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Teachers‘ acceptance and use of an educational portal

Abstract

In this study, teachers’ acceptance and use of an educational portal is assessed based on data from two sources: usage data (number of logins, downloads, uploads, reactions and pages viewed) and an online acceptance questionnaire. The usage data is extracted on two occasions from the portal’s database: at survey completion (T1) and twenty-two months later (T2). Framework for this study is C-TAM-TPB (Combined Technology Acceptance Model and Theory of Planned Behavior). 919 usable responses from teachers are obtained. Based on the observed use data at T1, four types of portal-users are distinguished: ‘new’ (N=37), ‘light’ (N=641), ‘medium’ (N=201), and ‘heavy’ (N=40). Path analyses show that all predictor variables in C-TAM-TPB influence teachers’ portal acceptance, but their significance level varies depending on the user type. The strongest predictors of behavioral intention to use the portal are attitude (‘new’) and perceived usefulness (‘light’, ‘medium’ and ‘heavy’), with variance explained ranging from .39 (‘medium’) to .71 (‘heavy’). The observed use data show that the portal is primarily used to search for and download material, rather than for sharing material or information. The use data at T2 show that teachers become more efficient in their search behavior and that the majority of the teachers use the portal more frequently. Guidelines are proposed to policymakers and school boards aiming to introduce a similar technology to teachers.

Key words:

learning communities; secondary education; evaluation of CAL systems; human-computer interface

1. Introduction

With the spectacular growth in the number of users and the amount of information on the Internet, portals gain in significance as they bundle relevant information for their users (Jacoby & Luqi, 2005). The occurrence of portals is a logical next step in the evolution of (non-expert) end-user computing from stand-alone computers for personal use, via personal computers connected enterprise-wide, to computers interconnected throughout the Internet (Al-Mudimigh, Ullah, & Alsubaie, 2011). Within the broad variety of existing portals, a distinction can be made between portals targeting a broad audience, such as MSN or Yahoo! (so-called horizontal portals), portals aimed at specific communities or areas of knowledge (vertical portals or vortals), intranet or enterprise portals and Internet gateways (Pienaar, 2003; Singh, 2006). In view of the rich variety of portals, Singh (2006) first reviewed existing definitions and then defined portals in terms of three characteristics, being: (a) gateways to information, (b) user-centric and community-based, and (c) providing multiple services to the community.

Also in education, portals can prove their value, and the potential benefits of educational portals are acknowledged in many countries, such as Glow in Scotland, Kennisnet in Holland, and the National Educational Portal in Kenya. Previous research shows that teachers use a computer or technology primarily as a preparation or supportive tool (Ottenbreit-Leftwich, Glazewski, Newby, & Ertmer, 2010; Russell, Bebell, O'Dwyer, & O'Connor, 2003) rather than an instructional tool in the classroom (Mahdizadeh, Biemans, & Mulder, 2008). Using a technology or computer as a supportive tool refers to using it for pro-active and administrative tasks (van Braak, Tondeur, & Valcke, 2004), such as for student administration and evaluation, preparing worksheets and keeping track of pupils' learning progress. Technology integration in the classroom seems to be strongly related to and depend on the use of technology as a supportive tool (Wozney, Venkatesh, & Abrami, 2006). Teachers who are already regular ICT users have more confidence in using technology in their teaching (Cox, Preston, & Cox, 1999). In this vein, educational portals can play a facilitating role, as they help teachers to become familiar with and confident in using ICT. Portals

are very accessible, not threatening (use can hardly be imposed by school boards) and prove their value almost immediately (as soon as valuable information is retrieved). Educational portals can be utilized in two ways as a supportive tool during preparation, either to retrieve information or to share knowledge and information. In both cases, teachers benefit from using the portal. On the one hand, while searching for (specific) material, a teacher could gain new insights as fellow teachers might take a different angle on a given subject (Ottenbreit-Leftwich, et al., 2010). Moreover, teachers should also gain in efficiency as someone else may have already shared the sought-after lesson or learning material (Wasko & Faraj, 2000). On the other hand, a teacher who shares material could benefit from "peer review" ultimately leading to improved teaching material (Kankanhalli, Tan, & Wei, 2005; Lai & Chen, 2011; Wasko & Faraj, 2000).

1.1 User acceptance

Previous research indicates that it is vital for a portal that its users develop positive attitudes towards the portal from the beginning, and that the portal meets the expectations of its users so that their initially positive attitudes are endorsed (Al-Mudimigh, et al., 2011; Hong, Kim, & Lee, 2008). One way to assess portal users' attitudes is by conducting an acceptance study, as will be done here.

To assess teachers' acceptance of the portal, we draw on the literature on technology acceptance. Numerous models (see Venkatesh, Morris, Davis, & Davis (2003) for an overview) have been developed to explain and predict technology acceptance, which can be operationalized or measured either as attitude, behavioral intention, behavioral expectation, and/or use (either observed or self-reported) (Brown, Massey, Montoya-Weiss, & Burkman, 2002; Davis, 1989; Pynoo, et al., 2007; Venkatesh, Brown, Maruping, & Bala, 2008; Venkatesh, et al., 2003; Warshaw & Davis, 1985). If these different operationalizations for acceptance coexist, attitude serves as an antecedent to behavioral intention/expectation, which in turn predicts use (Davis, Bagozzi, & Warshaw, 1989; Pynoo, et al., 2011a; Venkatesh, et al., 2003).

Following an extensive review of the literature, four categories of constructs were presented as core determinants of acceptance (Venkatesh, et al., 2003). These pertain to: the usefulness of the

technology, the ease of use of the technology, norms in the social environment concerning use of the technology, and perceived behavioral control or facilitating conditions. The latter of these determinants refers to objective factors that facilitate the use of the technology. There is an ongoing debate as to whether the last two factors have a direct (Venkatesh, et al., 2003) or indirect (Venkatesh & Bala, 2008) effect on acceptance. Attitude is a possible fifth determinant that can serve both as a dependent and an independent variable. For this study, consistent with previous research (Chau & Hu, 2002; Taylor & Todd, 1995), we combine the Technology Acceptance Model (TAM) (Davis, 1989) and the Technology of Planned Behavior (TPB) (Ajzen, 1991), two models that build upon the Theory of Reasoned Action (Ajzen & Fishbein, 1980). This combined model incorporates the five determinants; see Figure 1.

In business settings, the technology's usefulness is typically identified as the main determinant for acceptance, whereas the impact of the other factors depends on the technology (voluntary or mandatory use) and population (gender, age, experience) studied. Our findings might differ from those in business settings because [a] educational institutions serve very different goals than profit organizations (P. J. H. Hu, Clark, & Ma, 2003) (i.e. economic return and efficiency are inferior to learning goal realizations) and [b] teachers have a large degree of autonomy during teaching and preparation, including the choice of technologies they use (Teo, Lee, Chai, & Wong, 2009). Therefore, we consulted the literature on teachers' acceptance of computers or other voluntary educational technologies. The results of this search are presented below.

Wang and Wang (2009) and Gong, Xu, and Yu (2004) investigated teachers‘ acceptance of web-based learning systems. Both studies found that perceived usefulness was the main driver of acceptance, while perceived ease of use only indirectly influences acceptance, through attitude and / or perceived usefulness. Other factors with a direct influence on acceptance of web-based learning systems are subjective norms (Wang & Wang, 2009), or attitude and computer self-efficacy (Gong, et al., 2004). In a study on teachers' adoption of teacher blogs, Lai and Chen (2011) found no effect of peer or supervisor influence or self-efficacy, while perceived usefulness, perceived ease of use,

compatibility (closely related to perceived behavioral control or facilitating conditions, see Venkatesh, et al., 2003) and school support had a positive influence on teacher blog adoption. In the case of student teachers' acceptance of computers, perceived usefulness is a consistently strong predictor of acceptance (Ma, Andersson, & Streith, 2005; Teo, 2009; Teo, Lee, & Chai, 2008), while the effect of ease of use is less strong (Teo, et al., 2008) or only indirectly through usefulness (Ma, et al., 2005; Teo, 2009). The effect of subjective norms on teachers' computer acceptance is mixed, Teo et al. (2008) found a direct effect, whereas Ma et al. (2005) found no effect. Facilitating conditions indirectly influenced computer acceptance (Teo, 2009; Teo, et al., 2008). Other variables with a beneficial effect on computer acceptance were attitude, self-efficacy and technological complexity (Teo, 2009). Hu, et al. (2003) assessed teachers' acceptance of PowerPoint at the start and completion of a four week training program. Perceived usefulness was the main predictor, together with self-efficacy, while subjective norms were important in the beginning. Ease of use only indirectly influenced acceptance.

To summarize, the main drivers for teachers to accept a voluntary educational technology or a computer are perceived usefulness and attitude, while perceived ease of use and constructs related to facilitating conditions are either less importance or influence acceptance only indirectly. The evidence on the effect of subjective norms is mixed, depending on the technology and on the source of the norms. Next to these core determinants, several other variables were tested, which were sometimes found to influence teachers' acceptance.

1.2 Research questions

Throughout this paper we investigate why teachers accept and use an educational portal, drawing on data from two sources: objective usage data collected through a query of the portal's database and self-reported questionnaire data. Users of a particular technology are typically evaluated as a single group, in which no personal characteristics except for gender and/or age are taken into account: e.g. students using WriteOne (Davis, Bagozzi, & Warshaw, 1992), teachers using Smartschool (Pynoo, et al., 2011a), etc. We argue, in line with the gender similarities

hypothesis (Hyde, 2005), that personal characteristics other than gender and age exist that have a more profound impact on technology acceptance. Previous studies have already found personality to influence users' technology acceptance (Devolder, Pynoo, Duyck, & Sijnave, 2008; Pynoo, Devolder, Duyck, & Sijnave, 2009; Sykes, Venkatesh, & Johnson, 2007), while technology users also differ in terms of technology readiness (Parasuraman, 2000) and innovativeness (Marcinkiewicz, 1993; Rogers & Shoemaker, 1971; van Braak, 2001). Pynoo et al. (2011a) also found that right from the beginning teachers seem to adopt a base frequency of logging into their institution's portal site. Assuming this is also a personal characteristic, we investigate whether taking differences between teachers in the frequency of portal usage into account leads to a better understanding of portal acceptance. In the past, portal users were grouped based on their average number of logins per month (Lee, Zufryden, & Drèze, 2003), and it was found that users who logged in more frequently used the portal more effectively. For this study, more usage parameters are collected: three parameters relating to search behavior (number of logins, downloads and page views) and two relating to sharing behavior (number of uploads and reactions). Hence, the preliminary question is: *Which user types can be discerned based on the number of logins, downloads, uploads, page views and reactions?*

Teachers' acceptance of the portal is assessed through a questionnaire in which the combined TAM and TPB model serves as the theoretical framework. To account for the differences between the teachers in their usage behavior, as a first step separate analyses per "usage type" are run, to subsequently investigate whether these differences are statistically significant. Hence, two research questions are put forward:

RQ1: for the various user types: to what extent can perceived usefulness, perceived ease of use, attitude, subjective norms and perceived behavioral control explain teachers' intentions and self-reported frequency of use of the portal?

RQ2: to what extent do the different user types differ in their acceptance of the portal?

<Insert Figure 1 about here>

2. Material and methods

2.1 The portal: KlasCement

The educational portal in this study is KlasCement (www.klascement.net), a portal created by and for teachers that is supported by the Flemish Ministry of Education and Training. Separate Belgian (www.klascement.be) and Dutch (www.klascement.nl) versions have been developed and the site can be consulted in Dutch and English.

Overall, three types of educational portals can be discerned (networking, organizational, and resource-based portals) (Butcher, 2002), yet a single portal may integrate characteristics of all three types, as is the case for KlasCement.

The networking is reflected in the community of Flemish and Dutch teachers for whom the portal is created. Although primarily intended for Dutch-speaking Belgian teachers when founded in 1998, everybody can now enroll and become part of the community. To retain membership, one has to login at least once per six months.

The portal is resource-based as the members can download and upload all kinds of information (documents, articles, websites, software, exercises, video, links to interesting events...), while the administrators also maintain sub-sites on or provide links to interesting (educational) projects such as Hot Potatoes, Open Source Software, Smartboard, etc. Members cannot download without limits. Upon enrollment, one receives a (limited) amount of points to consult pages, to download information, etc. Points can be gained by uploading information or by reacting on contributions of other members.

The organizational aspect is reflected in the organization behind the portal, EduCentrum vzw, that closely monitors the portal, but also actively searches for new innovations of potential interest to the members of the portal.

2.2 Data collection and instruments

The study is an online questionnaire, embedded in a portal evaluation survey, targeting all registered members of KlasCement, and is administered in March and April 2009. The total study

covers 18 topics and is estimated to take 10 to 15 minutes to complete. The acceptance part is only a small part of the evaluation, and consists of 22 items (see Appendix A) measuring the following constructs: perceived usefulness, perceived ease of use, perceived behavioral control, subjective norms, attitude, behavioral intention, self-reported frequency and self-reported intensity of use, and voluntariness of use. 7-point Likert scales anchored between '1: completely disagree' and '7: completely agree' are used for scoring, except for voluntariness (anchored between '1: mandatory' and '7: voluntary'), intensity of use ('1: as little as possible' to '7: as much as possible'), and frequency of use (from '1: never' to '6: several times a day'), while for attitude semantic differentials are used. Upon completion of the survey user information is extracted from the database (number of logins, downloads, uploads, page views, reactions; demographic information; etc.) (T1). The same information is extracted a second time on January 11, 2011 (T2).

2.3 Sample

Every portal member can fill out the questionnaire. yet, for this study we are only interested in the responses from teachers. Therefore, out of a total of 1139 responses, 220 non-teachers are removed following an inspection of their member profiles, resulting in a dataset of 919 teachers (649 female and 270 male teachers). The average respondent age is 39.73 years, with an average length of membership (at T1) of 24.70 months. By the time of the second use data extraction (22 months later), 55 teachers abandoned use of KlasCement.

2.4 Data analysis

The data are analyzed as shown in Figure 1. First, descriptive statistics and bivariate correlations are calculated. Scale reliability is established through Cronbach's alpha. Cluster analysis in SPSS 15.0 with Schwarz's Bayesian Criterion as clustering criterion is used to unveil user types: to achieve this the use parameters extracted at T1 serve as the input. Path analyses per usage type in AMOS 6.0 are performed to identify the factors contributing to teachers' acceptance of the portal (RQ1). The following fit parameters are taken into account to assess model fit: goodness-of-fit index (GFI), comparative fit index (CFI) and the root mean square error of

approximation (RMSEA). For adequate fit, GFI and CFI should exceed .90, while RMSEA should be lower than .08; and for good fit exceed .95 (GFI & CFI) or lower than .06 (RMSEA) (L. Hu & Bentler, 1999). Finally, hierarchical linear regressions in SPSS 15.0 are used for RQ2.

3. Results

3.1 Descriptive statistics and reliability

First, descriptive statistics (mean and standard deviation) and bivariate correlations are calculated for both the questionnaire (Table 1) and observed usage (Table 2) data. From Table 1, we learn that the teachers are positive towards use of KlasCement. They evaluate the portal as useful (PU) and easy to use (EOU). Moreover, they hold a very positive attitude towards use of the portal. Scores on subjective norms and voluntariness reveal that teachers have the option to choose (VOL) whether or not they use KlasCement and that there is no pressure from the social environment (SN) to use it. Furthermore, teachers feel that they are in control (PBC) when they use the portal. Teachers also intend to continue using the portal, and their self-reported frequency of use (2.92) corresponds with the response category “I use KlasCement about once a week”, which is close to the observed average number of logins per month (3.16) as displayed in Table 2. The reliability of four scales (PU, EOU, BI and ATT) is good; the reliability of the subjective norms scale is very close to the threshold of .70 for acceptable reliability (Nunnally & Bernstein, 1994), whereas the reliability of perceived behavioral control is low. The correlation analysis reveals no unexpected findings. Two negative correlations are observed, which can easily be interpreted: subjective norms correlate negatively with both perceived behavioral control (Pearson r -.12, p<.001: more/less pressure <=> less/more control over behavior) and voluntariness (r -.13, p<.001: more/less pressure <=> less/more voluntary).

<Please insert Table 1 about here>

<Please insert Table 2 about here>

Table 2 shows a great disparity between the average number of downloads and uploads at both times. This difference even increases from T1 to T2: teachers downloaded significantly more

($t(863) = -5.528$, $p<.001$), while they uploaded significantly less ($t(863) = 2.529$, $p=.01$). It should be stated here that the number of uploads and reactions is a snapshot as teachers can remove uploads (and reactions) leading to a removal of the associated reaction(s). This explains the negative number of reactions at T2. The correlation analysis reveals very high correlations between the number of logins, downloads and page views, with all correlations exceeding .75 except for the correlation between downloads and logins at T2.

3.2 Clustering based on observed usage parameters: discerning user types

A cluster analysis is performed to group teachers as a function of portal use. Five variables serve as the input for the cluster analysis: the average number of logins, downloads, uploads, page views and reactions per month of membership between the registration date and the date the teacher fills out the questionnaire (T1). Prior to the clustering, a closer inspection of the usage parameters shows that 37 teachers complete the questionnaire upon enrollment as portal member (number of logins = 0). These teachers are labeled as new members (N=37) and they are not included in the subsequent cluster analysis.

The two-step cluster analysis reveals only two groups, heavy (N=40) and other users (N=842). As the heavy users blur the cluster analysis, we decide to conduct a second cluster analysis without the heavy users. This again results in two groups, light (N=641) and medium (N=201) users. So, in the end, four groups of users are discerned: new, light, medium, and heavy users of the portal. The cluster centers per user type are in Table 3, whereas the mean scale ratings are displayed in Table 4. Details on post hoc tests (Dunnett's T3) and effect sizes (Cohen's d) are in Appendix B and C.

<Please insert Table 3 about here>

Paired samples t-tests are used to compare the monthly use of the portal before (T1) and after (T2) the questionnaire. The light users make significantly more use of the portal to search for information: a significant increase in number of logins ($t(601) = -6.537$, $p<.001$), downloads ($t(601) = -10.250$, $p<.001$) and page views ($t(601) = -4.310$, $p<.001$) is observed. A slightly different

picture for the medium users arises. They log in more frequently ($t(192) = -2.230$, $p=.03$) and download more ($t(192) = -4.674$, $p<.001$) at T2, yet they consult fewer pages ($t(192) = 1.987$, $p=.05$) compared to T1. The heavy users use the portal significantly less: they upload ($t(39) = 2.076$, $p=.04$) and download ($t(39) = 2.368$, $p=.02$) less information while they also consult fewer pages ($t(39) = 2.741$, $p=.01$). No difference is observed in the number of logins ($t<1$). Despite these significant differences in usage behavior, the user types observed at T1 persist at T2.

<Please insert Table 4 about here>

Mean scale ratings (Table 4), the duration of membership and observed usage measures differ significantly between the user types at both times (all Oneway ANOVA's $p<.05$). Post hoc tests (Appendix B) show that at both times light users score significantly lower on almost all scales and observed usage parameters compared to the medium and heavy users. At T1, light & new users on the one hand, and medium & heavy users on the other differ only on the observed usage parameters, not on the acceptance scales (except on ATT or frequency of use), whereas at T2, the differences in observed usage are also eradicated. Overall, the strongest differences are observed between the heavy and new users. Table 3 also shows that the heavier the use of the portal, the shorter the length of membership. This could be an indication that use of the portal lessens gradually over time, but this is contradicted by the data at T2, which show that the portal is used more (in terms of downloads and pages viewed) by the majority of the teachers. Interestingly, none of the 55 teachers that discontinued use of the portal between T1 and T2 is a heavy user.

3.3 Portal use per session/login

Table 2 shows that teachers use the portal primarily for downloading and searching for information rather than for uploading material. To get a better view on what happens during one login/session, some extra parameters are calculated. These are displayed in Table 5. Although not every teacher uses the portal to download information, the average teacher downloads at least one item per login, but contributes only very rarely. Not much difference is observed in the number of pages a teacher views per login, yet a huge difference is observed in the number of pages viewed

per download. It can be stated that the light and medium users consult the portal for specific information, and that the medium users browse more efficiently. The heavy users appear to browse just for fun or without a specific goal. Inspection of the portal evaluation data shows that the heavy users are significantly more aware of the different functionalities of the portal and that they also use these functions more often compared to the medium and light users. This is also the case for the medium versus the light users. Finally, we also find an evolution over time. Light ($t(601) = -6.039$, $p<.001$) and medium ($t(192) = -2.013$, $p=.05$) users download more per login and need to consult fewer pages per download at T2 (respectively $t(505) = 6.769$, $p<.001$; $t(187) = 3.637$, $p<.001$). This indicates that these users become more efficient in searching for information, which is consistent with Rebelo, Brito, Soares and Jorge (2006). No such differences are found for the heavy user group: both the number of downloads per login ($t(39 < 1)$ and page views per download ($t(37) < 1$) remain stable. A significant decrease in pages viewed per session ($t(39) = 3.596$, $p=.001$) is observed in this user group.

<Please insert Table 5 about here>

3.4 Determinants of portal acceptance: influence of usage profile?

Thirty-seven teachers filled out the questionnaire at their first login. Data from these "new users" is an opportunity to investigate why a teacher decides to start using the portal. On the other hand, as these teachers have never used the portal, their ratings on self-reported frequency of use is an inaccurate estimation of their future behavior, and is therefore omitted from the path analyses in that user group. Below, the findings of the path analyses are summarized; a distinction is made between the new and existing users of the portal.

3.4.1 New users

The path analysis with the new users, see Table 6, shows that attitude is the best predictor of behavioral intention, whereas subjective norms and perceived usefulness exert a marginally significant direct effect on intention. Perceived behavioral control, perceived ease of use and perceived usefulness indirectly influence intention through respectively, ease of use, perceived

usefulness and attitude. Up to 55% of the variance in BI is explained and the model shows reasonable to good fit, depending on the fit measure (GFI .919, CFI .975, RMSEA .089). A strong correlation between ease of use and perceived behavioral control is observed.

<Please insert Table 6 about here>

3.4.2 Existing users

The results of the path analyses per usage profile (light/medium/heavy) are displayed in Table 4. Across groups, usage is best predicted by behavioral intention and to a lesser extent by attitude, with variance explained ranging from .24 (light) to .45 (heavy). Perceived usefulness is a good predictor of both behavioral intention and attitude, whereas ease of use and, depending on the type, subjective norms and perceived behavioral control influence perceived usefulness. Model fit is good to excellent in all cases: GFI ranging from .962 (heavy users) to .997 (light users), CFI either .993 (medium) or 1.000 (light & heavy), and RMSEA between .000 (light & heavy) and .033 (medium). Only a few differences between the types appear to exist. Perceived behavioral control seems to be somewhat more important for the heavy users (direct effect on BI, β .22, $p<.05$), less important for the medium users (indirectly on BI through PU, β .23, $p\leq.001$) and not important for the light users. Subjective norms and ease of use are more important for the light and medium groups.

To test whether these differences are statistically reliable, pairwise moderated linear regressions (Kankanhalli, et al., 2005) are performed. These are hierarchical linear regressions, with the main effects as the first block of predictors, and the interaction effects in the second block. Differences between the user types exist if F change is significant. All paths in Table 6 are tested, so 12 regressions are needed (four dependent variables: perceived usefulness, attitude, behavioral intention, use; three pairs: light/medium, light/heavy, medium/heavy). Results of these analyses are displayed in Table 7.

<Please insert Table 7 about here>

Table 7 shows how the various user types differ in the way they accept and use the portal. When comparing the light and medium users, we find that the portal's usefulness is more important

for light users in their attitude formation (β -.09, p=.01). Comparing the light and heavy users, we see that light users draw more on their social environment when evaluating the usefulness of the portal (β -.10, p=.01). Ease of use is also marginally more important for light users as a determinant of attitude (β -.09, p=.06). A significant increase in variance for frequency of use is observed, but none of the interactions turn out to be significant. Finally, for the medium and heavy users, we find that ease of use is more important for the heavy users (β .39, p=.05), while norms (β -.36, p=.01) and perceived behavioral control (β -.42, p=.01) are more important for the medium users as determinant of perceived usefulness. A marginally significant increase in variance explained in behavioral intention (perceived behavioral control more important for heavy: β .29, p=.04) and attitude (ease of use more important for medium: β -.32, p=.04) is observed.

4. Discussion and Conclusion

4.1 Main findings and discussion

In this study, we investigated how teachers used a portal for education and whether this affects their acceptance of the portal. In order to do this, questionnaire data on portal acceptance (based on a combination of TAM and TPB) are paired to usage data extracted from the portal database on two occasions. In addition to the new users who fill out the questionnaire on their first login to the portal, three user groups (light/medium/heavy) are discerned based on the average number of logins, downloads, uploads, page views and reactions per month of membership between registration and questionnaire completion. Differences between these user groups are found in their ratings of every acceptance scale (PU, EOU, PBC, ATT, BI, frequency of use), except for the subjective norms scale. The usage parameters show that the teachers use the portal to search for and download information rather than for sharing or uploading. A minority of the teachers appeared to browse through the portal for fun, or without a specific goal. This is consistent with Mahdizadeh, et al. (2008), who found that most teachers use the “basic” aspects of an e-learning environment, whereas only a minority of teachers use the more advanced functions that could really have an added learning value. The largest part of the teachers used the portal more at the time of the second

data extraction and they had become more efficient in browsing through the portal to download information. Contrary to what is generally found in the literature, attitude and not perceived usefulness is the main driver for new users to intend to use the portal, with perceived usefulness and subjective norms exerting a marginal direct influence on intention. Perceived usefulness and ease of use are important for attitude formation, whereas perceived behavioral control had no direct effects but was very closely related to perceptions of ease of use. For the existing user, the usefulness of the portal is the major determinant of acceptance. This is consistent with previous teacher' acceptance studies (Gong, et al., 2004; P. J. H. Hu, et al., 2003; Lai & Chen, 2011; Ma, et al., 2005; Teo, 2009; Teo, et al., 2008; Wang & Wang, 2009) and research in business settings. The influence of the other factors depends on the user type; subjective norms and ease of use are more important for the light and medium users; while perceived behavioral control is more important for the heavy users. Up to 71% of the variance in BI and 45% of the variance in frequency of use is explained by our research model.

4.2 Study contribution

This study adds to the literature in several respects. The primary contribution of this study is that we assess teachers' acceptance of an educational portal and whose use was entirely voluntary. Although some studies have questioned students' acceptance of (mandatory) educational portals (e.g. Maldonado, Khan, Moon, & Rho, 2011; Pynoo, et al., 2011b), to our knowledge no such study exists for teachers. As such, the present study meets an important empirical gap in educational technology literature. In view of the emerging educational portals in different countries (e.g. Glow in Scotland and National Education Portal in Kenya), insights from these studies might prove valuable for policymakers planning to develop or launch educational portals. Moreover, as use of the portal is completely voluntary, our study provides guidance to school boards and policymakers on how to introduce new technologies that cannot be imposed immediately, e.g. interactive whiteboards, etc. Finally, this study adds to the general literature on technology acceptance as we investigated technology acceptance while differentiating between users based on their observed use

behavior (and thus beyond gender and age). This way, our findings replicated the somewhat mixed findings of the literature review: perceived usefulness being a consistent predictor of acceptance, and the significance of the other predictors varying slightly depending on the user type. As such, taking a user's base frequency of technology use into account might explain the sometimes mixed findings of technology acceptance studies, especially in the case where use of the technology is voluntary and where a user has a large degree of autonomy while performing his/her job.

4.3 Implications

From this study, several guidelines for policymakers and school boards wanting to introduce an educational portal (or another educational innovation), can be derived. The guidelines are outlined below, in "chronological" order.

- Perceived behavioral control: Provide training and resources

In this study perceived behavioral control covers three aspects: skills and knowledge, control over time and location of use, and resources (computer, Internet, etc.). Control correlated strongly with perceptions of ease of use, and also influences either perceived usefulness or behavioral intention. Skills and knowledge can be addressed by providing training and support, but also by safeguarding the ease of use of the portal (or educational technology). Resources and control over time and location of use go hand in hand: school boards could provide a sufficient number of computers that are connected to the Internet to facilitate portal use at school. To facilitate use of a computer during teaching, attention should be payed to the physical location of the computer(s) in the classroom (Tondeur & Van Den Driessche, 2011). Policymakers on the other hand should promote the use of computers at home. Such an example is provided, for instance, by the Belgian federal government with the initiatives "Internet for all" and "Start to surf"[1], through which a computer and Internet connection could be obtained at a discounted rate.

- Perceived usefulness: Provide content

[1] http://www.fedict.belgium.be/nl/over_fedict/realisaties/Start2Surf.jsp; http://www.fedict.belgium.be/nl/over_fedict/realisaties/Internet_voor_iedereen.jsp (in Dutch) website last consulted October 31st, 2011

The usage data show that the majority of the teachers use the portal primarily for searching and downloading material. Next to material provided by teachers, policymakers/school boards could stimulate teachers to contribute, or could even provide additional interesting (yet non-essential as long as use of the portal is not mandatory) information themselves exclusively through the portal. This is in line with other studies that stress the importance of professional development as a permanent process, aimed at extending and updating the professional knowledge of teachers in the context of their work (see e.g. Sang, Valcke, van Braak, & Tondeur, 2010). In this respect, collaboration is a pivotal element in teacher professional development; by sharing their experience, knowledge, and reflection and collaborating in the educational portal. School leaders then have to provide [and] accommodate teachers' need for professional development, and manage existing resources to support teacher development. These findings concur with those of (Rhodes, Stokes, & Hampton, 2004) which underlined the importance of school leaders' support and involvement in professional development programs.

• Perceived ease of use: Safeguard portal ease of use

The review showed that ease of use is of secondary importance or influences acceptance only indirectly (Gong, et al., 2004; P. J. H. Hu, et al., 2003; Ma, et al., 2005; Teo, 2009; Teo, et al., 2008; Wang & Wang, 2009). Studies in settings other than education found ease of use to be of particular importance in the early stages following the introduction of a new technology (e.g. Venkatesh, et al., 2003; Pynoo, et al., in press), but evidence is mixed. Here, we found that ease of use is of particular importance for new and non-heavy users in their attitude formation. Safeguarding portal ease of use should be addressed in two ways: by providing training as mentioned above, and by making the portal as easy to use as possible. However, some room for improvement may exist. A great disparity in the number of downloads and uploads was observed, which may in part be explained by a disparity between the ease of downloading and the ease of uploading. Only one click of the mouse is needed to download information, whereas users have to complete a form and are urged to first search for possible duplicates prior to uploading. For example, when uploading a

document, users are obliged to indicate the file type and the language; choose the suitable course(s) and education level; indicate who can view it; provide a title, a text with the potential of the document for teaching, and key words; and answer a question concerning copyright. Easing and shortening the procedure for uploading in this case should increase the likeliness of uploading information by non-heavy users, who form the majority of the users.

• Subjective norms: Create an environment that supports and encourages use of the portal

In this case, teachers experience no influence from their colleagues or school boards to use the portal, yet for the majority of the teachers norms enhance perceptions of portal usefulness and/or have a positive influence on teachers' intentions to use the portal. Therefore, the existing members should be urged to promote use of the portal among their colleagues, while policymakers and school boards should put forward guidelines concerning portal use. As stated before, they need to encourage teachers' professional growth, provide an encouraging school environment for collaboration, accommodate teachers' needs for professional development and manage existing resources to support teachers' professional development as and when necessary (Tondeur, Valcke, & van Braak, 2008).

• Attitude: Portal use should be an enjoyable experience

Previous research showed that holding a positive attitude towards computers is beneficial for the integration of computers in the educational practice (Hermans, Tondeur, van Braak, & Valcke, 2008; Mueller, Wood, Willoughby, Ross, & Specht, 2008; Sang, et al., 2010; Shapka & Ferrari, 2003; van Braak, et al., 2004). Here, we saw that teachers' attitudes towards use of the portal are in large part determined by perceptions of usefulness and ease of use. However, attitude also covers the issue of whether use of the portal is enjoyable and whether the members love/hate using the portal. So next to being easy to use and providing useful information, using the portal should be an enjoyable experience, which could be ensured by the layout of the site, or by the provision of additional content such as facts and figures, cartoons, videos, pictures, etc.

• Differentiate between users

Small yet significant differences between the different types of users were observed in their acceptance and use of the portal. While the majority of the teachers appear to use the portal for retrieving information, a small yet very loyal number of teachers seemed to use the portal not only to download, but also to browse through the more advanced functionalities, or to the "dark corners" of the portal. These are also the teachers who contributed most. As these heavy users are very valuable as "feeders" of the portal and they could serve as promoters of the portal, portal administrators should consider introducing advanced functionalities from time to time, to stimulate these users.

4.4 Directions for further research

Small yet significant changes are observed between the user profiles in the way they accept the portal. This indicates that differentiating between users makes sense and could potentially benefit technology acceptance and usage if the technology becomes more finely tuned to the type of users. This offers possibilities for follow-up research in different settings, with different users and both voluntary and mandatory technology, but also for research on other differentiating characteristics.

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Self-reported acceptance data was paired to observed usage data

Data from 919 teachers revealed four groups of educational portal users

Portal is mainly used for searching and downloading rather than for sharing knowledge

Differences in observed use are reflected in teachers' portal acceptance

The study shows the value of differentiating between users

Table and Figure captions

Figure 1. Study strategy with the research model on the right. The research model is run per usage type.

Table 1. Questionnaire data: Descriptive statistics (Mean and standard deviation), bivariate correlations (Pearson r) and scale reliability (Cronbach alpha) on the diagonal.

Table 2. Descriptive statistics (Mean and standard deviation) and bivariate correlations (Pearson r) of the observed usage parameters at T1 (below the diagonal) and T2 (above the diagonal).

Table 3. Cluster centers: Mean and (standard deviation) per type of user, per time.

Table 4. Questionnaire data: Mean and standard deviation per user type. Right part of the table displays the outcome of Oneway ANOVA's (F-value, significance level, and effect size).

Table 5. Portal usage per login per time.

Table 6. Results of path analysis (RQ 1).

Table 7. Results of moderated regression analysis.

Table 1. Questionnaire data: Descriptive statistics (Mean and standard deviation), bivariate correlations (Pearson r) and scale reliability (Cronbach alpha) on the diagonal.

N = 919	**Mean (SD)**	**PU**	**EOU**	**SN**	**PBC**	**BI**	**Freq**	**ATT**	**Vol**
Perceived Usefulness	4.65 (1.33)	.84							
Perceived Ease of Use	5.01 (1.51)	.44***	.92						
Subjective Norms	1.41 (0.66)	.18***	.06°	.69					
Perceived Behavioral Control	6.16 (0.85)	.30***	.63***	-.12***	.45				
Behavioral Intention	4.28 (1.53)	.68***	.33***	.18***	.21***	.92			
Frequency of use	2.94 (0.91)	.41***	.21***	.14***	.13***	.53***	N/A		
Attitude	5.94 (0.97)	.61***	.48***	.11**	.33***	.55***	.40***	.88	
Voluntariness	6.66 (0.80)	.18***	.11**	-.13***	.23***	.12***	.08*	.28***	N/A

*Notes: °p<.10; *p<.05; **p<.01; ***p<.001; N/A: not applicable*

Table 2. Descriptive statistics (Mean and standard deviation) and bivariate correlations (Pearson r) of the observed usage parameters at T1 (below the diagonal) and T2 (above the diagonal).

	Mean (SD) at T1[a]	**Mean (SD) at T2[b]**	**t(863); p=**	**Logins**	**Uploads**	**Downloads**	**Reactions**	**Page views**
logins	3.16 (7.96)	3.82 (8.23)	-1.852; .06		.28***	.49***	-.21***	.85***
uploads	0.11 (0.53)	0.06 (0.50)	2.529; .01	.37***		.07*	-.04	.28***
downloads	4.49 (12.12)	7.14 (12.50)	-5.528; <.001	.77***	.31***		-.20***	.78***
reactions	0.13 (0.76)	-0.10 (0.39)	6.697; <.001	.23***	.50***	.50***		-.27***
page views	52.19 (118.73)	43.71 (77.44)	13.233; <.001	.82***	.43***	.88***	.52***	

*Notes: [a]mean number of logins,... per month of membership; [b]mean number of logins,... per month of membership between T1 and T2; *p<.05; ***p<.001*

Table 3. Cluster centers: Mean and (standard deviation) per type of user, per time.

	T1				T2			
	light	**medium**	**heavy**	**new**	**light**	**medium**	**heavy**	**new**
#months portal use[a]	27.88 (16.03)	21.32 (16.64)	13.03 (14.53)	0.46 (0.51)	18.28 (2.48)	18.99 (2.37)	19.98 (1.07)	17.10 (3.28)
logins[b]	1.46 (1.08)	4.99 (3.13)	22.68 (30.48)	0.00 (0.00)	2.20*** (2.83)	6.25* (7.34)	17.49 (29.07)	2.52*** (2.19)
uploads[b]	0.01 (0.03)	0.13 (0.25)	1.48 (1.87)	0.24 (0.72)	0.02° (0.09)	0.07° (0.30)	0.60* (2.14)	0.04 (0.12)
downloads[b]	1.36 (1.57)	8.55 (6.52)	36.13 (42.91)	0.00 (0.00)	4.07*** (6.98)	14.04*** (18.41)	20.41* (20.43)	6.66*** (9.07)
reactions[b]	0.02 (0.06)	0.21 (0.33)	1.52 (3.23)	0.11 (0.52)	-0.03*** (0.08)	-0.19*** (0.34)	-0.71** (1.46)	-0.01 (0.03)
page views[b]	18.77 (15.04)	87.86 (49.33)	380.89 (391.25)	108.43 (158.78)	23.90*** (29.12)	76.12* (84.29)	190.02** (223.53)	37.37** (44.70)

*Notes: [a]for T1: months since enrollment; for T2: number of months between filling out the questionnaire and last login; [b]average number of logins,... per month of portal use (see [a]); significance level of paired samples t-test: °p<.10; *p<.05; **p<.01; ***p<.001*

Table 4. Questionnaire data: Mean and standard deviation per user type. Right part of the table displays the outcome of Oneway ANOVA's (F-value, significance level, and effect size).

	light	**medium**	**heavy**	**new**	**F(3,915)**	**p**	**Partial Eta squared**
N	641	201	40	37			
Age	40.25 (10.20)	38.72 (10.95)	37.70 (10.69)	38.41 (12.18)			
PU	4.43 (1.30)	5.28 (1.17)	5.39 (1.20)	4.17 (1.40)	29.255	<.001	.088
EOU	4.86 (1.54)	5.44 (1.32)	5.81 (1.12)	4.41 (1.56)	13.650	<.001	.043
SN	1.39 (0.64)	1.42 (0.67)	1.66 (0.89)	1.42 (0.74)	2.096	.10	.007
PBC	6.10 (0.88)	6.34 (0.67)	6.41 (0.85)	5.96 (1.04)	5.845	.001	.019
BI	4.03 (1.49)	4.92 (1.42)	5.23 (1.53)	4.15 (1.40)	24.136	<.001	.073
Frequency of use	2.76 (0.81)	3.32 (0.93)	3.93 (1.12)	2.81 (0.88)	40.527	<.001	.117
ATT	5.80 (0.98)	6.37 (0.77)	6.55 (0.65)	5.32 (0.88)	30.461	<.001	.091
VOL	6.64 (0.82)	6.82 (0.49)	6.63 (0.93)	6.14 (1.29)	8.288	<.001	.026

Table 5. Portal usage per login per time.

	T1				T2			
	light	**medium**	**heavy**	**new**	**light**	**medium**	**heavy**	**new**
Downloads per login	1.07	2.25	2.56	N/A	1.63***	2.57*	2.51	1.91
Page views per login	15.21	23.77	26.49	N/A	11.36***	13.86***	15.35**	12.72
Uploads per login	0.01	0.05	0.11	N/A	0.00	0.00**	0.01°	0.01
Reactions per login	0.02	0.06	0.13	N/A	-0.02***	-0.06***	-0.10**	-0.00
Page views per download	24.69	17.33	75.97	N/A	15.33***	13.96***	38.79	19.06

*Notes: significance level of paired samples t-test: °p<.10; *p<.05; **p<.01; ***p<.001*

Table 6. Results of path analysis (RQ 1).

	New	**light**	**medium**	**heavy**
Dependent variable	**Behavioral Intention**	**Frequency of use**	**Frequency of use**	**Frequency of use**
pu <- eou	.59***	.40***	.21**	.40**
pu <- sn	--	.16***	.23***	--
pu <- pbc	--	--	.23**	--
att <- eou	.34*	.26***	.29***	--
att <- pu	.45**	.50***	.37***	.46**
bi <- pu	.27°	.51***	.57***	.58***
bi <- att	.50***	.23***	.10 (p=.11)	.27**
bi <- sn	.21°	.07*	--	.16°
bi <- pbc	--	--	--	.22*
use <- bi	N/A	.41***	.42***	.50***
use <- att	N/A	.12**	.18**	.25°
eou <-> pbc	.70***	.62***	.60***	.66***
sn <-> pbc	--	-.15***	--	--
eou <-> sn	--	.07°	--	--
Multiple correlation coefficients (mcc)				
PU	.35	.20	.21	.16
ATT	.50	.42	.29	.22
BI	.55	.48	.39	.71
Use Freq	N/A	.24	.27	.45

Notes: N/A: relationship could not be tested; --: insignificant relationship that was fixated on 0.

Table 7. Results of moderated regression analysis.

Dependent		light <=> medium	light <=> heavy	medium <=> heavy
PU	Sig F Change	ns	p=.05	p=.007
	Significant interactions	N/A	SN: β -.10 (p=.011)	EOU: β .39 (p=.05) SN: β -.36 (p=.006) PBC: β -.42 (p=.014)
BI	Sig F Change	ns	ns	ns (p=.075)
	Significant interactions	N/A	N/A	PBC: β .29 (p=.045)
ATT	Sig F Change	p=.022	p=.03	ns (p=.095)
	Significant interactions	PU: β -.09 (p=.008)	EOU: -.09 (p=.061)	EOU: β -.32 (p=.036)
Frequency	Sig F Change	ns	p=.008	ns
	Significant interactions	N/A	none	N/A

*Notes: Significant interactions are interactions between user-type and a predictor variable and should be read as e.g. PU*user_type. The interaction term (*user_type) is omitted for clarity*