

2 A Research Framework of VLE Design Characteristics

The **first objective of this study** is to simultaneously outline and concretise particular aspects being relevant to and surrounding the elicitation and evaluation of VLE design characteristics. In order to achieve this, selected aspects being considered as relevant to and surrounding the elicitation and evaluation of VLE design characteristics in general, and with a view to the present study in particular, are contextualised by means of a multidimensional research framework (static viewpoint). On this basis, the specific research design of this study is derived (process-oriented viewpoint), and its connection with the study's theoretical underpinning is outlined.

In particular, this section clarifies the following questions in more detail:

- does the research framework have a) the potential and b) actual ability to simultaneously outline and concretise particular aspects being relevant to and surrounding the elicitation and evaluation of VLE design characteristics in general, and with a view to this study in particular?
- does the research framework have a) the potential and b) actual ability to derive the research design of this study in regard to the elicitation and evaluation of VLE design characteristics?
- how far is the research framework and the research design connected with the theoretical underpinning of this study?

2.1 Dimensions

At the current stage of the research, a multidimensional research framework conflating specific aspects relevant to VLE design characteristics is considered to be most appropriate in order to better guide and structure the upcoming discourse of this emerging field of research in general, and the elicitation and evaluation of design characteristics being relevant to VLE success in particular. The framework distinguishes between the following aspects relevant to the exploitation of VLE design characteristics (see Table 1): type of success measure relevant to stakeholder, type of design characteristic, type of application target, range of validity, method of elicitation, method of evaluation and level of granularity. The type of success measure targeting at particular stakeholders is obviously of relevance for proper research on VLE design characteristics. For instance,

Tab. 1. A Research Framework of VLE Design Characteristics.

Type of Success Measure Relevant to Stakeholder	Decision Maker	System Developer	System Implementer	Content Provider	VLE User		
Type of Design Characteristic	System-Related			Information-Related			
Type of Application Target	Development		Implementation	Improvement			
Range of Validity	Universal			Contingent			
Method of Elicitation	Theory	Literature Review	Use Case	Case Study	Survey	[...]	Combinatorial Approach
Method of Evaluation	Theory		Non-Empirical		Empirical		Combinatorial Approach
Level of Granularity	Coarse-Granular		Medium-Granular		Fine-Granular		

VLE decision makers, system developers, system implementers as well as content providers, respectively, training and development-related stakeholders such as course designers, learning facilitators, respectively, teachers may focus on resource- (e.g. budget, time) and profit-related VLE success measures. In contrast, VLE users may tend to define VLE success with a view to their satisfaction with a VLE, respectively, their (perceived) net benefits of using this VLE, or their behavioural intention to use and actual use of it (e.g. Davis, 1989; Davis et al., 1989; DeLone & McLean, 2003; Seddon, 1997; Seddon et al., 1999; Seddon, Graeser, & Wilcocks, 2002; Venkatesh and Bala, 2008). Besides, system- and information-related design characteristics as a basic and rough categorisation of VLE design characteristics are illustrated in more detail (DeLone & McLean, 2003). In addition to that, crucial application targets of design characteristics are represented, amongst them, the development, implementation and improvement of VLE (e.g. Dennis et al., 2006; Kavanagh & Thite, 2009; Sommerville, 2007).

Furthermore, selected methods for the elicitation of VLE design characteristics are outlined depending on which researchers can set the course which particular design characteristics are evaluated subsequently at which quality. For example, VLE design characteristics may differ according to their level of validity (e.g. universally applicable vs. contingent characteristics) or granularity (e.g. coarse-granular vs. fine-granular characteristics).

2.1.1 Type of Success Measure Relevant To Stakeholder

VLE success, also called VLE effectiveness (DeLone & McLean, 1992, 2003; Grover, Jeong, & Segars, 1996), among others, is understood as the degree to which a person developing, implementing and improving a VLE believes that a particular stakeholder (for whom the development, implementation and improvement is made) is better off (Seddon, 1997). That is, VLE success measures can be classified according to the following VLE-related stakeholder groups: decision maker, system developer, system implementer, content provider and VLE user (Seddon et al., 1999; 2002; Urbach, Smolnik, & Riempp, 2009b). From a decision maker perspective, successful VLE may maximise, among others, the following aspects (e.g. Seddon et al., 2002): cost efficiency (e.g. VLE operations), service-to-the-business-related issues (e.g. VLE user satisfaction), business improvements (e.g. VLE support effectiveness) and resource- or profit-related matters (e.g. VLE profit generation). From a system developer perspective, successful VLE may be completed on time and under budget, and show a set of functionalities consistent with the system specification and operate properly (Dennis et al., 2006). Regarding the system implementers, successful VLE may be easy and fast to adjust according to specific user requirements (Dennis et al., 2006). Content providers may consider their learning materials delivered by a VLE as successful in case this information supports learners in the achievement of the intended learning outcomes (e.g. EQF, 2008). Finally, users may find a VLE to be successful if it maximises, among others, their satisfaction with this VLE, their (perceived) net benefits of using this VLE (e.g. expressed via users' maximised individual productivity), or their behavioural intention to use and actual use of it (e.g. Davis, 1989; Davis et al., 1989; DeLone & McLean, 2003; Seddon, 1997; Seddon et al., 1999; Venkatesh and Bala, 2008). However, in order to maximise VLE success, researchers have to know more about its underlying drivers. Thus, the subsequent section presents design characteristics as crucial drivers of VLE success.

2.1.2 Type of Design Characteristic

VLE design characteristics are all those properties inherent to VLE which determine, respectively, explain/drive/predict their success (e.g. Cho et al., 2009; Pituch & Lee, 2006; Wang & Wang, 2009). There are different possibilities to categorise VLE design characteristics. Following a common, general theoretical categorisation of IS-related characteristics relevant to IS success, system-, information- and service-related design characteristics are distinguished (DeLone & McLean, 2003). System-related characteristics are understood as a set of properties referring to VLE system functionalities (e.g. *reliable* VLE). Information-related characteristics are understood as a set of properties referring to learning materials inherent to VLE (e.g. *relevant* learning materials). Finally, service-related characteristics do not relate directly to VLE but to more human-related support processes which complement the system- and information-related aspects mentioned (e.g. *responsive* service staff). Since only system- and information-related characteristics directly refer to VLE, respectively, the learning materials inherent to them apparently they are used as the two major categories of VLE design characteristics in the following. Service-related aspects as well as further aspects such as instructor/VLE user characteristics, pedagogical approaches, respectively, teaching methods are also relevant to learning success (e.g. Hornik et al., 2007; Piccoli, Ahmad, & Ives, 2001). However, they are evidently not related to the VLE design as such and, hence, are not considered to constitute VLE design characteristics. Consequently, these aspects are excluded from the subsequent elaboration.

Since determining VLE success, adequate knowledge referring to VLE design characteristics is obviously relevant to all VLE-related stakeholders as described above and, hence, to all VLE-related processes such as the development, implementation and improvement of VLE (Dennis et al., 2006; Kavanagh & Thite, 2009; Sommerville, 2007). The subsequent section, thus, illustrates the development, implementation and improvement of VLE as the major fields of application where design characteristics can support the corresponding stakeholders involved in attaining successful VLE.

2.1.3 Type of Application Target

Design characteristics are presumed to support VLE-related stakeholders in accomplishing VLE-related processes such as the development, implementation and improvement of VLE successfully.

As for the development of a VLE, design characteristics may support the concretisation of the system specification (i.e. how a VLE will operate). For instance, VLE design characteristics may be concretised by means of technical concepts, alternatively referring to pure textual descriptions or visual representations such as unified modeling language diagrams or graphical user interface mockups. Based on such a system specification, VLE design characteristics may help the relevant stakeholders involved subsequently to either develop or select (in case of a *[pre-]packaged* software design) VLE successfully (Dennis et al., 2006). In particular, the selection of *pre-packaged* VLE by means of design characteristics may help to avoid costly misconceptions of VLE as the vendor software packages will not be selected based on an inaccurate, incomplete or irrelevant system specification (Kavanagh & Thite, 2009). Besides, organisations may decide to select an external VLE developer (i.e. to outsource the development to an external partner), or to obtain access to existing software through an application service provider. This is due to the fact that external software developers may yield vast resources, experiences and technical skills to develop, implement and improve a much more effective VLE than would this be possible otherwise (Kavanagh & Thite, 2009). Beyond that, content providers may be called in to conceptualise and craft the learning materials to be delivered by corresponding VLE system functionalities properly. In this context, information-related VLE design characteristics constitute a powerful tool by means of which such content creation processes can be guided more comprehensively and easily so that VLE users are able to achieve the intended learning outcomes more successfully (e.g. EQF, 2008). During the implementation of a VLE, design characteristics might guide the customisation (i.e. the precise adjustment of VLE) of the VLE system functionalities, respectively, the learning materials to be delivered by these functionalities according to the customers' requirements. Regarding the improvement of a VLE that is mainly ensured by its comprehensive evaluation, design characteristics may facilitate the VLE-related stakeholders involved for better monitoring the VLE's correspondence with design characteristics relevant to VLE success. Such evaluations can be undertaken by the VLE-related stakeholders themselves, or outsourced to professional institutions.

2.1.4 Range of Validity

In order to select and apply design characteristics within each of these application targets properly, VLE-related stakeholders have to know more about their validity. That is, are VLE design characteristics thought to be universally applicable to the entire category of technology

enhanced learning systems, among others, or are they dependent on diverse contingency factors (Kuechler & Vaishnavi, 2008; Luthans, 1976)?

In regard to possible contingencies, the VLE success measures to be achieved constitute a prominent influence factor which may have a crucial impact on the validity of particular VLE design characteristics to be selected and applied by the VLE-related stakeholders involved. For instance, whereas VLE-related decision makers, system developers, system implementers and content providers may focus more on resource- or profit-related VLE success measures, VLE users may tend to define VLE success with a view to their satisfaction with a VLE, respectively, their (perceived) net benefits of using this VLE, or their behavioural intention to use and actual use of it (Davis, 1989; DeLone & McLean, 2003; Seddon, 1997; Seddon et al., 1999; Seddon et al., 2002; Venkatesh and Bala, 2008). Hence, VLE design characteristics may act as a function of their underlying contingencies, in this particular case the kind of VLE success measure to be achieved by the corresponding stakeholders involved. Based on these contingencies, design characteristics for each stakeholder group can be shaped. For example, decision makers may decide upon a *pre-packaged* VLE solution to maximise VLE success in terms of resource- or profit-related measures (Seddon et al., 2002). As distinct from this, VLE user-oriented design characteristics such as the delivery of *relevant* learning materials might be optimised by corresponding content providers, among others, to maximise VLE success in terms of users' satisfaction with a VLE, respectively, their (perceived) net benefits of using this VLE, or their behavioural intention to use and actual use of it (e.g. Davis, 1989; DeLone & McLean, 2003; Venkatesh & Bala, 2008).

In addition to VLE success measures to be achieved the type of application target constitutes a further, crucial contingency factor of VLE design characteristics. For instance, during the development or implementation phase VLE design characteristics contingent on the organisational culture (Orlikowski & Iacono, 2001), the organisational context (e.g. resource constraints [e.g. Petter, DeLone, & McLean, 2008; Raymond, 1990; Schonberger, 1980; Tait & Vessey, 1988]), or the technological change in general (Schonberger, 1980) may be considered to better adjust a VLE to the customers' requirements. In particular, specific human resource core functions to be supported by VLE solutions (Schonberger, 1980), amongst them training and development (Teo, Soon, & Fedric, 2001), may constitute an important contingency factor which has a crucial impact on the appearance of VLE design characteristics. A potential example of such contingent VLE design characteristics is, among

others, the *multilingualism* of learning materials provided by a VLE. On the contrary, universally valid VLE design characteristics may be best suited for the improvement of a VLE, and replaced by more contingent ones to better adjust to specific VLE properties (e.g. *portable* competence profile) or unexpected system errors. Imaginable examples of such universally valid design characteristics are, among others, the *reliability* of a VLE as the warranty of these system-related VLE design characteristics should be always ensured, and not be driven, by cultural, organisational or technological contingencies.

Further important contingency drivers of VLE design characteristics to be taken into account carefully are, among others, the kind of VLE sub-category under consideration (e.g. adaptive learning environments, blended learning systems, digital libraries) or the kind of application area they are deployed in (e.g. companies, schools, Universities).

Hence, VLE design characteristics are thought to be located on a continuum of validity, ranging from universally applicable VLE design characteristics to highly contingent ones. Thereby, the knowledge about such a continuum of validity supports researchers in eliciting and evaluating appropriate VLE design characteristics properly so that practitioners can develop, implement and improve VLE more successfully (Hevner et al., 2004).

2.1.5 *Method of Elicitation*

The elicitation of VLE design characteristics is predominantly to be undertaken by researchers so that practitioners can refer to comprehensive sets of well-extracted design characteristics relevant to the development, implementation and improvement of successful VLE. In particular, the elicitation of VLE design characteristics constitutes an important scientific milestone as researchers determine which VLE design characteristics will be evaluated subsequently at which quality. Hence, methods of elicitation are understood as rigorous and, thus, systematic ways of ascertaining design characteristics so that practitioners are able to develop, implement and improve VLE more successfully. In particular, theory-grounded as well as literature-, review-, use case-, case study- and survey-based approaches, or combinations of them, are suggested.

Theories as a base for eliciting VLE design characteristics can be generally described as a general set of statements which aim at explaining what is, predicting what would happen, and providing a basis for intervention and action (Gregor, 2006). The prominent literature provides three fundamental criteria a theory should meet, namely, a) identification of

constructs (i.e. independent variables and dependent variables [e.g. VLE design characteristics, VLE success measures]), b) specification of relationships among these constructs which c) finally have to be falsifiable (Doty & Glick, 1994).

Literature reviews constitute another potential method for the elicitation of VLE design characteristics. A literature review supports researchers in better extracting, contextualising and structuring information relevant to design characteristics. In particular, these are the kind of foundation (e.g. conceptual vs. theoretical), the object of analysis (e.g. VLE in general vs. specific VLE sub-categories in particular), the data gathering, respectively, data analysis method, or specific results achieved, among others.

Use cases as a potential means for the elicitation of VLE design characteristics provide a standardised way of capturing, exploring and documenting what a VLE should exhibit (Bittner & Spence, 2003). In particular, use cases support VLE developers in better contextualising and, thus, specifying VLE stakeholder requirements. Beyond that, use cases may also support VLE-related decision makers and implementers during the customisation and improvement of VLE due to their simplified depiction of a VLE's successful end condition (Bittner & Spence, 2003).

Case studies are equally considered to be a valuable instrument to help in imitating or simulating a real situation where VLE design characteristics may be an issue (Ellet, 2007). Thereby, the main purpose of case studies, which can be described as verbal representations of reality (Ellet, 2007), is to illuminate a decision or set of decisions regarding the development, implementation and improvement by means of VLE design characteristics, their impact on particular VLE success measures included (Yin, 2003). Hence, case studies are well-suited for training purposes (e.g. best practices in VLE design characteristics) as they cover a huge plethora of contingencies that is highly pertinent to the elicitation of particular design characteristics being relevant to the success of a specific VLE (Yin, 2003).

Regarding survey techniques, qualitative approaches can be distinguished from quantitative ones (Kaya, 2007), whereas both of them can be either conducted experimentally or non-experimentally, offline or online. Referring to quantitative approaches (VLE expert-/VLE user-oriented) Delphi studies may be well-suited to eliciting hitherto unknown design characteristics as distinguished from large-scale field surveys (e.g. Grisham, 2009; Haeder, 2002; Haeder & Haeder, 2000; Landeta, 2006). These Delphi studies, in turn, can be based on

solid and appropriate theories. With a view to qualitative approaches, focus groups may be particularly useful for exploratory research when rather little is known about the phenomenon of interest (e.g. Catterall & Maclaran, 2006; Patton, 1990; Stewart, Shamdasani, & Rook, 2007). For example, a focus group may support researchers in the elicitation of hitherto unknown and/or the operationalisation of previously elicited VLE design characteristics (e.g. Schwarz & Oyserman, 2001). Further approaches for the elicitation of VLE design characteristics are, among others, experimental standardised written offline interviews (e.g. Pituch & Lee, 2006; Tobing et al., 2008), respectively, non-experimental standardised written offline or online interviews (e.g. Arbaugh, 2000; Lee, 2006; Roca, Chiu, & Martínez, 2006; Wang & Wang, 2009).

Subsequent to the ascertainment of VLE-related design characteristics, the content analysis may support researchers in coagulating, respectively, extracting relevant system- and information-related design characteristics out of the data acquired (e.g. Mayring, 2000, 2003; Rourke & Anderson, 2004; Weber, 1985).

Beyond mere manifestations, combinatorial approaches may pool the forces of each method illustrated. For instance, the necessity of a theoretically well-substantiated VLE expert-oriented Delphi study to elicit specific system- and information-related VLE design characteristics could be the main outcome of a preceeding literature review. The outcomes of such a VLE expert-oriented Delphi study may be then further discussed and refined by means of a theoretically well-substantiated focus group. In particular, a focus group may enable researchers to operationalise the VLE design characteristics elicited in a clear and understandable manner, considering everyday language of interviewees (e.g. Kaya, 2007; Pospeschill, 2010; Schwarz & Oyserman, 2001). The corresponding questionnaire drafted based on these outcomes may be then deployed, respectively, evaluated in the course of a large-scale field survey.

2.1.6 Method of Evaluation

Supplement to the elicitation, the evaluation of design characteristics is an important step to find out in how far a VLE actually meets the (elicited/existing) design characteristics being relevant to VLE success. Hence, the evaluation of VLE employing appropriate design characteristics constitutes a central point to ensure the improvement and, thus, the success of VLE. This expertise, in turn, can be then further exploited to ensure a proper development and

implementation of VLE likewise. In particular, theory-grounded approaches can be distinguished from empirical, respectively, non-empirical ones.

Similar to the elicitation of VLE design characteristics, theoretical foundations may drive and guide empirical as well as non-empirical evaluation procedures of design characteristics rigorously. This is due to the fact that such theoretical underpinnings support researchers in better specifying sound research instruments depicting (inter-) relationships between particular VLE design characteristics and important VLE success measures.

Non-empirical methods of evaluation can be understood as a means by which researchers can conduct a plausibility check of a VLE employing particular design characteristics. That is, VLE design characteristics enable researchers and practitioners to eliminate elementary system errors in the course of each above-mentioned application target based on logical reasoning. Such plausibility checks, respectively, logical reasoning, in turn, is best applied on the basis of a solid and appropriate theory. Further non-empirical methods of evaluation are the so-called compatibility verifications. Such an approach supports researchers in carving out, for instance, in how far the elicitation of VLE design characteristics by means of a particular theory may have led to the same result than applying the methods thoroughly described above.

Empirical methods of evaluation are exemplarily represented by the case study approach, experiments, and the survey approach. To begin with, the case study approach best supports researchers whilst analysing a pioneering VLE, respectively, the (pioneering) design characteristics inherent to it. This is mainly due to the fact that this approach allows for an extensive and comprehensive evaluation of design characteristics using the example of a specific, innovative organisation. Regarding experiments, researchers profit from their benefits while evaluating VLE as this approach enables them to isolate the impact of specific design characteristics on particular VLE success measures. Concerning survey-based approaches (VLE expert-/VLE user-oriented) Delphi studies as well as large-scale field surveys constitute prominent examples to evaluate VLE by means of corresponding design characteristics. These surveys, in turn, can be based on solid and appropriate theories likewise. Further empirical methods of evaluation are, among others, the observation or the documentation of VLE design characteristics (Bailey, 1987).

Design Characteristics of Virtual Learning Environments

A Theoretical Integration and Empirical Test of
Technology Acceptance and IS Success Research

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2013, XV, 233 p. 18 illus., Softcover

ISBN: 978-3-658-00391-3