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Predictors of perceived importance and acceptance of digital delivery modes in higher education

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Teaching and assessment in higher education institutions are increasingly supported by digital tools and services. Students, however, perceive and value the importance of such e-learning offerings in very diverse ways. The goal of this article is to examine which predictors significantly influence students' perceptions of the value of digital learning formats. Based on Küpper's acceptance model, we generate hypotheses that are subsequently tested using data from a German student survey. The results show that individual-related characteristics, especially motivation and orientation patterns of students, have a high impact on the perceived importance of digital learning formats. Our analyses indicate that besides individual performance and motivation, the practical orientation of a student is also a key predictor for a high rating of the importance of digital learning formats. An analysis of characteristics regarding the field of study shows that students who major in economic sciences, especially those who frequently work with digital learning formats in their classes, find them significantly more important than students who major in social science. Regarding innovation-based characteristics, students who express a need for flexible course offerings rate the use of digital learning formats as particularly important. The discussion provides an evaluation of the results of the student study based on the hypotheses and presents further implications.

Keywords: digital learning formats; online learning; online learner characteristics; motivation; perceived benefit

Introduction

Online learning as a learning format has become increasingly important at universities (Allen and Seaman 2013). Various reasons prompt the implementation of online-learning platforms or tools in higher education institutions, for example, pedagogical and strategic considerations, as well as public funding programmes, which serve as an extrinsic motivation or promoting the reputation of the institution (Kreidl 2011). Flexibility regarding location and time are specific strengths of digital learning formats (Gerlach 2005); furthermore, some studies refer to positive effects concerning the participation, motivation and learning success of students (Beschorner 2008; Landfried 2008). Today's students are seen as being particularly media savvy and open to dealing with information technologies, compared to their non-student contemporaries (Kleimann, Özkilic, and Göcks 2008). Furthermore, a connection has been

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established between a high level of education and high internet usage (TNS EMNID 2012). However, learning using a selection of new media and tools also presents challenges for students: they are expected to have the skills for self-directed learning and self-organisation, a high level of autonomy, and an active association with new media, like digital learning formats or online-learning platforms (Zawacki-Richter 2004). The characteristics and needs of students are the vital starting point in the instructional design process (Morrison *et al.* 2011; Zumbach 2010). In selecting appropriate media, the perceived value and importance rating of e-learning tools and services by the student target population should be taken into account. Such an approach supports the development of e-learning offerings by higher education institutions aiming to provide optimal student support in terms of the challenges of self-directed learning.

Theoretical considerations and research assumptions

This paper focuses on the research question: What predictors influence the importance rating of digital learning formats by university students? The importance rating is closely connected to the question of acceptance of a certain learning format because a specific digital learning offering will only be viewed as important if students perceive a clear benefit in using it (Kreidl 2011). In the context of using e-learning tools, the question of acceptance has turned out to be essential (Kreidl 2011; Küpper 2005). Therefore, a brief theoretical overview is provided here, based on specific dimensions of an understanding of 'acceptance'.

Küpper's acceptance model

Küpper (2005) developed a model of acceptance based on an analysis of existing models regarding the use of e-learning offerings and programmes in business-related contexts. She confirms her empirical findings as follows: 'In nearly all models, three groups of impact variables can be distinguished: individual-related, business-related and technical/innovation-related input variables' (Küpper 2005, p. 144). The model is particularly appropriate for investigating the use of electronic learning opportunities by students because – viewing a higher education institution as a business – Küpper's dimensions can be interpreted in the higher education context as well as in the business context. These three dimensions therefore significantly influence the acceptance of digital learning formats (Figure 1).

Within these dimensions, Küpper outlines concrete sub-dimensions of super-ordinate impact variables (e.g. 'time saving' as a sub-dimension of the innovation-related impact variable 'relative advantage' (Küpper 2005, p. 150)). Küpper's model was designed based on the premise of deriving concrete hypotheses that can then be analysed empirically. Regarding the question of why and to what extent students should attribute importance to existing or possible digital learning formats, concrete research-based hypotheses are formulated and investigated in what follows, based on this model. The interpretation of the model and its variables is presented in the following sections.

Individual-related characteristics

Self-directed learning is of particular significance in the context of using new media. Students need to be equipped with or acquire self-study skills (Fisher, King, and

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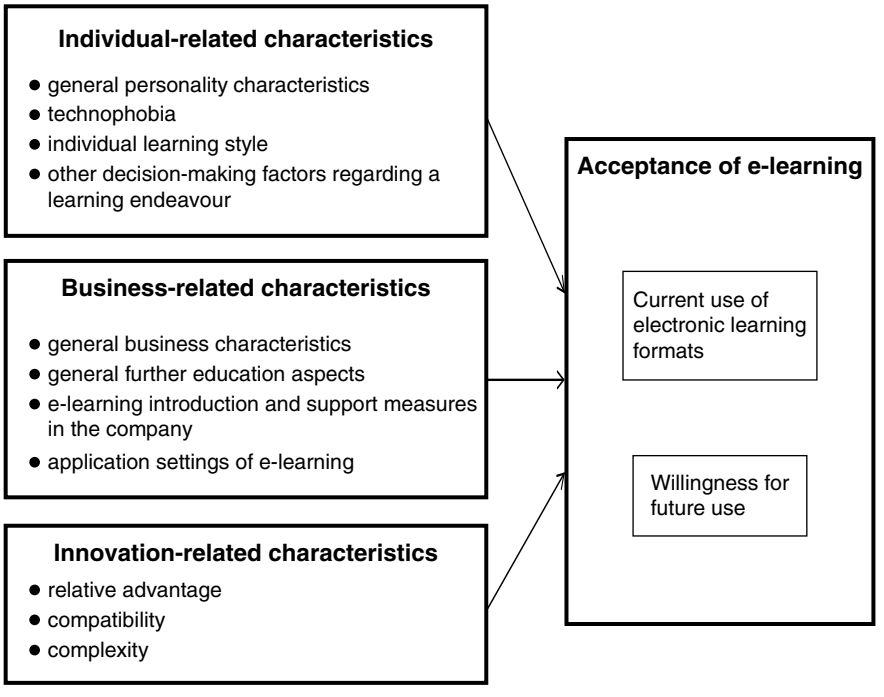

Figure 1. Küpper's acceptance model (Küpper 2005).

Tague 2001). Making use of various e-learning applications can contribute to developing such competencies (Euler 2004). Many theories on self-directed learning have a focus on the impact of motivation (Dreer 2008); in particular, aspects of both intrinsic and extrinsic motivation can simultaneously impact the handling of certain tasks. For example, digital media offer various opportunities in terms of the development of individual learning paths, which, in turn, could motivate students intrinsically (Deci and Ryan 1993). Furthermore, students with a distinct academic orientation – with the expectation of acquiring particular academic skills – tend to perceive the use of media as being beneficial. Especially when they experience a well-organised form of content in the learning environment, whereby strategic thinking is supported (Wilbers 2003).

On the other hand, Prenzel (1996) found that for students who are extrinsically motived, the achievement of learning outcomes correlates closely with the extent of self-regulated learning opportunities that they experience. Students with high levels of extrinsic motivation and practical orientation – the expectation that classes are preparing them for professional, work related contexts – tend to assess digital learning formats as being important because they promote skills that will be useful and beneficial in the workplace.

Our thoughts on motivation and orientation (academic or practical) can be summarised as hypotheses H1a and H1b:

H1a: Students with strong intrinsic motivation and a distinct academic orientation assess the use of digital learning formats as being more important than their fellow students do.

H1b: Students with high extrinsic motivation and a distinct practical orientation assess the use of digital learning formats as being more important than their fellow students do.

Characteristics regarding the field of study

In the context of this research project, characteristics regarding the field of study are set as equivalent to the 'business-related impact variables' in Küpper's model. The 'general business characteristics' as well as the 'e-learning environment and context' are particularly important in this case (Küpper 2005, pp. 146–148). The study programme can be viewed as a form of 'business'.

In programmes with a high number of mass lecture sessions (e.g. engineering or economic sciences) digital learning formats (e.g. recorded lectures) are more likely to be requested, in order to compensate for lack of attendance at lectures (Wilkesmann *et al*. 2012), although there are indeed pedagogical opportunities of recorded lectures as well (cf. Herreid and Schiller 2013; Jamaludin and Osman 2014). Comparable studies (Kleimann, Özkilic, and Göcks 2008) point to the subject-specific use of e-learning platforms by students. In particular, economics majors stand out, showing a significant benefit from various digital learning formats. However, to what extent a generally positive attitude towards technology is relevant, cannot be derived from close monitoring of engineering students, which may share this attitude often. This leads to the next hypothesis:

H2a: Economics students value the importance of digital learning formats higher than students in other disciplines do.

Moreover, authors (Wilkesmann *et al*. 2012) found a correlation between the active use of digital learning formats and associated positive learning experiences thus leading to a higher importance placed on digital learning formats:

H2b: The frequency of use of digital learning formats has a positive impact on the assessment of their importance.

Innovation-related characteristics

An important aspect with regard to Küpper's innovation-related characteristics (2005) is the relative advantage that the user sees in his or her use of digital learning formats. In the on-going debate about the benefits of e-learning, the opportunity for learning independent of time and space is always emphasised (Dreer 2008; Horton 2000). This benefit makes it possible for students to individually regulate their learning time. For example, students who are under a lot of work or social time constraints (e.g. childcare) tend to value the use of digital learning formats as being important (Zawacki-Richter and Müskens 2013):

H3a: Students with family obligations (childcare, care of a relative) assess the use of digital learning formats as being more important than their fellow students do.

Furthermore, we expect that students who generally have a high desire for flexible learning opportunities that are more compatible with an individual life style (e.g. summer schools, tuition per module, unusual course times, longer self-study phases, more flexible exam system) value digital learning formats as being important:

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H3b: Students with a need for flexible learning opportunities value the use of digital learning formats as being more important than their fellow students do.

Methods and sample

The data for this paper was collected during a project (Stu + Be) funded by the German Federal Ministry of Education and Research.[1] A total of 3,801 students from three universities (Carl von Ossietzky University Oldenburg, University of Duisburg-Essen, and Technical University of Dortmund) took part in a survey during the winter semester 2009/10. The sample consists of 3,687 undergraduate students and a small subgroup of 114 students enrolled in continuing education programmes. The present study is limited to the undergraduate students. Participating students were enrolled in the areas of engineering (34.7%), economics (35.2%) and social science (30.1%)[2]; they completed a paper-based questionnaire.

The opening part of the questionnaire contained general study-related questions. The second part collected details about the students' professional experience and present occupational situation (including part-time jobs, etc.). In the next step, students' expectations regarding the organisation of their study programme and the instructional design of learning environments were collected. This part included a list of different digital learning formats (see below). The next part of the questionnaire asked about study motivation and orientation patterns (practical and academic). The questionnaire concluded with questions to collect personal data.

The following list of digital learning formats was provided. Questions were posed about their perceived use in the current study programme and their estimated importance:

e-portfolios on the intra- or internet; web-based training modules; e-assessments; lab simulations; lectures via pod- or vodcast (e.g. iTunesU); virtual courses and tutorials; interactive learning; study materials (e.g. provided via the learning management system).

A multivariate regression analysis was conducted using various measures to reflect latent traits of the respondents, for example, intrinsic study motivation. The scales were identified on the basis of explorative factor analyses. Table 1 offers an overview of the latent measures used in the descriptive and multivariate analyses, the number of items per scale, the internal scale consistency (Cronbach's alpha), and one sample item to illustrate the scale content by example. The scale consistency of all measures varies between acceptable and good.

In order to distinguish between various types of study motivation, the (motivation) items underwent a factor analysis.[3] Four factors were extracted: intrinsic knowledge motivation, intrinsic performance motivation, extrinsic study motivation and lack of motivation towards studying. Due to the strong discriminatory power of the four motivational factors, performance motivation and lack of motivation were analysed exploratively, in addition to intrinsic and extrinsic motivation (as predicted in our hypotheses).

Besides the different types of motivation, two major patterns of orientation were identified by explorative factor analysis: academic orientation and practical orientation. For academic orientation, the calculated Cronbach's alpha is quite low at 0.60. However, this scale consists of only two items, so the rather low value can be considered as being marginally acceptable (Wilkesmann and Virgillito 2012). The items focusing on the use and importance assessment of the listed digital learning

Table 1. (Latent) Measures used for descriptive and multivariate analyses.

Measure	Number of items	Cronbach's alpha coefficient	Item (example)
			Why are you studying?
Intrinsic (knowledge) motivation	7	0.839	It makes me happy to acquire new knowledge
Intrinsic performance motivation	3	0.771	To prove to myself that I'm intelligent
Extrinsic motivation	5	0.745	To earn more money after completing my studies
Lack of motivation	3	0.798	I can see no reason for what I'm studying and honestly I don't care about it
			Please assess the following statements . . .
Practical orientation	3	0.735	The course contents should be linked with a high degree of practical application
Academic orientation	2	0.600	Primarily, my studies should lead me to doing scientific research
			How important is the use of . . .
Importance of digital learning forms	8	0.874	Web-based training modules
			How often are . . . used in your study programme
Actual use of digital learning format in university context	8	0.840	Web-based training modules

Source: StuBe Survey.

formats were combined into two one-dimensional scales. Both measures show very good internal scale consistency with Cronbach's alpha values of 0.84 and 0.87. Apart from the continuous measures, a dummy variable reflecting 'family obligations' was used. The dummy variable takes the value '1', if the respondent has children or the obligation to care for relatives; otherwise it takes the value '0'.

Single items[4] were included in the regression analysis, reflecting in different ways the need for greater (temporal) flexibility: (1) interest in summer schools; (2) interest in tuition fees per attended module compared to a lump sum per semester; (3) courses and lectures at unusual hours (in the evening, on the weekend as a compact course); (4) longer periods of self-study; (5) a more flexible examination system (scrutiny periods and registration deadlines).

Besides the latent variables, demographic control variables (gender, age, migration background[5]), a field of study (dummy) variable, and the number of working hours per week were included in the multivariate analysis.

Results

Selected descriptive results

In a first step, the students were asked to assess the current use of the listed digital learning formats in their programme, on a scale of 1 ('not at all') to 5 ('very often') (Extent of Implementation). In a second step, they were asked to assess the

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importance of the use of the listed digital learning formats in university learning on a scale of 1 ('not important at all') to 5 ('very often') (Assessment of Importance) (see Figure 2).

Figure 2 shows that nearly all the digital learning formats were assessed with an average level of importance, with the exception of the 'study materials' provided via the learning management system. The supply of these learning materials (e.g. presentations/PowerPoint slides, articles, etc.) was assessed as being more important than all other digital learning formats. It must be taken into account that the majority of students are already familiar with this digital learning format and have already experienced its benefits. Hence, its importance can be more validly estimated in comparison to the other learning formats, with which they may be rather unfamiliar. Overall, Figure 2 depicts that the extent of implementation and use of digital learning formats in the university context tends to influence the assessment of their importance.

A first visual impression of particular relationships between the chosen indicators 'practical orientation'/'academic orientation' and the assessment of the importance of digital learning formats is shown by line diagrams (see Figures 3 and 4). The diagrams show the connection between the degree of importance assessment (single items) and three different levels of practical orientation (Figure 3) or three different levels of academic orientation (Figure 4). The position of the mean value for each group is presented. In order to operationalize different levels of orientation pattern characteristics (and therefore three different groups), the empirical values of practical orientation and academic orientation were subdivided into three categories: below average (students with values for practical/academic orientation more than one standard deviation below the mean); average; and above average (students with values for practical/academic orientation more than one standard deviation above the mean).

The findings show that students with an above average practical orientation, as well as those with an above average academic orientation, assess the importance of digital learning formats as being higher than their fellow students do (Figures 3 and 4).

However, for practical orientation the differences between the three groups are higher than those for academic orientation. Students with a high degree of practical orientation value the importance of e-portfolios, web-based training modules and

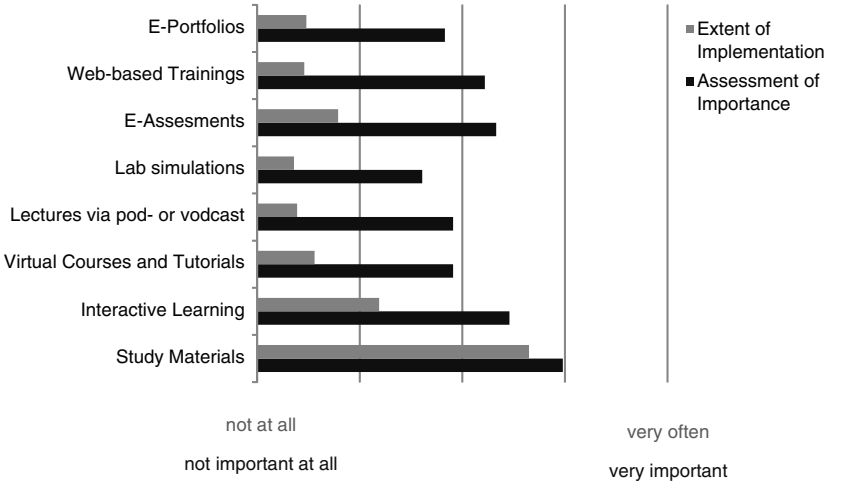

Figure 2. Student assessment of the use and importance of digital learning formats.

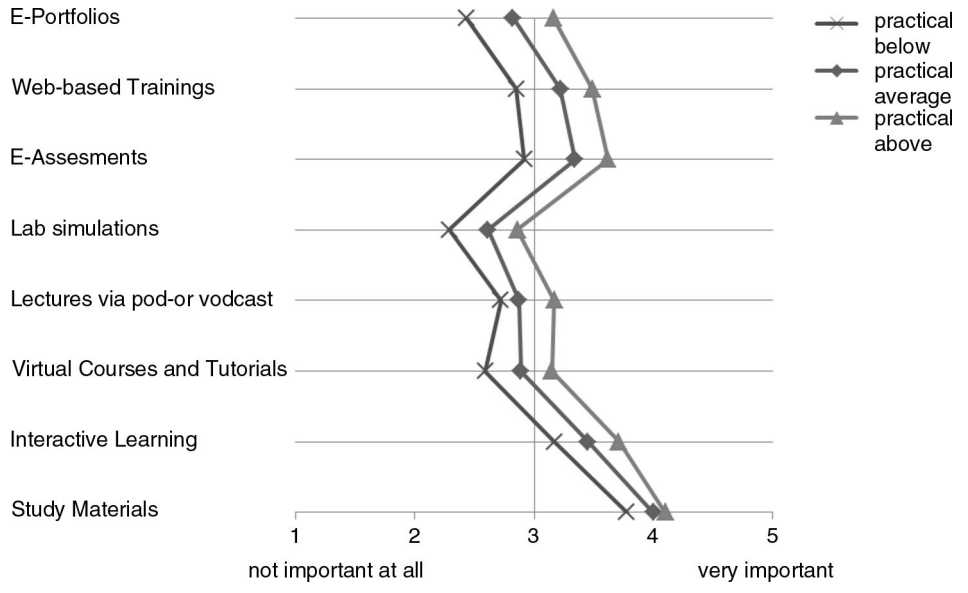

Figure 3. Importance assessment of the digital learning formats according to the degree of practical orientation.

assessments considerably higher than the ratings by fellow students with a low practical orientation (Figure 3). Students with a low academic orientation assess e-portfolios and lab simulations in particular, as being less important compared to the ratings by fellow students with a high academic orientation (Figure 4). The importance assessment of study materials appears not to depend on the degree of practical or academic orientation.

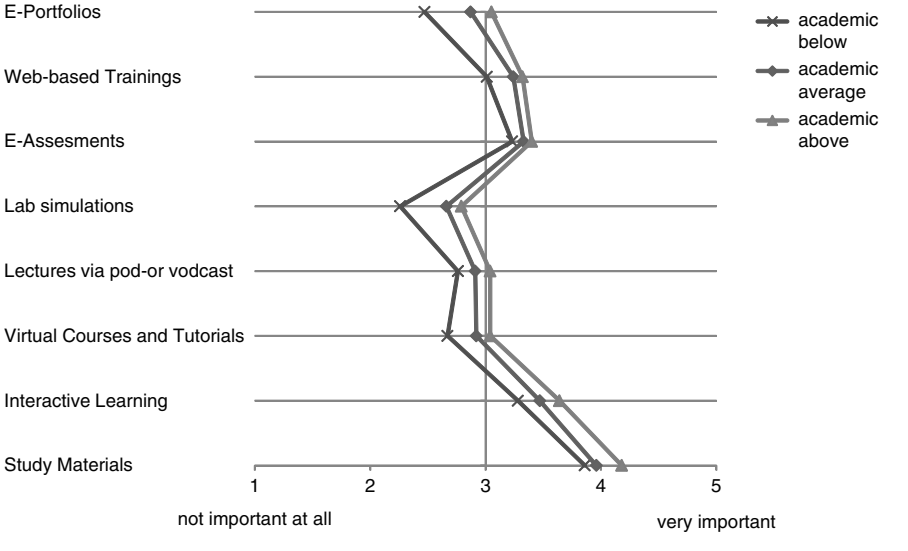

Figure 4. Importance assessment of the digital learning formats according to the degree of academic orientation.

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Results of the multivariate regression analysis

The multivariate regression analysis provides a descriptive overview of (selected) possible factors that have an impact on the importance assessment of digital learning formats. Multivariate analysis can illustrate relationships in detail and minimise the distortion of possible overlapping effects between variables (e.g. subject of study and orientation pattern). As part of the multivariate regression analysis, predictors of the importance assessment of digital learning formats were identified (see Table 2). Table 2 presents the regression coefficients (b), the standard errors in parentheses and the standardised regression coefficients (ß), allowing a comparison of the impact of the different predictors. The model explains 25% of the variance.

Considering the individual-related characteristics, extrinsically motivated students and those who are highly motivated in terms of performance assess the use of digital learning formats in the university context as more important than other students do. In contrast, intrinsic motivation and the lack of motivation do not have a significant influence on the importance rating. Students with a high degree of practical orientation value the importance of digital learning formats to a significantly higher level; however, academic orientation does not have a significant impact within the multivariate model.

Age, gender and the migration background of students were included as control variables. Students with a migration background assess the application of

Table 2. Determinants of the importance assessment of digital learning formats.

	OLS-regression		
Importance assessment of the digital learning formats	b	SE	ß
Individual-related characteristics			
Extrinsic motivation	0.08**	0.03	0.06
Performance motivation	0.09**	0.02	0.10
Intrinsic motivation	0.00	0.03	0.00
Lack of motivation	0.02	0.02	0.02
Practical orientation	0.16**	0.02	0.13
Academic orientation	0.01	0.02	0.01
Age	−0.02**	0.01	−0.07
Gender (Ref. female)	0.03	0.03	0.02
Migration background	0.18**	0.04	0.09
Programme-related characteristics			
Field of study (Ref. social science)			
Economics	0.13**	0.04	0.07
Engineering	0.11**	0.04	0.06
Frequency of use of digital learning formats	0.25**	0.03	0.18
Innovation-related characteristics			
Number of working hours (besides university) per week	0.00	0.00	0.00
Family commitments	0.10 +	0.06	0.03
Summer schools	0.10**	0.01	0.15
Tuition fees per study module	0.06**	0.01	0.10
Unusual course times	0.06**	0.01	0.08
Longer periods of self-study	0.11**	0.01	0.14
Flexible examination system	0.10**	0.02	0.10
N/R^2		2424/0.25	

Note: **p <.01, + p <.10.

digital learning formats as being more important than students with no migration background. Age has a negative effect on the importance assessment; that is, older students assess the importance of digital learning formats at a lower level than younger students do. Gender has no effect on the importance rating.

All programme-related characteristics have a significant impact on the importance assessment of digital learning formats. Economics and engineering students assess the application of digital learning formats in the university context as being more important than students in the social sciences do. The effect is found to be strongest for economics students ($ß = 0.07$). The frequency of using digital learning tools has the highest impact on the importance assessment. Students who are familiar with digital learning tools assess them – based on their experience – as more being important than students who had little contact with digital learning environments.

Considering the innovation-related characteristics, it can be seen that demands due to employment while studying do not increase the importance assessment of digital learning formats. Students with additional family commitments show a slight tendency towards a higher importance assessment; however, the effect is only marginally significant ($p < 0.10$). Students with a stronger demand for various flexible and innovative ways to learn (summer schools, longer periods of self-study, etc.) assess the importance of digital learning formats consistently higher than students who have no need for flexible ways of learning.

Discussion

The results of this survey provide an insight into the predictors that influence students' importance assessment of digital learning formats. Based on the descriptive analysis, it is clear that orientation patterns have a visible effect: students with a high practical orientation value digital learning formats significantly higher than students with lower practical orientation. A positive correlation was also found concerning academic orientation; however it is less significant.

The multivariate analysis differentiated between individual-related, programme-related and innovation-related predictors (Küpper 2005). Each of these categories is discussed below.

Individual-related impact criteria

Considering the individual-related predictors, hypothesis 1a cannot be confirmed: intrinsic study motivation and high academic orientation have no significant impact on the importance assessment of digital learning formats. However, evidence was found for hypothesis 1b: students with high extrinsic motivation and a distinct practical orientation, value the importance of digital learning formats significantly highly. Moos (2014) shows that students who are more extrinsically motivated monitor personal learning goals more frequently than others. Therefore, one reason for valuing the importance of digital delivery modes higher may be that digital delivery modes can support extrinsically motivated students monitoring their individual learning process systematically. Nevertheless, it must be taken into account that this result may refer especially to those digital delivery modes and design features that enable students to document their learning process and personal learning progress. Aside from extrinsic and intrinsic study motivation, performance motivation and the lack of motivation were embedded for explorative reasons, resulting from the factor analysis. While the

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lack of motivation has no impact on the importance assessment, performance motivation appears to be a significant predictor. This kind of motivation ('mastery motivation', according to Harackiewicz *et al.* 1997) primarily explains the individual urge to feel competent and to deliver a good performance. Hence, it can be considered as a specific kind of intrinsic motivation. The non-significant result for (general) intrinsic motivation may be explained by the performance motivation (the most important intrinsic impact factor on the assessment of digital learning formats) being assigned to a separate variable.

Programme-related impact criteria

Programme-related predictors have a constant and significant impact on the importance assessment of digital learning formats in higher education. Hypothesis 2a can be confirmed: students in economics value digital learning formats more highly than students in the other disciplines considered. In comparison to students majoring in social sciences, a significantly positive effect can also be observed for engineering students. The results show that the frequency of the use of digital media in a particular programme positively influences the perceived importance. Hypothesis 2b can therefore be confirmed: through the active use of the respective media, students may come to realise to what degree digital learning formats lighten the study routine and make it more productive. In other words, without the knowledge of a tool's usefulness, there is no reason to find it important (Küpper 2005, p. 150).

Innovation-related impact criteria

Finally, the influence of innovation-based characteristics on the importance assessment of digital learning formats in higher education was tested. Referring to the theoretical background developed by Küpper (2005), particular predictors can be identified that focus on the aspect of personal, relative advantage through the use of digital learning formats. Hypothesis 3a states that students who are under time constraints due to their employment, value digital learning formats as being beneficial and therefore more important. However, there is no evidence to confirm this hypothesis. There is a marginal effect for students with family obligations; thus hypothesis 3b can be partly confirmed. There is a tendency for students with family duties to value the flexibility regarding time and space as being beneficial and important; and such flexibility is supported by means of digital learning formats. However, this effect is vague and its significance is considerably weaker than that of other predictors (e.g. motivation, practical orientation, programme-related characteristics). Hypothesis 3b can be confirmed: students expressing a need for innovative and flexible learning formats at university and rated digital learning formats higher. The effect is confirmed for all innovative and flexible learning formats covered in the questionnaire.

Implications and the need for further research

It can be concluded that various predictors influence the importance assessment of digital learning formats in the university context. In particular, motivation and orientation patterns of students play an important role regarding individual-related characteristics. It is clear that students with a practical orientation and a focus on

career opportunities value digital learning formats highly. Hence, fields with a high degree of practical orientation – for example, specialised and part-time executive master's programmes, or at universities of applied sciences – should meet these needs by incorporating a range of digital learning formats as essential components in study programmes.

Open questions remain for further research. Motivation and orientation patterns seem to be important for the assessment of digital delivery modes. However, the topic can be analysed in more detail, for example, focusing the question, if special design features of digital delivery modes may address different types of motivation. Furthermore, the existing data covers only assumptions on why digital formats are valued more highly in certain fields of study. However, it is clear that being familiar with digital learning formats (and therefore having the skill to use them and to estimate their benefits) significantly and immediately increases the assessment of their importance. University educators should therefore familiarise students with digital learning formats and instruct them in working with them professionally. This implies, however, that educators need to be given the opportunity for further training in instructional design for online learning and teaching, as well as the chance to implement such practices (Kerres *et al*. 2005).

With regard to innovation-based predictors, the results show that the impact of external criteria (number of working hours, family obligations) is smaller than expected. Students who are open-minded and have a high interest in innovative and flexible forms of teaching and learning, also value digital learning formats as being more important. A subsequent analysis would be required to examine which factors particularly increase the demand for flexible (and therefore also digital) learning formats. In further studies, it would be useful to examine to what extent certain study structures (e.g. mass lectures) in particular fields raise the importance assessment, or if personal preferences of certain student groups (e.g. positive attitude towards technology) play an important role.

Conclusion

Based on Küpper's model, this study transfers various predictors that influence the acceptance and importance assessment of digital media in businesses settings to the university context (Küpper 2005) and confirms their impact. Furthermore the model showed its usefulness as a theoretical approach to structure various aspects of student's acceptance of digital media. Recommended actions for instructional design and for target group orientation at higher education institutions have been presented, which are necessary to match the needs of learners with digital learning tools (Sankaran and Bui 2001). At the same time, this analysis provides the impetus to examine certain aspects more closely (e.g. impact of subject discipline). Subsequent studies will be helpful in order to assess and implement the needs and application of digital learning formats in universities tailored to the needs of specific target groups. These target groups will be more experienced in using digital technologies and therefore do expect universities to give them proper and high quality digital learning opportunities. This study revealed some hints how teachers, lecturers and course designers could select the right media for the right target groups.

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Notes

1. There are previously published analyses basing on data of the Stu + Be-project, dealing with different issues of Higher Education (Mertens 2013; Wilkesmann and Virgillito 2012). Moreover, one anthology has been published, summing up some results of the Stu + Be-project (Kerres *et al.* 2012).
2. In the survey, a clear distinction is made between Economics (economic subjects, business studies) and Social Science (Psychology, Sociology, Political Science, Education).
3. Based on the Kaiser Meyer Olkin criterion, the measure of sampling adequacy is good (0.833). A varimax rotation with Kaiser normalisation was used as the rotation method.
4. The items were included as single items because they do not show sufficient reliability for scale construction. Although the items can be assigned to a common dimension ('more open and flexible ways to learn' and 'time-based flexibility of learning'), they correlate with each other only weakly. Therefore, including them as single items does not provoke any multicollinearity bias.
5. The dummy variable 'migration background' takes the value '1' if the interviewee does not have German citizenship or if Germany is not the home country of one or both of the interviewee parents.

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