementation in the system, which implicitly influences the frequency of usage (life cycle). Finally, results are theoretically discussed and managerial implications are provided.

Literature Review

Interface Design for E-Learning Information Systems

Information systems (IS) are developed to assist people with specific problems (De Marsico and Levialdi 2004). E-learning systems, for instance, are intended to support the learning process and knowledge acquisition. Since e-learning was first developed, technology has changed dramatically. The first e-learning generation concentrated on providing printed materials (Dagger et al. 2007; Taylor 2001) enabling self-paced learning anytime and anywhere (Coffey 1990). Its downside was that students experienced limited interaction with lecturers and classmates (McKee 2010) and therefore these systems did not add any value to the learning process (Ismail 2001). In recognition of this drawback, e-learning was enriched by audio and video, and after advances in information technologies, synchronous elements of learning such as audio- or video-conferencing were offered (Taylor 1995). Contemporary e-learning systems allow personalization, online connection with colleagues, sharing, and synchronous co-editing of documents (McKee 2010). Many different features have been introduced to enrich the e-learning environment by providing add-on advantages for learners. According to Ismail (2001) many e-learning projects face the problem that development becomes purely technical, resulting in the implementation of features that are not needed, and consequently not used by learners.

An essential measure of educational software quality, satisfaction, acceptance, and future usage, is the design of the user interface (e.g., Davis et al. 1989; Venkatesh et al. 2003). User interface design is defined as "*the structural design of an interface that presents the features and instructional support of an [IS]*" (Cho et al. 2009). Chou (2003) argues that in the context of e-learning, human-interface-interaction is the most important issue for the quality improvement of education. A good user interface design comprising features that are desired and needed motivates learners to capture information, produces interest, and improves learning performance, which in turn encourages course completion (Mendez et al. 2006). The huge impact of poor interface design is also highlighted by Crowther et al. (2004) who argue that design is even more important in an e-learning environment than in business. The cognitive load theory (Sweller 1988) explains that badly designed user interfaces cause excessive strain for learners. There are two dimensions of cognitive load: intrinsic cognitive load is related to the content of the learning material, while extraneous cognitive load is connected with the way content is displayed (Martin-Michiellot and Mendelsohn 2000; Paas et al. 2003; Sweller 1988). When content is provided or displayed, a student's level of knowledge should be considered since the cognitive load differs depending on whether the learner is a novice or an expert (Paas et al. 2003). Furthermore, the interface design has to be in accordance with

the aim of learning; factual learning demands different interface design than problem-solving tasks (Kekkonen-Moneta and Moneta 2002). Cognitive load may be reduced by providing learning materials with increasing levels of difficulty, or by giving step-by-step instructions for the solution of problems (Paas et al. 2003).

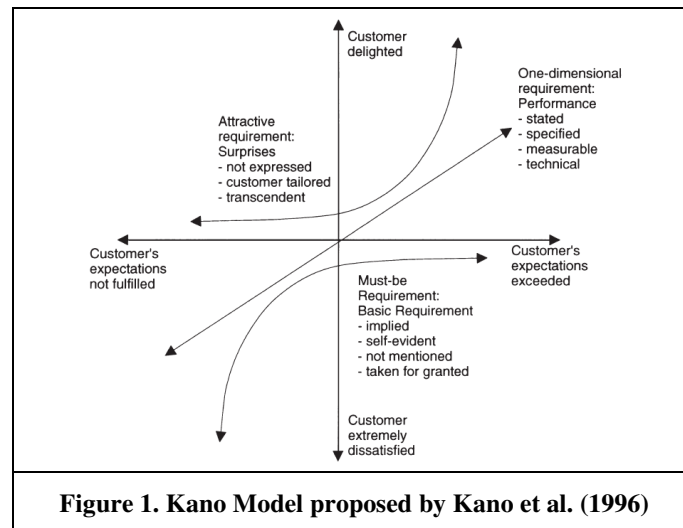
In order to ensure that IS translate features and operations in a clear and satisfying way, standards and evaluation criteria (e.g., ISO 1992; Nielsen 1999; Shneiderman 2003; Shneiderman and Hochheiser 2001; Visciola 2003) require that design aspects concerning information presentation, access, and informative content architecture are adapted according to the objectives of the system and the needs of the target group/s (Sullivan 1997). Norman (2002) suggests a design that matches the users' mental model to facilitate interaction between the user and a system. However, checklists and evaluation guidelines do not assist designers in deciding which design factors and features are essential for a specific website (Alexander and Tate 1999). An empirical study by Zhang and von Dran (2000) contributes to this gap by examining hygiene and motivator factors based on the theory of Herzberg (1968). In the context of the CNN.com website, they examine the contribution of the perception of 44 core design aspects to dissatisfaction in the case where these aspects are not available (hygiene factors), and the contribution to satisfaction when the aspects are provided on the website (motivators). They argue that both hygiene and motivator factors should be considered and that designers must be aware that hygiene factors are prerequisites for motivators. Zhang and von Dran (2001) also conducted a study based on the Kano model (Kano et al. 1996) to identify the impact of quality features in a web environment. However, each of these studies focus on the perception of interface design constructs and not on technical features, or so called "concrete cues", available for implementation in a system or on a website (Parasuraman et al. 2005).

Usually Davis' (1989) famous technology acceptance model (e.g., Arbaugh 2002; Liu et al. 2010; Pituch and Lee 2006), and extensions of it, are applied to examine the perception of e-learning environments (e.g., Cho et al. 2009; Lee 2006; Roca et al. 2006). Often design is reflected in the construct's ease of use and perceived usefulness. Others investigate the design construct explicitly. Sun et al. (2008) for instance, include student characteristics, instructor, course, technology, design, and environment as antecedents of satisfaction. Concerning features provided, a literature review by Clarebout and Elen (2006) uncovers 17 studies dealing with the relationship between student characteristics and the usage of specific features, and five studies addressing influence of the usage of features on students' performance (Carrier et al. 1985; Gräsel et al. 2000; Renkl 2002). Furthermore, research shows that a features' type (e.g., downloading, bookmarking, or visualization tool) influences the usage (Fischer et al. 2001; Oliver and Hannafin 2000). To gain insights into the impact of different features, most of the studies analyze log files and track the usage of the feature. A drawback of this method is that only frequencies of usage of a certain type of feature are considered. The question of whether features are suitable, or even needed by students, cannot be answered by applying this approach. Other methods applied are surveys, observations, and think-aloud procedures, which can gain better insights into the adequacy of usage (Clarebout and Elen 2006). Inadequate usage of embedded features, for instance, is revealed by Greene and Land (2000) through qualitative analysis. However, no studies examine which features should be implemented into an e-learning system for economics and business students in order to reduce dissatisfaction (basic factors), to linearly increase satisfaction (performance factors), or to surprise learners if features are provided but do not dissatisfy them if they are not offered (surprise factors). This is a challenging task because a huge variety of e-learning features exist. Several authors make an effort to categorize existing features based on the activity a feature supports during the learning process (Clarebout and Elen 2006; Hannafin et al. 1999; Jonassen 1999). More recently, seven categories have been suggested based on previous categorizations and a qualitative study, namely, information presentation, information search and filtering of data, communication and collaboration, continuous learning progress control, learning support, evaluation (of materials and teachers), and auxiliary tools (Kastner and Stangl 2011). The present study does not focus on these categories, but examines the contribution of each concrete e-learning feature to (dis-)satisfaction by using the Kano model (Kano et al. 1996) as a theoretical basis.

The Kano Model

Previous research shows that the Kano model is a worthwhile tool for product development because it reveals latent needs (Matzler and Hinterhuber 1998; Sauerwein et al. 1996). Based on the Kano model, product attributes and features of e-learning systems, respectively, can be categorized into basic,

performance, and surprise factors. By using the Kano model, the availability and non-availability of certain features have a dissimilar impact on satisfaction (Kano et al. 1996). The unavailability of basic factors (synonym: must-be criteria) results in extremely dissatisfied learners, because it is expected that these features should be provided. The degree of availability of so called performance factors (synonym: one-dimensional criteria) impacts proportionally on satisfaction and dissatisfaction. Surprise factors (synonym: attractive criteria) are features that are not expected by learners, however, users perceive such features positively if they are available. Thus, surprise, performance, and basic features all impact on satisfaction and dissatisfaction but in different ways and with varying intensity (see Figure 1). A feature that causes neither satisfaction nor dissatisfaction regardless of its fulfillment is called an indifferent factor.



Direct questioning techniques are not sufficient to detect the different categories mentioned in the Kano model (Kano et al. 1996), because an explicit question pertaining to the impact of a feature on satisfaction would overtax survey participants. Furthermore, basic factors, for instance, can only be stated if they are not satisfying or if they are not implemented at all, since learners are not aware of them because they are perceived as standard. Surprise factors often are only in the awareness set if they are actually available, thus, a direct questioning technique is not much help. For the evaluation procedure proposed by Kano (1984) it is necessary to question users twice: about their satisfaction if a feature is available, and their dissatisfaction if it is not available. Afterwards the results can be combined and in this way the impact of features can be revealed indirectly.

It is worth mentioning that Kano (2001) provided evidence that successful products follow a life cycle from indifferent to surprise to performance to basic (i.e., indifferent --> surprise --> performance --> basic), and that unsuccessful products remain as indifferent. In other words, features that are not perceived as useful or accepted by the students stagnate in the indifferent phase. Nilsson-Witell and Fundin (2005) empirically tested the life cycle of different e-services. They discovered that e-services are experienced as indifferent factors right after the time of implementation. When some time passes by, most customers perceive these services as a surprise; only the segment of early adopters already evaluates them as performance or even basic factors. Nilsson-Witell and Fundin (2005) also tested an alternative life cycle, namely, a shift from indifferent to performance and back to indifferent (i.e., indifferent --> performance --> indifferent).

Closely linked to the concept of the life cycle is the adoption curve of a service, product or feature, respectively. Parasuraman (2000) identifies that the degree of technology readiness is crucial for the adoption of an e-service, in the sense that early adopters have a higher degree of readiness. Therefore, early adopters who use products/services first are more demanding than the group of followers and laggards. Customer groups in the different stages of adoption can be used as a way to exhibit life cycle dynamics. Additionally, dynamics are influenced by the frequency of usage (Nilsson-Witell and Fundin 2005).

Methodology

In a preliminary study, a sample is gathered of 20 e-learning systems offered by privately owned enterprises and universities from English and German speaking countries. Further system selection criteria are quality labels (e.g., EQUIS) and size of the enterprise. Based on a literature review and online search, a catalog of criteria comprising available features is compiled and this catalog is systematically used to evaluate the sample of 20 e-learning systems. The initial catalog is extended where new features appear in the examined systems (Früh 2007; Krippendorff 2004), and the resulting list of features is sent to ten e-learning experts at our university requesting their feedback regarding the catalogue's completeness and correctness in respect to contemporary e-learning features. This procedure produced a list of 73 e-learning features (Kastner and Stangl 2011). In a further step, an online questionnaire based on the approach by Kano (1996) is developed. For the present study an online survey is more appropriate than a paper-and-pencil survey because the whole population of students has access to the Internet (Sax et al. 2003). Since the students surveyed are all from the Vienna University of Economics and Business and are familiar with the University's e-learning system, no explanation regarding the system itself is necessary in the survey. Students are asked to complete the questionnaire with the e-mail invitation highlighting the incentive that their participation will assist in the development of the e-learning system that they will use during their studies. The questionnaire is designed in a way that the features are designated by their names. For interviewees who are not familiar with certain features, written definitions appear by moving the mouse over the name of the respective feature.

Respondents evaluated the 73 features three times. First it is asked how one feels if a certain feature is available (functional question). Second, the feeling if a feature is NOT available is queried (dysfunctional question). The response scale used for functional and dysfunctional questions is a German translation by Bailom et al. (1996) („Das würde mich stören“, „Das könnte ich in Kauf nehmen“, „Das wäre mir egal“, „Das würde ich voraussetzen“, and „Das fände ich gut“). This is in fact an adaptation of the original scale by Kano (1984) “I like it that way”, “It must be that way”, “I am neutral”, “I can live with it that way”, and “I dislike it that way”. Due to the fact that several authors report that not all features are equally important within one single category proposed by Kano, features are assessed a third time. As suggested, Kano's method is combined with a self-stated importance ranking to increase the discrimination among customers' requirements (Berger et al. 1993; Lee and Newcomb 1997; Sauerwein 1999; Yang 2005). The authors of this study include questions to rate the importance of the features, following the procedure proposed by Yang (2005). In order to decrease frustration and to reduce confusion, the introductory text to the study includes an explanation that all features will be evaluated three times due to the indirect measurement technique employed.

To profile social science students of a university of economics and business the last part of the questionnaire comprises several control variables such as age, gender, degree program, and study progress. Additionally, we control for learning styles based on items borrowed from the VARK (i.e., V=visual, A=aural, R=read and write, and K=kinesthetic) questionnaire by Fleming and Mills (1992).

Two pretests are undertaken: the first to reveal which features require definition within the questionnaire, and the second to assure comprehensibility and correctness of definitions and questions. An invitation to participate in the study was distributed at the end of December 2010 via the University's mailing-list which includes 27,835 e-mail addresses. A follow-up mail was distributed in January 2011. Altogether the field period lasted about one month. In order to increase the response rate, attractive incentives, including a city break worth €300.00, two iPod Touch devices, and three iPod Shuffles, were raffled.

Analysis

Due to the specific survey technique it is necessary to recode the data accordingly before doing any calculations. Each answer from the functional and dysfunctional questions can be transformed into one of the following evaluation categories: attractive (A), must-be (M), reverse (R), one-dimensional (O), indifferent (I), and skeptical (S). Further explanations about these categories and how the data matrix has been established are presented in Table 1.

Table 1. Evaluation Table by Kano et al. (1996)						
Product requirements		Dysfunctional (negative) question				
		like	acceptable	no feeling	must-be	do not like
Functional (positive) question	like	S	A	A	A	O
	acceptable	R	I	I	I	M
	no feeling	R	I	I	I	M
	must-be	R	I	I	I	M
	do not like	R	R	R	R	S

A: Attractive evaluation – satisfied when fulfilled, no feelings when not fulfilled
M: Must-be evaluation – dissatisfied when not fulfilled, no feelings when fulfilled
R: Reverse evaluation – dissatisfied when fulfilled, satisfied when not fulfilled
O: One-dimensional evaluation – satisfied when fulfilled, dissatisfied when not fulfilled
I: Indifferent evaluation – neutral towards the feature regardless of the fulfillment
S: Skeptical evaluation – questionable that students understood the meaning of the feature

The easiest way to inspect a data matrix such as Table 1, is through an interpretation based on frequencies of answers. However, quite often this evaluation falls short because answers are spread out over more than one category, a situation that can be caused by different expectations of various segments (Matzler and Hinterhuber 1998). Previous literature provides guidelines on how to handle such circumstances. Table 2 summarizes recommended indices/decision rules and their intended objectives.

Table 2. Indices/Decision Rules Assisting Data Analysis	
Index / decision rule (Reference)	Intended objective
Type of Quality (Gitlow 1998)	Distinction between satisfaction and dissatisfaction.
Total Strength (Lee and Newcomb 1997)	Classification of features due to their importance.
Category Strength (Lee and Newcomb 1997)	Increases clearness of the classification.
Customer Satisfaction Coefficient (Berger et al. 1993)	Facilitates interpretation.
Evaluation rule (Sauerwein et al. 1996)	Sheds light on the sequence of implementation.

Type of Quality: Gitlow (1998) points out that people who assign a feature to category A, O, or M say that they need the feature to be satisfied and/or they do not want to be dissatisfied. On the other hand, if the evaluation results in R, I or S, then they are either dissatisfied if the feature is implemented or it does not affect them. Another possibility is that they do not understand the feature or are careless when filling out the questionnaire. To take these considerations into account it is worth estimating the Type of Quality (ToQ) by applying the following equation:

$$\text{ToQ} = \begin{cases} \max(A, O, M) & \text{if } (A+O+M) > (I+S+R) \\ \max(I, S, R) & \text{if } (A+O+M) \leq (I+S+R) \end{cases}$$

Hence, first the ToQ is calculated. This means that if $(A+O+M) > (I+S+R)$ the most frequently selected category is either A, O, or M. If $(A+O+M) \leq (I+S+R)$ then it is I, S, or R depending on the frequencies of answers.

Total Strength and Category Strength: Lee and Newcomb (1997) suggest labeling the sum of A+O+M as Total Strength (TS), which shows whether a feature is seen as important by more than 50% of the respondents or not. Lee and Newcomb (1997) further suggest evaluating Category Strength (CS) to determine whether the classification of a feature is clear or not. Basis for the estimation of TS and CS are the frequencies of each category expressed as a percentage value. The difference between the highest and the next-highest percentage is calculated. In our case we use $\max(A, O, M)$ or $\max(I, S, R)$ depending on the result of the ToQ equation calculated previously. The assignment to one category is clear if the CS is above a threshold of 5%. If it is below that value, it is recommended to create a category which is a combination of the two most frequently assigned categories (Lee and Newcomb 1997; Sauerwein et al.

1996).

Customer Satisfaction Coefficient: Interpretation can be improved by calculating Customer Satisfaction Coefficients (CSC). There are two kinds of CSCs called “Better” and “Worse”. The CSC Better ranges from 0 to 1; the closer Better is to 1, the greater is the impact on satisfaction if the feature is implemented. The CSC Worse is between -1 and 0; the smaller the coefficient, the higher is the dissatisfaction if a feature is not available (Berger et al. 1993). The formulas for estimating the CSCs are:

$$\begin{aligned}\text{Better} &= (O+A) / (A+O+M+I) \\ \text{Worse} &= - (M+O) / (A+O+M+I)\end{aligned}$$

Evaluation rule: To determine the sequence for implementing features, the evaluation rule $M > O > A > I$ is useful (Sauerwein et al. 1996). According to this rule the basic factors (M) have the highest impact on dissatisfaction. Therefore, these factors need to get the highest attention and should be realized first. Next, the implementation of performance factors (O) is recommended because these features cause dissatisfaction if they are missing. Exceeding customers’ expectations is possible with surprise factors (A). Hence, surprise factors create a competitive advantage, differentiate the product, and excite customers (Ungvari 1999). Time of implementation of this third group depends on the aim of the e-learning system provider. Since the academic sector suffers from decreasing funding (Hoppe and Breitner 2003; Huynh et al. 2003), having guidelines for implementation priorities is an important benefit.

In terms of inspecting life cycle dynamics of the features, Bachelor students are considered to be early adopters. This is based on the fact that Bachelor students at the University are more or less forced to use the system since all courses are conceptualized as blended learning courses for huge classes (up to 600 students). Hence, they are obliged to use a wide variety of features from the beginning of their studies. The courses in the Master program are designed for smaller classes (on average about 30 students) and are less dependent on the e-learning system. Additionally, when Master and Doctoral students entered the University, e-learning was not that advanced. This and the fact that they use the system less frequently results in later feature adoption. Consequently, Master students are considered to be followers, and Doctoral students, who use the system even less frequently, are therefore called laggards (Roger's terminology 2003).

Results

Sample Description

Offering attractive incentive prizes resulted in the survey being completed by more than 1,000 students from a European university of economics and business. The initial and follow-up e-mails generated 1,034 usable questionnaires, resulting in a response rate of 3.7%. The age of students ranges from 17 to 65 years, with a mean of 24.4 years ($SD=5.55$). Slightly more women (54.5%) than men took part in the study. More than 70% are Bachelor students (746 BSc); most of the others are Master students (253 MSc), and there are some (3%) undertaking their Doctorate (35 Dr). Regarding study progress, one third of the students have just started their program, about 30% are in the middle of their studies, and 36% are close to finishing. These sample characteristics match that of the population of 27,835 students. Likewise, the gender statistics are also nearly equally distributed in the population (49% female, 51% male). Pertaining to degree program participation, the sample reproduces the reality of 74% Bachelor students, 21% Master students, and 5% Doctoral students. A χ^2 goodness-of-fit test proves that the gender distributions related to the degree program and the time spent at university is in accordance with the population: new Bachelor students ($n=291$ BSc-new) $\chi^2=.243$, $p=.622$; Bachelor students in the middle of their studies ($n=281$ BSc-middle) $\chi^2=3.023$, $p=.082$; Bachelor students in the final part of their degree ($n=174$ BSc-final) $\chi^2=1.972$, $p=.160$; Master students ($n=253$) $\chi^2=2.501$, $p=.114$; and Doctoral students ($n=35$) $\chi^2=.560$, $p=.454$. Thus, there is evidence that the sample is representative (Hatzinger et al. 2011).

Learning style results, based on the VARK questionnaire, indicate that the majority follows a multimodal learning strategy. Summed scores of mentioned learning styles indicate that, on average, a social science student is a multimodal learner preferring reading and writing (537.3 mentions) followed by aural learning (445.7 mentions), visual learning (278.7 mentions), and learning by doing (193.3 mentions).

Basic, Performance, Surprise, and Indifferent Factors

After the transformation of the functional and dysfunctional questions into Kano's categories, frequencies of A, M, R, O, I, and S are inspected. As expected due to the experience of previous studies (e.g., Gitlow 1998; Matzler and Hinterhuber 1998), a frequency analysis is inappropriate, as the answers of respondents are spread out over more than one category. Consequently, different indices must be calculated. By calculating ToQ indices 33 features are identified as important for implementation because in these cases the sum of (A+O+M) is higher than the sum of (I+S+R). The classification via TS, which is one part of ToQ, shows that 33 features are considered important by more than 50% of the respondents (for these 33 features $\Sigma (A+O+M) > 517$). The required threshold of 5% for the CS (Lee and Newcomb 1997; Sauerwein 1999) is not exceeded by eight features. These features include audio-books/podcasts/audiofiles, encyclopedias, home assignments, information on new elements, interactive presentations, learning-progress indicators, notification services, and online tutors. Hence, they are allocated to three different combinations of the two most frequently assigned categories in (A,O,M) or (I,S,R), namely A+M, O+A, and M+O. Table 3 presents the classification results after the inspection of ToQ, TS, and CS.

Table 3. Classification of Features Based on ToQ, TS, and CS	
Basic (M)	announcements, calendars, class schedules, discussion forums, downloadable learning resources, exercises, FAQs (regarding content), FAQs (regarding organization), file uploads, glossaries, grade books, help functions, index by topics, learning modules, learning statistics, lecture casts/video-taped lectures, printable resources, sample exams, syllabi, and worked-out examples
Performance (O)	annotated presentations, e-books, and online tests
Surprise (A)	educational videos
Indifferent (I)	(animated) pedagogical agents, 3D/virtual worlds, avatars, blogs, bookmarks, brainstorming features, calculators, chats, collection of links, desktop sharing, document processing in shared workspace, editing of calendars, e-mails, e-portfolios, file storage, graphics, group calendars, internet telephony, intranet for group work, learning games, learning reminder: benchmarking with colleagues, learning reminder: question of the day, live streaming, mind-mapping features, multilingual control elements, notepads, online office hours, online survey, peer review, real-time document processing in shared workspace, screen reader for the visually handicapped, simulations/animated visualizations, site personalization, SMS services, social networks, tagging, templates/models/grids, tool to post improvement suggestions, video conferences, webinar/online education, and wikis
Combinations	A+M: encyclopedias, information on new elements, and notification services O+A: audio-books/podcasts/audiofiles, interactive presentations, and online tutors M+O: home assignments and learning-progress indicators

Aggregated Results Based on Better-Worse

In order to see how strongly a feature influences satisfaction or dissatisfaction, the CSCs Better and Worse are calculated. Better indicates how much an available feature impacts on satisfaction, while Worse shows dissatisfaction if a feature is not offered. Due to the fact that the scale is always between -1 and 1, direct comparisons of features' contribution to (dis-)satisfaction are possible. As shown in Figure 2, features generally cause dissatisfaction rather than satisfaction, meaning that there are more features with a Worse ratio of ≤ -0.50 or lower, than there are with a Better ratio higher than 0.50 . The features accounting most for dissatisfaction when not provided are: sample exams, worked-out examples, lecture casts/video-taped lectures, exercises, downloadable learning resources, printable resources, announcements, learning modules, discussion forums, class schedules, FAQs (regarding content and organization), calendars, annotated presentations, and online tests ($Worse \leq -0.50$). Annotated presentations, educational videos, interactive presentations, audio-books/podcasts/audiofiles, and intranets for group work, pay off in terms of satisfaction ($Better \geq 0.50$). Annotated presentations have a Worse ratio of ≤ -0.50 and a Better ratio of ≥ 0.50 , meaning that they trigger (dis-)satisfaction if (not) provided.

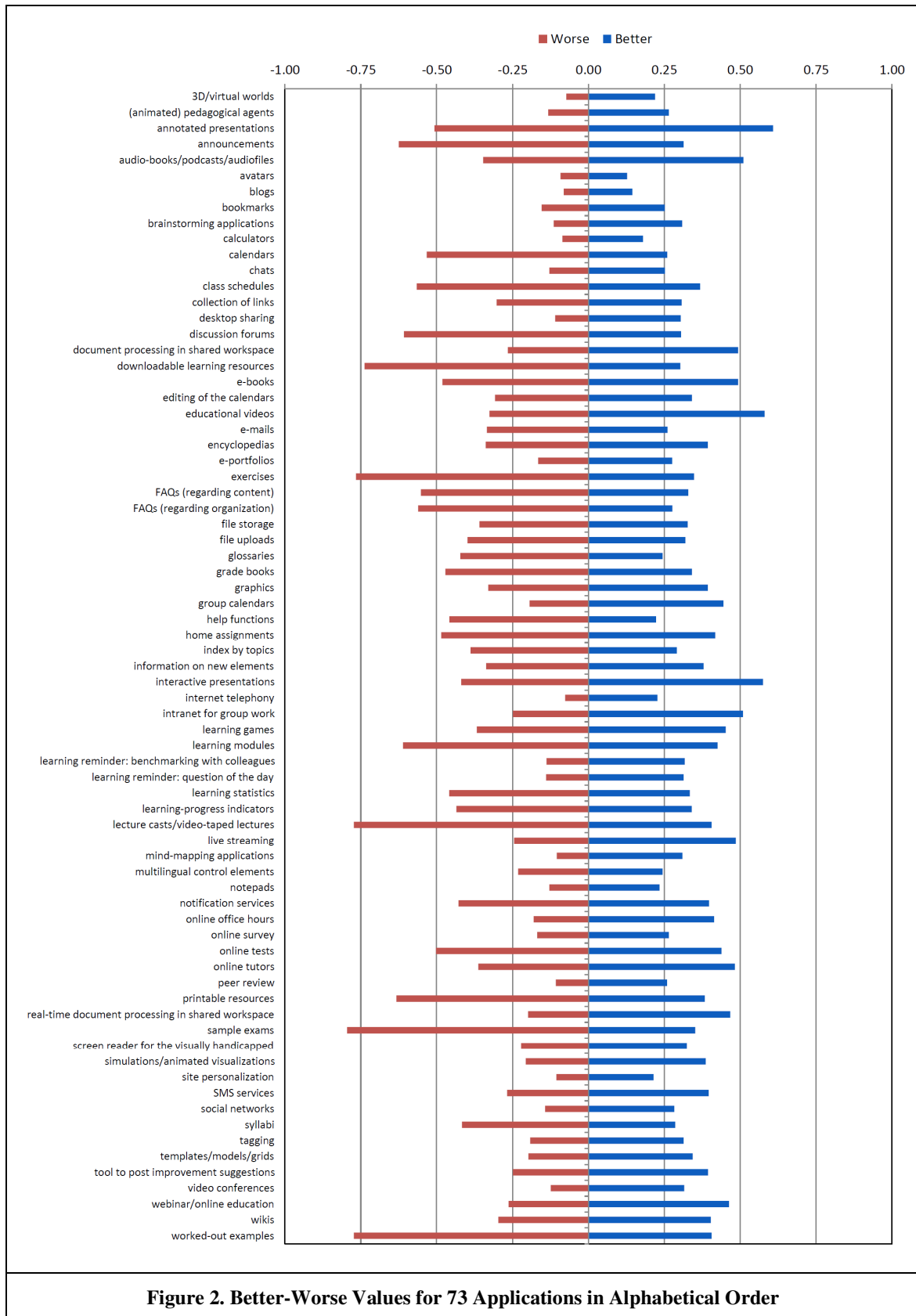


Figure 2. Better-Worse Values for 73 Applications in Alphabetical Order

Sequence of Implementation and Importance Ratings

The ideal implementation sequence of features belonging to a certain Kano factor (i.e., M, O, A, or I) is suggested in Table 3. However, so far we do not know anything about the sequence of implementation within each of the basic, performance, surprise, and indifferent factors. To give recommendations concerning this aspect, we calculate the importance of each feature following the procedure suggested by Yang (2005). Figure 3 shows that among the basic factors - that according to the evaluation rule (Elmar Sauerwein, et al., 1996), should be implemented first - most important are sample exams, downloadable learning resources, exercises, and worked-out examples, followed by learning modules, announcements, discussion forums, and printable resources. The least important among the basic factors are glossaries, file uploads, and help functions. After all basic factors are offered on a system, home assignments and learning-progress indicators (factor combination M+O) should be implemented, followed by notification services, encyclopedias, and information on new elements (factor combination A+M). Features of the factor O should be considered; followed respectively by the factor combination O+A and then factor A. Interestingly, the least important features among the factor I are chats, blogs, site personalization, calculators, 3D/virtual worlds, and avatars.

Needs of Different Segments

The questionnaire also included several variables intended to discover whether the sample includes some groups who differ in their needs. For the purpose of this paper, comparisons are undertaken between students doing their Bachelor, Master, and Doctorate degrees. The usage of the e-learning system for each group is quite different. 34% of Bachelor students use the system several times a day, and 23% once a day. Master students' usage is 14% and 15% respectively, and Doctoral students use the e-learning system even less (7% and 20%). Only 3% of Bachelor students use the e-learning system less than once a week compared to 14% of Master, and 40% of Doctoral students. A χ^2 test shows that frequency of usage is significantly different between the groups ($p < .001$). An ANOVA exhibits that most Bachelor students perceive the system as important for their studies ($\bar{x}_{BSc}=1.66$ on a 6-point Likert scale ranging from 1=important to 6=not important); Master and Doctoral students rate it less important ($\bar{x}_{MSc}=2.27$ and $\bar{x}_{Dr}=2.80$; $p < .001$). In regard to recommending the system to fellow students, the degree of agreement also significantly decreases from Bachelor to Master to Doctoral students ($\bar{x}_{BSc}=1.63$, $\bar{x}_{MSc}=2.02$, and $\bar{x}_{Dr}=2.25$; $p < .001$). Furthermore, an ANOVA confirms that Bachelor students are present at the University for less time than Master and Doctoral students ($\bar{x}_{BSc}=2.74$, $\bar{x}_{MSc}=3.43$, and $\bar{x}_{Dr}=4.03$; $p < .001$).

As already mentioned in the previous section, when investigating the whole sample, educational videos are the only surprise factor (A). A closer look at more homogenous groups gives deeper insights. While for Bachelor students educational videos remain the only surprise factor, Master students however, also rate the following features as surprise factors: audio-books/podcasts/audiofiles, intranet for group work, real-time document processing in shared workspace, and lecture casts/video-taped lectures. Doctoral students would be delighted by lecture casts/video-taped lectures, interactive presentations, online tutors, webinar/online education, annotated presentations, and online tests (see Table 4 for group differences).

Regarding basic factors (M), Bachelor students are the most demanding, nominating 18 features as must-bes. Among these are announcements, calendars, class schedules, discussion forums, content FAQs, organization FAQs, glossaries, indexes by topics, and worked-out examples. For Master students only 14 features are basic factors. Seven features are basic factors for Doctoral students, including class schedules, discussion forums, downloadable learning resources, exercises, FAQs (regarding organization), and help functions.

Features contributing to both satisfaction if provided, and dissatisfaction if not provided, are performance factors (O). Looking at Doctoral students, content FAQs, home assignments, and syllabi are O factors; for Bachelor and Master students O factors are annotated presentations and e-books. In addition, lecture casts/video-taped lectures are assigned to performance factors by Bachelor students. Table 4 summarizes all 34 (out of 73) features evaluated differently by the three segments.

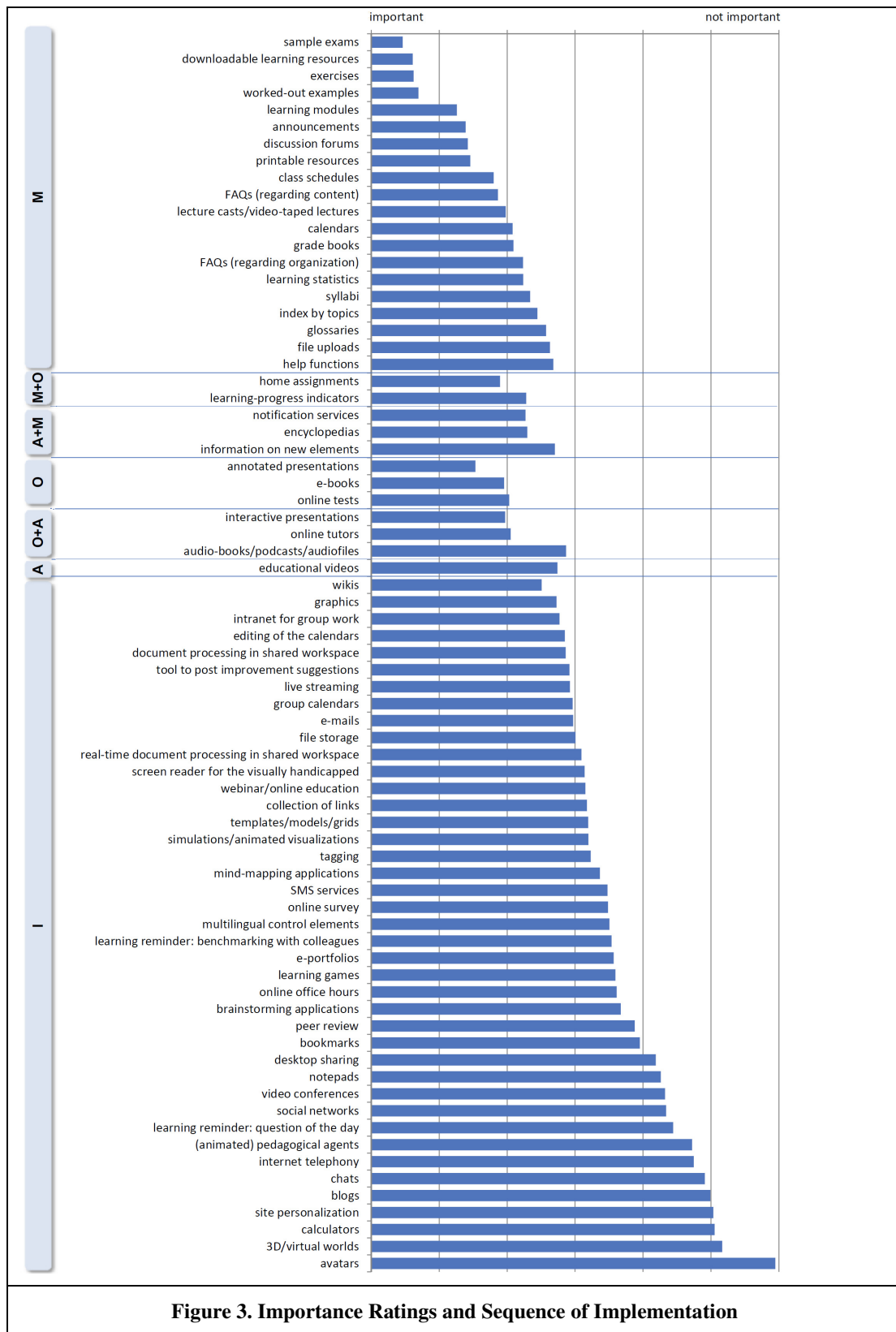


Figure 3. Importance Ratings and Sequence of Implementation

Table 4. Needs of Different Segments – Features Sorted by the Time of Implementation

Feature	All Students	Doctoral Students	Master Students	Bachelor Students
graphics ¹	I	I	I	O+A
index by topics ¹	M	I	I	M
glossaries ¹	M	I	I	M
calendars ¹	M	I	M	M
FAQs (regarding content) ¹	M	O	M	M
syllabi ¹	M	O	M	M
sample exams ¹	M	M+O	M	M
worked-out examples ¹	M	M+O	M	M
file uploads ¹	M	M+O	M	I
collection of links ¹	I	M+O	I	I
file storage ¹	I	M+O	M+O	I
class schedules ¹	M	M	M+O	M
learning statistics ²	M	I	I	M
learning-progress indicators ²	M+O	I	I	M+O
grade books ²	M	I	M	M
printable resources ²	M	M+O	M	M
learning modules ²	M	A+M	M	M
home assignments ³	M+O	O	M+O	I
e-books ³	O	M+O	O	O
annotated presentations ⁴	O	A	O	O
lecture casts/video-taped lectures ⁴	M	A	A	O
encyclopedias ⁵	A+M	I	I	O+A
learning games ⁵	I	I	I	O+A
audio-books/podcasts/audiofiles ⁵	O+A	I	A	O+A
online tutors ⁵	O+A	A	I	O+A
interactive presentations ⁵	O+A	A	O+A	O+A
notification services ⁵	A+M	A+M	M+O	A+O+M
online tests ⁵	O	A	M+O	I
webinar/online education ⁵	I	A	I	I
document processing in shared workspace ⁵	I	I	O+A	I
intranet for group work ⁵	I	I	A	I
real-time document processing in shared workspace ⁵	I	I	A	I
help functions ⁵	M	M	I	M

Note: Superscripts indicate the time of implementation on the University's e-learning platform:
¹ Feature has been available since the launch of the system in 2002.
² Feature has been added in the course of the first system advancement between 2003 and 2005.
³ Feature has been brought in the university's system around 2007/2008.
⁴ Feature introduced during the last update of the system.
⁵ Feature that is not yet implemented.

A more detailed inspection of differences between the three segments allows the investigation of considerations raised in connection with the life cycle where features pass through the following stages: indifferent --> surprise --> performance --> basic (Nilsson-Witell and Fundin 2005; Parasuraman 2000). In our case, Bachelor students are categorized as early adopters (see Analysis section for further details). Results show that they are more demanding than Master and Doctoral students.

With respect to features that are available from the system's launch (see Table 4 for the implementation time of the features), some follow a typical life cycle. For instance, index by topics, and glossary, are indifferent for Doctoral and Master students (i.e., followers and laggards), but basic for Bachelor students (i.e., indifferent --> basic). Further, Bachelor students rate several features as basic factors while Doctoral students are still in the performance stage. This development is true for content FAQs (regarding content)

and syllabi. A similar dynamic appears for sample exams and worked-out examples; accordingly, early adopters (i.e., Bachelor students) are in a further advanced stage than Master and/or Doctoral students (i.e., performance --> basic). Other features possess an alternative life cycle (i.e., indifferent --> performance --> indifferent) suggested by Nilsson-Witell and Fundin (2005). Features from first implementation of the system following this cycle are file uploads, file storage, and collection of links (i.e., performance/basic factors for Doctoral students --> indifferent factors for Bachelor students).

Features implemented in the first improvement phase of the system are learning statistics, learning-progress indicators, gradebooks, printable resources, and learning modules. These features are basic factors for Bachelor students, whereas for Master and Doctoral students they are indifferent and/or surprise factors (i.e., indifferent/surprise --> basic). Interestingly, e-books that are implemented in the second phase of system expansion are in a later stage for laggards compared to early adopters and followers. Features of the third system upgrade surprise Doctoral students but are performance factors for Bachelor students (i.e., surprise --> performance).

Finally, features not yet offered must be interpreted in a different way; it is essential to learn about each features' necessity for the respective student group. Doctoral students miss help functions (M) followed by notification services (A+M). Currently, online tutors, interactive presentations, online tests, and webinar/online education (A) features are surprise factors for Doctoral students. For Master students, notification services and online tests (M+O) are lacking features. Master students are delighted by features that assist group work (A): intranet for group work and (real-time) document processing in a shared workspace. Bachelor students are not surprised by any feature. They are dissatisfied when encyclopedia, learning games, audio-books/podcasts/audiofiles, online tutors, and interactive presentations (O+A) are not provided; interestingly, missing from this list are notification services (A+O+M) and help functions (M).

In the next step, a differentiation of Bachelor students in respect to the time they have spent at the University is further examined. Generally, the frequency of e-learning system usage does not differ between the three cohorts: new students, students in the middle of their studies, and students in the final part of their degree ($p=.058$). The importance students' assign to the e-learning system for their studies differs significantly ($\bar{x}_{\text{BSc-new}}=1.50$, $\bar{x}_{\text{BSc-middle}}=1.66$, and $\bar{x}_{\text{BSc-final}}=1.94$ on a 6-point Likert scale; $p<.001$). Regarding life cycle dynamics, students in the final part of their Bachelor program evaluate more features as basic factors than do new students (the amount of must-be features of BSc-new=16, BSc-middle=17, and BSc-final=22). E-mail, notification services, and the help function, are basic factors for BSc-final but not for BSc-new students; they are indifferent about these features (i.e., indifferent --> basic). In terms of surprise factors, BSc-final students are attracted by more features than other Bachelor students (i.e., indifferent --> surprise). While new students do not perceive any feature as surprise factors, BSc-middle students are attracted by information on new elements, graphics, and wikis. BSc-final students are indifferent; hence, these features follow a modified alternative life cycle (i.e., indifferent --> surprise --> indifferent).

Concerning features not yet implemented, BSc-new students recognize a lack of encyclopedias and learning games (A+M). BSc-middle students want help functions (M) and they would be attracted by intranet for group work (A). BSc-final students want notification services (M), and they would be happier with intranet for group work, (real-time) document processing in a shared workspace, learning games, and online tutors (A).

Discussion and Conclusion

Theoretical Implications

Results of this study based on a representative sample show that, from a methodological point of view, the Kano model is not only a worthwhile technique to categorize website perception issues (Zhang and von Dran 2001), or e-services (Nilsson-Witell and Fundin 2005), but also to assign concrete features. By revealing features' contributions to (dis-)satisfaction in an indirect manner it is possible to identify additional student needs regarding available features, and user requirements concerning features that are not yet implemented. Researchers must be aware that results for features that are not provided need to be

interpreted in a slightly different way: M are desperately missed features, O are features whose absence causes dissatisfaction (obviously satisfaction is not an option because features are not offered), and A are surprise features as in the traditional Kano model.

Concerning the life cycle, we can confirm that the Kano model allows the detection of dynamics as suggested by Nilsson-Wittel and Fundin (2005). Based on the time of each feature's implementation and the frequency of usage, we demonstrate that Bachelor students (=early adopters), Master students (=followers), and Doctoral students (=laggards) basically follow the traditional life cycle: indifferent --> surprise --> performance --> basic. However, not all features pass through all stages. For instance, sample exams and worked-out examples proceed from performance --> basic. Generally, Bachelor students are in an advanced adoption stage when compared with Master and/or Doctoral students, indicating the adoption sequence follows: early adopters --> followers --> laggards. Other features follow the alternative life cycle from indifferent --> performance --> indifferent (Nilsson-Wittel and Fundin 2005). File uploads, file storage, and collection of links, belong to the group showing this dynamic. Such an alternative cycle indicates that these features are not successful. Regarding the time Bachelor students have spent at the University, the life cycle dynamic results allow an a posteriori classification of the three groups BSc-new, BSc-middle, and BSc-final, into laggards, followers, and early adopters respectively. This is intuitive since all of them started with a sophisticated e-learning system providing all features; thus, the longer they are at the University the more experienced and consequently the more demanding they are.

The list of e-learning features developed via a multi-method approach is a good starting point for other studies as well. The list might be useful for educational, social science, and information technology researchers, and can easily be extended by adding features developed in future.

In summary, this study contributes to theory by demonstrating that the Kano model is a technique that can be used for concrete features and also for large amounts of features. Due to the fact that currently no theory-driven method allows recommendations regarding which features should be implemented in which sequence, this study is an initial step to detect and develop other - perhaps more convenient - methods such as a non-linear structural equation approach. Moreover, this study has demonstrated that one can determine in which stage of the life cycle certain e-learning features belong and whether or not they are successful features. Since we know the exact sequence of a traditional life cycle based on the Kano categories, it is possible to identify which adoption segment diverse groups of users belong to. In our case, we detected feature dynamics to determine that BSc-final are early adopters, BSc-middle are followers, and BSc-new are laggards.

Managerial Implications

In terms of management recommendations, such a theory-driven approach assists in overcoming the trial and error procedure of finding the most appropriate interface design (Zhang and von Dran 2000; 2001); an issue that is of increasing importance due to the ascending expectations of users (De Marsico and Levialdi 2004) and the existence of an overwhelming amount of features. Outcomes indicate that the most important basic factors for all three segments are sample exams, exercises, and downloadable learning resources. Consequently, no e-learning system in economics and business should exist without having these features. Since other features are evaluated differently by the examined student groups in terms of impact on (dis-)satisfaction, lecturers should use the results to meet educational principals by taking into account course objectives and the desires of different student groups. For this purpose it would be a good idea to enable lecturers to activate segment-specific features and hide inappropriate or undesired ones.

Regarding group specific requirements detected in this study, Bachelor students need worked-out examples, discussion forums, learning modules, announcements, printable resources, content FAQs, calendars, and grade books. These features should be implemented in addition to the three features relevant for all student groups. For Master students, exactly the same features are basic factors, however, there is a difference between the two groups in regard to the recommended sequence of implementation. To satisfy Doctoral students, basic factors are the three features which are most important for all segments, as well as help functions, announcements, organization FAQs, and class schedules. These results assist designers to develop interfaces that match users' expectations (Kekkonen-Moneta and Moneta 2002).

Life cycle results enable managers to define which people belong to the groups of early adopters, followers,

and laggards. Awareness about the members of these groups (e.g., demographics and information technology affinity) facilitates an understanding of target group feature requirements and assists to align marketing campaigns accordingly. Arguably, it is imperative to identify the group of early adopters in order to develop and market new and innovative products and services.

Knowledge about the sequence of implementation allows e-learning designers to further develop and improve e-learning systems. In addition, it is especially valuable in the case of budget or time restrictions (Matzler and Hinterhuber 1998; Sauerwein et al. 1996), and for the funding-squeezed academic sector in particular (Hoppe and Breitner 2003; Huynh et al. 2003), to have a method for determining which features must to be provided, which can be used to position the e-learning system, and which can be considered at a later time or not at all. Therefore, unpopular features that only clutter user interfaces and overstrain learners can be excluded from implementation, thereby reducing costs. Furthermore, designers can diminish cognitive load by offering features in a simple-to-complex sequence (Martin-Michiellot and Mendelsohn 2000; Paas et al. 2003; Sweller 1988). This means, for instance, that interface designers should develop a system that guides learners to use worked-out examples before problem solving features such as “exercises” (Paas et al. 2003).

In summary, this study supports interface designers, universities, and lecturers in terms of which features are recommended and in which order they should be provided. Since results are clearly summarized in the tables and figures within this paper, the practical usage of these findings requires only little effort. Following the sequence of implementation, target groups can be catered to by considering the degree programs of users and their stage of progression. Since the usage of e-learning systems and the number of possible features has been increasing exponentially, from a management point of view this research assists interface designers to provide features that are adapted to the needs of specific users (Visciola 2003).

Limitations and Future Research

Certainly this study also holds several caveats. The Kano model requires a functional and a dysfunctional way of surveying features. Asking the respondents a third time is necessary to be able to propose a sequence of implementation and thus, the questionnaire for this study was correspondingly long. Investigation into whether it is possible to classify based on the Kano model by applying a non-linear structural equation approach would be helpful. Other motivational theories such as the Two-factor theory (Herzberg 1968) and the Self-determination theory (Deci and Ryan 1980) should be examined to explore their capability of revealing (dis-)satisfiers and results should be compared with findings of this study. A second limitation is that this study does not provide any insights with respect to learning styles. A similar analysis differentiating between visual, aural, read/write, and kinesthetic learners may be useful. Above all, follow-up studies should examine other aspects of learning, for instance, the topics that people are studying (e.g., art, architecture, and languages) and cultural differences. Further, different traits/characteristics of features should be considered along with their impact on learning styles. Finally, investigations focusing on life cycle dynamics would be desirable. Considering such cycle characteristics as time of implementation, frequency of usage since implementation, and perceived life cycle stage by experts and users, would be a useful approach. Another possibility study would be to examine features through the whole life cycle and whether skipping life cycle stages has any impact. By means of a longitudinal study, life cycle dynamics and changes in terms of assignments of the features to the Kano factors for a certain student over a period of time could be tracked.

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