Feature-Driven Adoption Patterns of Online Learning Environments – The Instructors' Perspective

Margit Kastner
Vienna University of Economics and Business
margit.kastner@wu.ac.at

Bernd Simon
Knowledge Markets Consulting GmbH
bernd.simon@km.co.at

Michael Schraml
Vienna University of Economics and Business
michael.schraml@wu.ac.at

Abstract

In the educational domain Online Learning Environments (OLEs) have become part of many institutions' Information and Communication Technology (ICT) infrastructure. As revealed by previous studies, instructors in combination with their ability to utilize ICT are the key for creating an effective OLE. While previous work mostly focused on the identification of adoption barriers, this study investigates drivers related to OLE's main functions. By applying the paired comparison technique and analysis of more in-depth questions we can conclude that feature-driven adoption patterns are determined by variables such as instructor's age and experience with OLEs, while gender only partly influences the adoption of OLEs. Based on these findings, concrete practical conclusions can be drawn for providers of OLEs and the governing body of schools using these OLEs.

1. Introduction

Nowadays, Online Learning Environments (OLEs) have become part of the basic infrastructure for teaching and learning. In general, an OLE takes advantage of Information and Communication Technology (ICT) to support the management of learning materials (e.g., syllabus, literature, slides) as well as the interaction between the instructor and students (e.g., notifications, assignments) or between students and students (e.g., student wikis) [1]. OLEs with all the plethora of features available offer new pedagogical ways but the impact on students' learning varies [2]. Hattie [3] investigated 4,498 studies by analysing 76 meta-studies and concluded that the positive effect of ICT in the classroom is heavily influenced – amongst other drivers – by factors such as (a) diversity in teaching strategies, (b) pre-training in the use of ICT, and (c) the provision of multiple learning opportunities. Hence, instructors in combination with their ability to utilize ICT are the key for creating an effective OLE.

While studies have revealed that instructors differ in their technology use [4], little is known about what drives instructors' perception and utilization of ICT in the classroom [5]. This means that we need a clear understanding of how instructors use educational technology and what drives usage.

So far research has mostly focused on the identification of adoption barriers (vs. drivers) of ICT in the classroom. Barriers to applying technology in education are manifold. Pajo and Wallace [6] grouped them into personal, attitudinal, and organizational barriers. Personal barriers include instructors' limited time to practice [4, 6, 7, 8], to develop online materials [9], and to plan how to implement this technology [4, 6, 8]. In addition, the increased workload with online teaching [8] and insufficient knowledge [9] are reported. Attitudinal barriers are related to an instructor's unwillingness to work with technology, no belief in technology [6], the missing vision or rationale for the application [4], concern about student access [9], and a lack of extrinsic incentives/rewards [cited in 10]. Recognized organizational barriers are inadequate hardware and software or depreciation of the value of online teaching by the institution [6]. Furthermore, a lack of assistance, training as well as administrative and technical support is stressed [4, 6, 8, 9]. A study by Betts [7] exposes that support should not only concentrate on the development of skills to use new technologies but also on course design, teaching strategies, and merits of online education techniques by offering pedagogical development e.g., hands-on trainings, coaching, tutorials, or guided practices.

As far as drivers of adoption are concerned, Lee and Busch [11] and Wilson et al. [12] prove that attitudes are more important than personal factors. For example, instructors' interests have a higher relevance than their knowledge and skills [12] and the perception of appreciation of instructors' effort is positively

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related to the willingness to teach online and not to the actual effort and time needed to develop course materials [11]. Though, many instructors perceive that their effort is not valued [12]. Organizational factors are the principal's and leading teachers' vision and motivation and the history of innovations in a given institution [13].

Besides investigating barriers Mahdizadeh et al. [5] also point out that ICTs such as general communication features (e.g., e-mail, mailing lists), information features (e.g., calendar, news), and content management features (e.g., presentation of literature, slides) are most often used by instructors. Features such as chat, online discussions, online collaboration, shared whiteboards, and interactive modules or simulations are seldom applied. Taken together the authors conclude that instructors only use the very basic features and not the full power of OLEs to support higher level learning processes. However, the study did not take into account if the adoption of OLE features differs for certain user groups and how important the diverse functions of OLEs are perceived to be by instructors.

Since instructors are crucial for the effective utilization of OLEs by students [14], and, as a consequence for the success of OLEs, this paper therefore aims to obtain a better understanding of how diverse types of instructors use OLEs in order to facilitate teaching and learning. A feature-driven understanding of the adoption of an OLE, however, also has practical implications that are highly relevant when it comes to tuning and customizing an OLE for certain user groups. As development and customization resources are always scarce, improving ICT providers' knowledge of feature-related adoption drivers supports these providers in optimizing their resource investments.

2. Theoretical background and hypotheses

Age and teaching experience. Since younger instructors are often readily familiar with the new technology, it is commonly believed that they will use technology more intensively in their teaching practice [4]. ICT and its use in the classroom has also become a compulsory part of the curriculum of many colleges of education [15]. Hence, it is not surprising that Madden et al. [16] could confirm that older instructors with more teaching experience use ICTs less frequently within classes. As a matter of fact, these instructors have often developed their courses and their way of teaching several years ago; in many cases before the emergence of ICTs. Thus, quite often, OLE features only supplement existing courses [17] and are of a basic nature [5] and as such, the opportunities OLEs offer are underutilized and ineffective [18]. Only when ICT is rooted in the course design in a pedagogical way will it have a positive impact on learning [19] and this is easier when a course design is completely new and trainings of these new teaching techniques are received by teachers. Moreover, older instructors are less convinced of ICTs' importance to teaching [16]. Nonetheless, the lack of administrative support as a barrier to use OLEs is reported more often by teachers with 10 to 19 years of experience than by teachers with 20 or more years of experience [4]. Bebell [20] and Mahdizadeh et al. [5] – in contrast – discovered that the frequency of technology use is nearly the same regardless of how many years a teacher has been in the profession. However, younger instructors use technology more often for preparation and less frequently for delivery and during class time than the more experienced instructors [20]. Therefore, the first hypothesis is formulated as follows:

H1: Instructors of different age groups favor different functions of an OLE.

Gender. There is support in the research literature that males have more positive attitudes toward computers than females [21]. This is confirmed by the meta-analysis conducted by Witley Jr. [22] who found small but significant gender differences in computer-related behavior. This means that males are less anxious to use computers [21] and educational software [23]. Furthermore, web-based instructions have a higher value for males than for females [24], and male teachers integrate ICT in their classroom practice more often [25]. Since technology and computers nowadays belong to our workplace setting, it is claimed that computing is not a male domain any longer [26]. Thus, current studies report that there are neither gender differences for students' readiness for online learning [27] nor for teachers regarding their prospective ICT integration in class [28]. However, several scholars still identified gender differences in the intention to use OLEs and argue that easy to use functions are more likely used by females while it is most important for males that functions are useful and enhance their performance [29, 30]. In addition, male and female instructors also have a different teaching [31] and communication style [32] that also calls for the use of different functions. So, in relation to the above literature, we can state a second hypothesis:

H2: Male and female instructors prefer different OLE functions.

Experience with OLEs. Innovators and early adopters of e-learning tend to appreciate technology while the majority of instructors are not interested in online education [10]. Innovators or persons with more

experience are also more demanding because OLE features follow a life cycle which means that, based on the time of each feature's implementation and/or the frequency of usage, they are perceived as surprise, performance, or basic features [33]. According to West et al. [34] instructors usually do not use all features of OLEs right away. They rather start to utilize features that meet instructional or organizational needs. Based on how successfully the instructor manages the utilization, s/he will adopt more features, only use the essential ones, or discontinue usage. For this reason we can pose the following hypothesis:

H3: Instructors differ in the importance judgment of OLE functions with respect to their registration time.

Based on these hypotheses, Figure 1 depicts the expected relations.

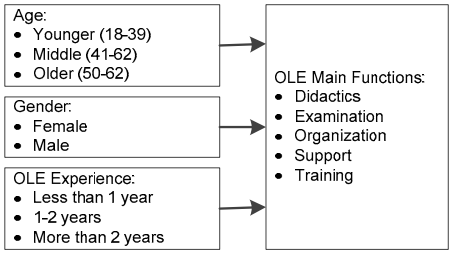

Figure 1. Research model

3. Research design

In a preliminary study, first the main functions of the OLE were identified. This was driven by the development of high-level user stories following the procedure described by Cohn [35]. The added value assigned to each of the high-level user stories differentiated between using the technology for (a) facilitating learning (i.e., didactics), (b) documenting learning results (i.e., examination), (c) organizing classes and courses, (d) providing ad-hoc support, and (e) training related to the particular OLE. Next, an expert panel was iteratively involved to assign concrete features to these user stories. Beyond core features such as file storage or discussions, additional training- and support-related services that can be accessed via the OLE were added (see Table 1).

For the present study we developed an online questionnaire based on previous literature and comments gathered from experts (including academics and practitioners) with significant experiences in online learning and the investigated OLE called *LMS* ("Lernen mit System"; English translation: "learning following a systematic approach"). The first part of the questionnaire concentrated on instructors' use of *LMS*, starting with a pairwise comparison of the *LMS* main functions didactics (D), examination (E), organization (O), support (S), and training (T) to establish an overall ranking of these functions. Then, the intensity of actual usage of all features belonging to these main functions has to be pointed out. This is followed by an open-ended question asking for instructors' perception of *LMS*'s value and enrichment. The second part consists of general items about instructors' demographics and their *LMS* experience.

After the pretest of the instrument, instructors registered at *LMS* were invited to participate in the study. The initial and follow-up mailing generated 361 usable responses.

Table 1. Main functions and features

Didactics (D): Assignments, chat, content-pools, discussions, file storage, learning resources, library, problem-based learning, seating plan, self-study material, study planner, wiki
Examination (E): Competencies, grading
Organization (O): Calendar, circular mails, course overview, FAQs, member management, news, photo album
Support (S): Hotline, local face-to-face support, peers, self-study material (*LMS* 4 Teachers), support by remote experts
Training (T): E-lectures, local trainings, on-site trainings, trainings organized by teacher training centers (TTC), webinars

4. Analysis

The Bradley-Terry (BT) model [36] is a technique for paired comparison with the aim to obtain an overall ranking of several items while persons only have to express their preference for a specific item when comparing several pairs of items. The basic BT model is defined by the following equation:

$$\Pi_{(jk)j} = \pi_j / (\pi_j + \pi_k)$$

This means that in a given comparison of item j to item k denoted by (jk), $\Pi_{(jk)j}$ is the probability that item j is preferred to item k. π_j and π_k are the non-negative 'worth' parameters describing the location of the item on the preference scale. In comparing the five *LMS* main functions, didactics (D), examination (E), organization (O), support (S), and training (T) $\binom{5}{2}$ comparisons are necessary. The results of instructors' *LMS* main function preferences are shown first.

The BT model can also be fitted as a log-linear model which holds the advantage that, besides the main effect, further parameters for the subjects, so called subject covariates, can be included which characterize the subjects [37, 38]. With regard to the research model (see Figure 1) these are the instructors' gender (G), age (A), and *OLE* experience measured by the time of registration to *LMS* (R). In this way

different rankings of the *LMS* main functions can be obtained for different groups of instructors defined by gender, age, and *LMS* experience.

To find a parsimonious model we use a backward elimination procedure. Following the model selection tree displayed in Figure 2 the most complex model which includes all possible interactions between the three subject covariates gender, age, and *LMS* experience as well as the items which are the *LMS* main functions is calculated first (i.e., model G + A + R + G:A + G:R + A:R + G:A:R of Figure 2). Next, the three-way interaction (i.e., G:A:R) is removed and the model with all two-way interactions (i.e., model G + A + R + G:A + G:R + A:R) is estimated. Then, one two-way interaction after the other is omitted (e.g., A:R) and the respective models are computed before excluding either gender, or age, or *LMS* experience. Afterwards, the main-effect models (e.g., model G + A + R) and finally the basic model (i.e., model 0) are run. The last step of the selection process is the calculation of deviance differences of the nested models and the significance of these changes to determine which subject covariates and interactions are retained in the final model. The final model is that in which all non-significant subject covariates and interactions are omitted. All calculations are done by the use of the package 'prefmod' by Hatzinger and Dittrich [39] available in R.

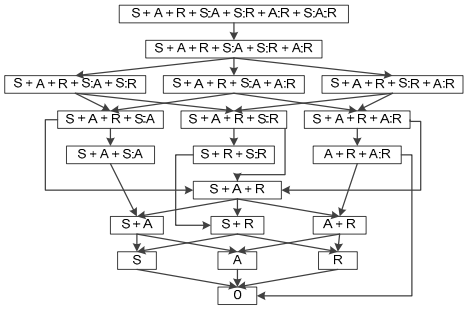

Figure 2. Model selection tree

For a better insight, usage differences or similarities of all *LMS* features are assessed for instructors with different gender, age, and *LMS* experience. Gender differences are judged by applying an independent t-test that tests whether two groups have the same mean. For the inspection of age and *LMS* experience differences, where we compare three groups, we perform two ANOVAs. The ANOVA tells us whether three or more means are the same and generates an F-statistic similar to the t-test because it compares the amount of systematic variance in the data to the amount of unsystematic variance [40].

In addition, instructors were asked to comment whether *LMS* is valuable and enriches their work or not. As suggested by MacQueen and Guest [41] the comments to this open-ended question were collaboratively coded. This means that the answers were first coded by one coder. Then, the coding list and the original answers were inspected by the second coder to confirm the coding. Whenever the second coder disagreed with the coding of the first coder both coders debated the particular answer and code to find a solution acceptable for both coders. For visualization purposes, tag clouds applying R [42] are utilized that facilitates interpretation.

5. Results

5.1. Sample description

After data cleaning, 361 questionnaires are usable for the purpose of this study. The data was gathered from teachers working in primary schools up to teachers in academic secondary schools who have access to *LMS*. Among the respondents 64.8% are female and 35.2% are male. This gender distribution matches that of the teacher population in the country (χ^2 goodness-of-fit test for female teachers: χ^2=1.497, p=0.699; for male teachers: χ^2=.305, p=0.581). The age of teachers ranges from 18 to 62 years, with a mean of 43.4 years. This means that on average they have already worked for 17.1 years in their jobs. Another χ^2 goodness-of-fit test proves that the age of the teachers in the sample is in accordance with the population (for all age groups: χ^2=0.009 to χ^2=1.097, p>0.295). Hence, there is evidence that the sample is representative [43].

5.2. Instructors' *LMS* adoption

For the purposes of an accessible and general overview, instructors' general preferences regarding the five *LMS* main functions didactics (D), examination (E), organization (O), support (S), and training (T) are calculated and displayed in Figure 3.

Figure 3. Instructors' *LMS* adoption

It becomes evident that the didactics and organization functions are most strongly preferred, followed by examination and finally training and

support with the lowest values. When calculating the parameter estimates and the corresponding standard errors, the last item (training) is set to zero as a reference. All estimates turned out to be significant, i.e., the importance of these functions is different (see Table 2).

Table 2. Estimates of the basic model

item	estimate	se	z	p-value
O	0.573	0.037	15.356	<0.001**
D	0.606	0.038	16.115	<0.001**
E	0.393	0.036	10.840	<0.001**
S	-0.182	0.037	-4.902	<0.001**
T	0.000			

In the next step, the effect of the subject covariates on the *LMS* main functions is evaluated starting with the model selection. Therefore, we calculated all models shown in Figure 2 starting with the most complex model and, also, the deviance changes between the models. The inspection of these deviance changes exhibits that the change is highly significant for all models that omit the interaction effect between gender and experience (G:R) and for all models that remove the subject covariate age (A) (see Table 3).

Table 3. Model selection

Model	omit	deviance change	df	p-value
G+A+R+G:A+G:R+A:R+G:A:R	G:A:R	24.299	16	0.083
G+A+R+G:A+G:R+A:R	A:R	18.266	16	0.309
G+A+R+G:A+G:R+A:R	G:R	15.909	8	0.049**
G+A+R+G:A+G:R+A:R	G:A	7.207	8	0.515
G+A+R+G:R+A:R	A:R	18.327	16	0.305
G+A+R+G:A+G:R	G:A	7.268	8	0.508
G+A+R+G:R+A:R	G:R	17.446	8	0.026**
G+A+R+G:A+A:R	G:A	8.752	8	0.364
G+A+R+G:A+A:R	A:R	18.911	16	0.273
G+A+R+G:A+G:R	G:R	16.547	8	0.035**
G+A+R+G:R	G:R	17.920	8	0.022**
G+A+R+A:R	A:R	18.801	16	0.279
G+A+R+G:A	G:A	8.642	8	0.373
G+A+R+G:R	A	27.625	8	0.001**
G+A+R+A:R	G	1.816	4	0.770
G+A+R+G:A	R	9.480	8	0.304
G+A+R	G+A+R	39.059	20	0.007**
G+A+R	R	8.900	8	0.351
G+A+R	A	29.538	8	0.001**
G+A+R	G	1.473	4	0.831
G+A+G:A	G:A	8.062	8	0.428
G+R+G:R	G:R	19.832	8	0.011**
A+R+A:R	A:R	18.459	16	0.298
G+A	G	9.713	12	0.641
G+A	A	36.520	16	0.002**
G+R	R	27.653	16	0.035**
G+R	G	21.516	12	0.043**
A+R	R	27.537	24	0.280
A+R	A	48.207	24	0.002**
G	G	1.700	4	0.791
A	A	28.507	8	<0.001**
R	R	7.838	8	0.445

As the subject covariates gender (G) and experience (R) are included in the significant two-way interaction effect (G:R) these subject covariates cannot be removed from the model. In addition, age (A) needs to be retained in our model. Hence, the final model is G + A + R + G:R showing that all three subject covariates and one interaction between two of the covariates play a role for the ordering of the *LMS* main functions.

Table 4 reflects the output of the final model incorporating the estimates for the *LMS* main functions (coefficients in line 1:4), the estimates of the one-way interactions with one subject covariate (line 6:24), and, finally, the two-way interaction terms with two subject covariates (line 25:32).

The highly significant coefficients for organization (0.534), didactics (0.626), and examinations (0.318) imply that the importance of the *LMS* main functions is perceived differently. Between training and support no difference is detected.

Table 4. Estimates of the final model

item	estimate	se	z	p-value
O	0.534	0.101	5.271	<0.001**
D	0.626	0.103	6.075	<0.001**
E	0.318	0.099	3.218	0.001**
S	-0.053	0.100	-0.522	0.602
O:A2	-0.097	0.093	-1.038	0.299
D:A2	-0.078	0.093	-0.840	0.401
E:A2	-0.068	0.091	-0.753	0.451
S:A2	-0.143	0.091	-1.566	0.117
O:A3	-0.301	0.094	-3.205	0.001**
D:A3	-0.214	0.095	-2.263	0.024**
E:A3	-0.421	0.091	-4.612	<0.001**
S:A3	-0.248	0.093	-2.664	0.008**
O:R2	0.184	0.119	1.556	0.120
D:R2	0.052	0.120	0.429	0.668
E:R2	0.291	0.116	2.511	0.012**
S:R2	0.065	0.118	0.553	0.580
O:R3	0.292	0.117	2.484	0.013**
D:R3	0.148	0.119	1.241	0.215
E:R3	0.344	0.114	3.006	0.003**
S:R3	-0.002	0.116	-0.015	0.988
O:G2	0.306	0.174	1.756	0.079
D:G2	0.103	0.173	0.595	0.552
E:G2	0.240	0.166	1.445	0.149
S:G2	-0.129	0.174	-0.741	0.459
O:R2:G2	-0.168	0.227	-0.746	0.456
D:R2:G2	0.080	0.226	0.355	0.723
E:R2:G2	-0.287	0.216	-1.327	0.184
S:R2:G2	-0.016	0.225	-0.071	0.943
O:R3:G2	-0.551	0.210	-2.625	0.009**
D:R3:G2	-0.232	0.210	-1.109	0.267
E:R3:G2	-0.326	0.202	-1.613	0.107
S:R3:G2	0.127	0.210	0.604	0.546

It is further revealed that age influences the instructors' preference of the *LMS* main functions (*H1*). The interactions O:A3, D:A3, E:A3, and S:A3 suggest that the importance of the functions we named

as organization, didactics, examination, and support is significantly lower for instructors between 50 and 62 years than for instructors of the other age groups (e.g., the estimate for the youngest group of instructors for the organization function is: 0.534, for the group of middle-aged instructors: 0.534-0.097=0.437, and for the oldest group of instructors: 0.534-0.301=0.233). Therefore, *H1* is treated as empirically confirmed.

H2 presumed that gender impacts instructors *LMS* main function preference. Results show that the overall gender effect seems negligible. Though, a two-way interaction effect depicts that experienced males put less weight on the organization function than others (O:R3:G2). Accordingly, *H2* is only partly confirmed because merely the organization function is perceived differently.

The coefficient for the E:R2 and E:R3 interaction points out that instructors who have already had experience with *LMS* for more than one year have a much higher preference for using the examination function. Furthermore, instructors with the longest experience also have a significantly higher preference for the organization function (interaction O:R3). Consequently, *H3* is supported.

In addition, the preference plot resulting from the above analysis is displayed in Figure 5. It is informative to examine it in detail because there we see the interaction between all three subject covariates.

For the older cohort (50-62 years) there is an increase in the relevance of the training and didactics function while it is the other way round for examination and organization.

Table 5 outlines that this finding is also confirmed by inspecting instructors' actual usage. An ANOVA exhibits that the oldest cohort uses the offered training alternatives (trainings organized by teacher training centers, local trainings, and e-lectures) more often than the other age groups although usage in general is rather low. Especially, the feature study planner is more often employed as a didactical feature by the older instructors while the reverse is true for chats. In addition, the grading feature is more often used by younger instructors. Although the organization function decreases in importance the older the instructors are, the actual usage for most organizational features is not that different between all age groups; for FAQs we can even observe a more intensive usage.

Let us return to Figure 5. Now we compare females and males with less than one year's experience. We see that for females didactics is more important than organization while it is the other way round for males. Then, we have the opposite picture: for females between 18 and 49 who are registered for a longer time period, organization is more important than didactics and for males didactics is more important than organization. Females and males belonging to the oldest group order didactics and organization in the same sequence. However, didactics is far more important for males. Usage differences can also be observed by inspecting Table 5. In general, instructors use all features more often the more experienced they are. This is even true for most of the features belonging to the support and training functions.

Regarding examination we can also detect gender differences. These can be especially viewed if we compare the most experienced female and male instructors. Male instructors in the age range between 40 and 49 rank the examination function higher than the organization function (Figure 5). Again, the finding is supported by the actual usage of the grading feature (Table 5).

5.3. Value of *LMS*

In order to get more detailed insights the instructors were asked to comment on whether *LMS* is valuable and enriches their work or not. Out of 233 comments only 16 were negative.

These comments again reflect the empirical findings that the oldest cohort values the system also for didactical reasons (see Figure 4) because it allows for self-paced learning and provides additional possibilities for students to practice. Further, it gives a good overview for the students, allows for the exchange of learning materials and for access to all resources around the clock. In general, it is perceived to be an enrichment that has the power to enhance students' motivation, boost their interest, and provides higher pleasure in their learning. Instructors can give immediate feedback that is personalized to the student and communication in general is simplified. Furthermore, grading is more transparent due to the system. On the negative side, a few struggle with ease of use of the system and think that the adaption rate is rather long. Hence, they would like alternative OLEs.

Figure 4. Older instructors' perceptions

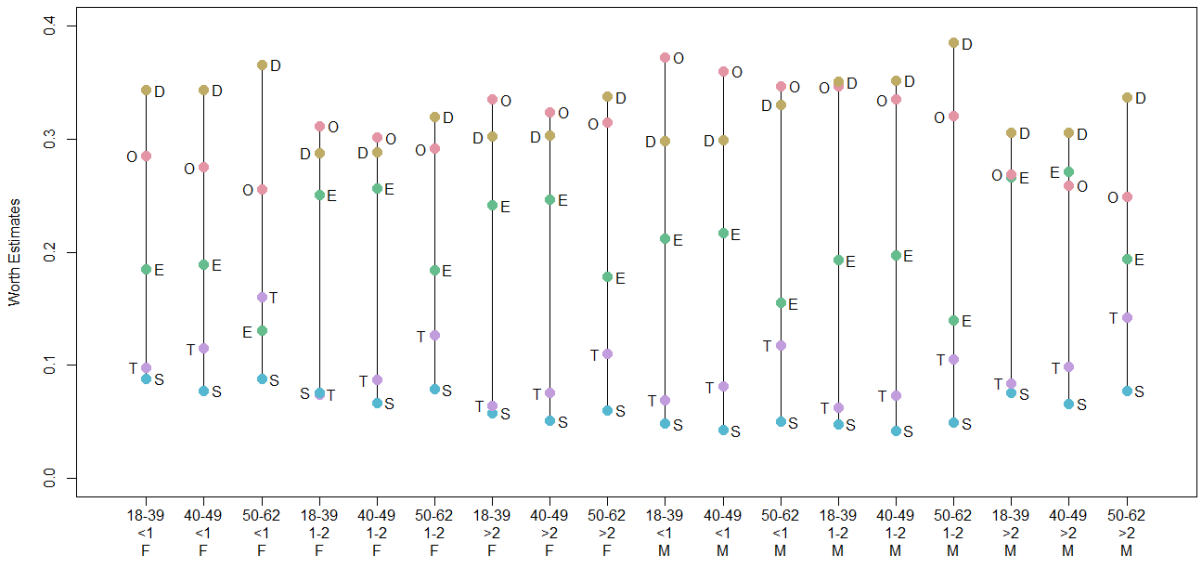

Figure 5. Instructors' *LMS* adoption patterns

Table 5. Usage of *LMS* features

LMS main functions and features	Age				Experience				Gender		
	18-39	40-49	50-62	p-value	<1	1-2	>2	p-value	F	M	p-value
D Assignments	2.66	2.76	2.81	0.815	3.24	2.88	2.37	0.001 **	2.83	2.58	0.177
D Chat	5.02	5.42	5.28	0.041 **	5.48	5.28	5.08	0.053 *	5.25	5.23	0.940
D Content Pools	4.55	4.50	4.27	0.429	4.60	4.54	4.29	0.309	4.56	4.23	0.472
D Discussions	4.66	4.61	4.97	0.174	4.92	4.94	4.49	0.036 **	4.83	4.58	0.215
D File storage	3.32	3.49	3.38	0.769	3.59	3.47	3.24	0.323	3.32	3.54	0.165
D Learning resources	2.46	2.62	2.60	0.695	2.85	2.70	2.29	0.020 **	2.53	2.60	0.492
D Library	3.83	3.46	3.47	0.236	4.07	3.67	3.28	0.009 **	3.71	3.38	0.177
D Problem-based learning	5.08	5.00	4.74	0.183	5.04	4.83	4.99	0.562	4.98	4.89	0.803
D Seating plan	4.58	4.51	4.85	0.271	4.82	4.88	4.37	0.022 **	4.79	4.37	0.008 **
D Self-study material	4.04	4.14	3.69	0.148	4.21	4.13	3.71	0.062 *	3.95	3.99	0.545
D Study planner	5.23	5.30	4.84	0.025 **	5.13	5.08	5.18	0.827	5.10	5.19	0.418
D Wiki	5.19	5.07	5.01	0.571	5.01	5.07	5.15	0.724	5.16	4.96	0.224
E Competences	4.55	4.39	4.19	0.295	4.35	4.39	4.39	0.985	4.39	4.37	0.865
E Grading	2.49	2.70	3.07	0.089 *	3.21	2.89	2.37	0.006 **	2.86	2.53	0.009 **
O Calendar	3.71	3.52	3.84	0.408	4.11	3.82	3.36	0.007 **	3.66	3.73	0.856
O Circular mails	4.09	4.21	4.25	0.762	4.47	4.47	3.80	0.002 **	4.06	4.40	0.551
O Course overview	2.42	2.30	2.65	0.268	2.76	2.53	2.22	0.040 **	2.36	2.61	0.016 **
O FAQs	5.09	5.23	4.78	0.032 **	4.94	5.08	5.06	0.736	5.07	4.98	0.085 *
O Member management	2.60	2.36	2.51	0.474	3.18	2.48	2.12	<0.001 **	2.49	2.50	0.591
O News	3.54	3.59	3.50	0.924	3.69	3.63	3.40	0.389	3.46	3.70	0.256
O Photo Album	5.10	5.07	4.97	0.769	5.20	4.91	5.08	0.337	5.06	5.03	0.276
S Hotline	5.26	5.03	5.00	0.288	5.40	5.22	4.85	0.006 **	5.18	4.94	0.002 **
S Local face-to-face support	4.94	4.38	4.26	0.006 **	4.59	4.73	4.36	0.227	4.50	4.61	0.626
S LMS4Teachers	4.30	4.28	3.85	0.092 *	4.20	4.38	3.94	0.114	4.16	4.13	0.554
S Peers	4.18	3.80	3.88	0.250	4.02	4.08	3.83	0.508	3.90	4.06	0.524
S Support by remote experts	4.88	4.63	4.32	0.046 **	4.66	4.83	4.44	0.169	4.57	4.72	0.412
T E-lectures	5.14	5.37	4.89	0.033 **	5.29	5.14	5.06	0.464	5.19	5.06	0.804
T Local trainings	5.38	5.11	4.93	0.039 *	5.26	5.33	4.95	0.052 *	5.24	4.98	0.142
T On-site trainings	4.40	4.16	3.86	0.059 *	4.42	4.33	3.86	0.021 **	4.22	4.02	0.661
T Trainings org. by TTC	5.51	5.41	5.41	0.716	5.53	5.48	5.38	0.570	5.49	5.36	0.045 **
T Webinars	4.96	4.95	4.57	0.124	5.15	4.83	4.66	0.093 *	4.79	4.91	0.016 **

Actual usage measured on a 6-point Likert scale ranging from 1=extremely often to 6=extremely seldom
** Significant at a 0.05 level; * Significant at a 0.1 level.

Moreover, some users also comment that they use only a few features or that they hardly see benefits of the OLE.

For instructors between the ages of 40 and 49 years we can derive the higher preference for the examination function also from the word cloud in Figure 6. Most often mentioned were that grading is more transparent and that students and their parents have access to the grades at all times. Therefore, no surprises will occur at the end of the semester. In addition, *LMS* facilitates the organization and the allocation of learning material. It is also perceived as a great tool for the submission of homework and communication with students.

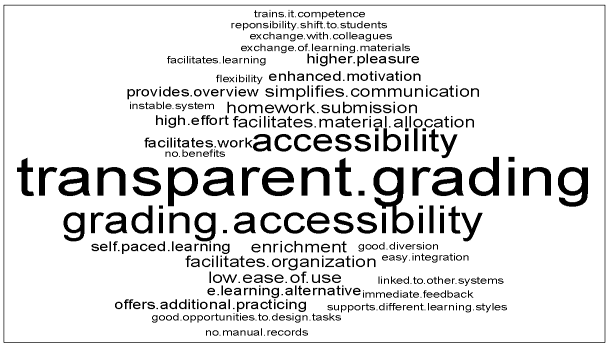

Figure 6. Middle-aged instructors' perceptions

The statements from the youngest instructors stress grading transparency. Besides the access to the grade-book, the allocation of materials and the communication features are valued and belong to the few, rather basic, features they use (see Figure 7).

Figure 7. Younger instructors' perceptions

6. Conclusion and implications

The study's aim was to investigate which functions of an OLE are valued by instructors.

Findings suggest that the didactics and organization functions are the most preferred ones. Then, examination is valued, and at the end of the list (and the least important) are the training and support functions. Although the ratings for didactics are high there is a clear trend of a stronger usage of basic OLE features (for details see Table 5) which is in agreement with the findings of Mahdizadeh et al. [5].

However, results of this study have shown that an undifferentiated view on the instructor population would be too short-sighted. It becomes evident that instructors' age, gender, and their experience with an OLE play an important role in the evaluation of the functions.

Older instructors, for instance, attach less importance to the functions organization, didactics, examination, and support than younger ones (Table 4). This might be explained by the fact that the older population is less familiar with ICT while young teachers have grown up with it [4] or received appropriate training during their teacher education [15]. Besides support and training, the oldest cohort also takes advantage of the didactical feature 'study planner' and the organizational feature 'FAQs' more often. These are very basic functions which can easily be supplemented to an existing course. Hence, this is in line with previous findings [5, 17]. On the other hand, grading is less important for the older instructors than for the younger ones, which can be depicted from Table 5. This is also supported by the instructors' comments. In particular, transparent grading, the access to the grade-book for students and parents as well as the facilitated allocation of learning material are most often named as important by the younger instructors (Figure 6-7). The oldest cohort stresses enrichment, enhanced motivation, and self-paced learning more often than examination purposes (see Figure 4). This implies that a difference with respect to our analyses is detected because the documented lower usage of the didactical features does not reflect the fact that the older instructors aim to utilize OLEs to enhance their courses with functions to motivate their students. Perhaps this is the reason why the group suppresses a higher need for support and training. Important in this context is that the offered training concentrates on course design and teaching strategies as suggested by Betts [7]. Nevertheless, training for the development of skills to use these new technologies should not be disregarded because these instructors did not get the necessary training during their teacher education and they often need to catch up with their younger colleagues. Thereby, one of the most reported organizational barriers to the use of OLEs in education can be torn down [4, 6, 8, 9].

With regard to gender, no overall gender effect was detected in the evaluation of the importance judgment of the main functions of an OLE. Only in combination with the OLE experience was a preference difference for the organization function discovered. This result, while preliminary, might explain contradictory results

in previous studies. A glance at the actual usage of OLE features indicates that males use the seating plan, FAQs, the grading function, and the support offered via the provider's hotline more often than females. Since these are useful functions which facilitate work or yield a quick solution to problems and, thus, enhance the performance of male teachers, the ratings are consistent with previous research [29, 30]. The course overview function on the other hand is utilized more frequently by female teachers. In summary, we could hardly detect usage differences, meaning that male teachers do not integrate ICT in their classroom practice more often than female colleagues [25] and, thus, we cannot talk about a male domain [26]. However, the genders, do, according to our research, prefer different functions.

Pertaining instructors' experience with an OLE the study shows that more experienced instructors perceive the examination function as more valuable and have a significantly higher preference for the organization function than less experienced instructors. In addition, usage pattern displayed in Table 5 reveal that the more experienced an instructor is the more often OLE features are used. This finding corroborates the idea of West et al. [34], who suggest that instructors adopt at the beginning of their usage only a few essential features. Depending on the success of this adoption, utilization continues by the adoption of further features; or usage stops. Insights into these different adoption patterns allow us to conclude that there is a need for a customized pre-configuration of an OLE. One unanticipated finding is that more experienced instructors also use training more often than the less experienced ones. This could be grounded in the fact that instructors need more training for more sophisticated features or that the usage of the whole array of features needs more knowledge about how to match them in a meaningful way to enhance students' experience. Since we can only speculate about what the reasons for the higher usage could be, further research should be undertaken to be able to adapt future training to the specific needs of these experienced teachers.

Another important finding is that the observed difference between the preference value and the usage of the features. To close this gap and to boost usage several actions could be taken. Already mentioned is training that can either be offered by OLE providers or the governing body of the school. Since training is, in particular, rarely used, the latter could be combined with the introduction of extrinsic incentives/rewards which could be used to challenge other ICT usage barriers [cited in 10]. This incentive could for instance be a reduction of the teaching load so that instructors cannot bring in the arguments other researchers detected (e.g., no time to practice [4, 6, 7, 8], to develop online materials [9], and to plan ICT implementation [4, 6, 8]). In this way the governing body of the school would also value and appreciate successful utilization so that another barrier, the depreciation of the value of ICTs and OLEs specifically, is removed [6].

Taken together, this study provides a first valuable insight into the adoption patterns of instructors in relation to OLEs. However, this research has thrown up several new questions in need of further investigation. First, why are didactical functions highly valued and not intensively used? Does this behavior arise because of the missing training opportunity as suggested? Second, are there other factors such as the subject taught, the school, the school region, or the school type that affect the adoption of OLEs? Third, are there teacher groups we did not cover within our study since we used an online-questionnaire? All these questions call for more in-depth studies. These could either be personal interviews or postal questionnaires to reach all instructors. In conclusion, then, we are convinced that the development of OLEs is leading to them being more heavily used and becoming an even more important tool for facilitating education.

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