ICT and Schools: Identification of Factors Influencing the use of new Media in Vocational Training Schools

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Abstract: In this paper, we analysed teachers' characteristics described in the literature on classroom media use to identify those factors, which can explain teachers' use of new media in classrooms with some degree of validity. Using this literature as a basis, in this paper we develop a theoretical model which describes both positive and negative factors, which influence teachers' use of new media in classrooms. These factors include: "constructivist teaching style", "willingness to cooperate", "openness to change", "lack of ICT-competence", "lack of time" and "lack of ICT confidence". We assessed the validity of the model by testing it using data collected from a survey of fifty-two Swiss and Austrian teachers, We carried out Pearson correlations to evaluate whether the factors in the model had a positive or a negative influence on teachers' classroom media use. The hypothesized correlations between our variables were all statistically significant. Specifically, all six variables were significantly correlated with the dependent variable "use of new media in classrooms". This result supported our hypothesis concerning positive and negative relationships between variables. In a second, exploratory investigation, we performed OLS regression analysis to investigate, which of the factors in our model are of predictive value with respect to the dependent variable "use of new media in classrooms". Our findings show that the variable "constructivist teaching style" was of particular explanatory value. This suggests that only teachers who adopt a pupil-oriented, constructivist teaching style are likely to make use of new technology in classrooms. The variable "lack of available time" was identified as a second important factor influencing the "use of new media in classrooms". This suggests that teachers are not able to make full use of new media when they lack the time needed to prepare teaching material using the new media, since time is also needed for teachers to learn new hardware and software computer skills. The results of this study have a series of important, practical implications.

Keywords: Media use, Classroom, and teachers' characteristics, Predicting factors

1. Introduction

Over the last couple of years, researchers have made great efforts to analyse the use of new media in schools. As part of this line of research, several aspects of classroom media use have been investigated, including, for instance: the identification of obstacles to the integration of information and communication technology (ICT) in education, the use of laptops and internet in classrooms, the impact of ICT on the teachers, etc. (Ehmke et al., 2004, Schaumburg, 2002, Smeets et al., 1999). Another focus of attention has been the identification of factors that determine the successful and sustainable use of new media in schools, as well as the derivation and implementation of long-term measures. Thus far, three types of relevant factors have been identified: the technical equipment available in schools, the general conditions of the school organization, and the characteristics of teachers.

Regarding technical equipment, obstacles for the integration of new technologies in the classroom can occur, because of schools' insufficient availability of said equipment (Pelgrum, 2001), the location of devices (Becker, 2000), and insufficient access to computer laboratories (Schaumburg, 2002).

Conditions related to school organization comprise aspects such as the cooperative culture of the school (i.e., formal and informal exchange of information between teachers and sections), and the compatibility of innovation with current curricula. Further, the school principal acting as a promoter for the use on new media plays an important role, as do offers for vocational teachers' training (Schaumburg, 2002, Scholl and Prasse, 2000).

Finally, the teachers' characteristics play an important role. According to a Becta study (Becta, 2004) study, which reviewed the research literature on barriers to the uptake of ICT by teachers, a number of teacher-level barriers have been identified:

- lack of time — for both formal training and self-directed exploration (Fabry & Higgs 1997), and for preparing ICT resources for lessons (Preston et al. 2000);
- lack of self-confidence in using ICT (Pelgrum 2001);
- negative experiences with ICT in the past (Snoeyink & Ertmer 2001);
- fear of embarrassment in front of pupils and colleagues, loss of status and an effective degrading of professional skills (Russell and Bradley, 1997);

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- classroom management difficulties when using ICT, especially where pupil-to-computer ratios are poor (Cox et al. 1999);
- lack of the knowledge necessary to enable teachers to resolve technical problems when they occur (Vanfossen, 1999);
- lack of personal change management skills (Cox et al. 1999);
- perception that technology does not enhance learning (Preston et al., 2000, Yuen and Ma, 2002);
- lack of motivation to change long-standing pedagogical practices (Snoeyink & Ertmer 2001); perception of computers as complicated and difficult to use (Cox et al. 1999).

Additional factors not mentioned in the BECTA study, and reported elsewhere in the literature as well, are: teaching style (constructivist vs. traditional teaching); teacher roles, willingness to cooperate with others (Schaumburg, 2002, Smeets et al., 1999, Ehmke et al., 2004).

In this paper we report on the findings of a study, which was carried out as part of the Lab@Future project funded by the European commission. The study analysed a number of teachers' characteristics (derived from the literature on classroom media use) with the aim to identify factors those factors, which can explain the use of new media in classrooms with some degree of validity. Using the literature as a basis, we constructed an explanatory model of factors influencing classroom media use. We assessed its validity by testing it using data collected from a survey of fifty-two Swiss and Austrian teachers.

As already mentioned earlier, prior research pinpointing key factors influencing classroom media use can be summarized by categorizing these factors into three domains: technological factors, teacher characteristics and school characteristics. As part or the literature review, we selected empirical studies for further analysis as illustrated in Table 1. For each study we specified the focus, identifying the core questions it addresses. The goal has been to facilitate differentiating between studies analysing implementation processes, and studies investigating the usage of ICT or other aspects. In parallel, the technology under investigation was identified – some studies used a somewhat narrow understanding of ICT, for example they exclusively analysed laptop- or internet-use in schools.

Table 1: Overview of literature review

Empirical Studies	Domain			Focus of study		Technology under investigation
Authors	Technology	Teachers	Schools	Implementation of new media in schools	Use of new media in classrooms	
Becker (2000)	✓	✓	✓		✓	Hardware, Software
Chen & Looi (1999)	✓		✓	✓	✓	Computer-technology / IT
Duffy & McMahon (1999)	✓		✓		✓	Computer
Ehmke et al. (2004)		✓	✓	✓	✓	Digital media, new media
Pelgrum (2001)	✓	✓	✓	✓		ICT
Schaumburg (2002)	✓	✓	✓		✓	Laptop, mobile computers
Scholl & Prasse (2001)		✓	✓		✓	Internet use
Smeets et al. (1999)	✓	✓	✓	✓	✓	ICT, new technologies
Veen (1993)		✓		✓		Computer
Venezky & Davis (2000)		✓	✓	✓		ICT

2. Teachers' characteristics

Several authors (Ehmke et al., 2004, Cuban et al., 2001) have pointed out that cooperation and communication between teachers, such as the exchange of ICT experience and mutual encouragement to use new media, has a positive effect on the willingness to utilize new media in the classroom.

Another variable, which influences classroom use of new media positively is teaching style (Veen, 1993, Schaumburg, 2002). For instance, Becker (2000) found that "Computer-using teachers (…) are distinctively more constructivists than non-computer-using teachers (p. 12)". Constructivism claims that skills and knowledge cannot be directly transmitted from teacher to students. The theory suggests getting students to articulate their understanding, and defending them against contrary points of view, claiming that understanding comes from individuals expending effort to integrate newly communicated claims and ideas with their own prior beliefs and understanding. Veen (1993) further states that using computers should fit into existing skills of teachers and should not demand for too much effort to change. The literature on factors which impact the use of new media in classrooms positively has identified the teachers' openness to change as a key issue (Mumtaz, 2000, Fabry and Higgs, 1997, Snoeyink and Ertmer, 2001, Dawes, 1999)

In addition to variables which have a positive influence on classroom media use, a number of variables have been identified, which have a negative influence.

It is common knowledge that teachers are not able to make full use of new media because they lack the time needed to prepare teaching material using new media. Additionally, time is also needed for teachers to learn new hardware and software computer skills (Fabry and Higgs, 1997) (Manternach-Wigans et al., 1999, Cuban et al., 2001).

An important additional determinant of teachers' engagement in the use of new media in classrooms is their confidence in using technology (Lokken et al., 2003). Teachers with little confidence in using ICT in their work will try to avoid them. Russel and Bradley (1997) reported that many teachers who were not using computers were doing so because they lacked confidence with, or felt frightened by computers.

Thus, lack of ICT-competence is clearly a barrier to teachers' use of new media in classrooms. As Becker (2000) notes: "Teachers who have a reasonable amount of technical skill and who use computers to address their own professional needs use computers in broader and more sophisticated ways with students than teachers who have limited technical skills and no personal investment in using computers themselves (p. 7)." Similar results have also been found by others (Schaumburg, 2002, Venezky and Davis, 2002, Ehmke et al., 2004, Smeets et al., 1999).

Based on these findings in the literature, we developed an exploratory model that incorporates factors that have both positive and negative impact on use of media in a classroom by teachers (see Figure 1).

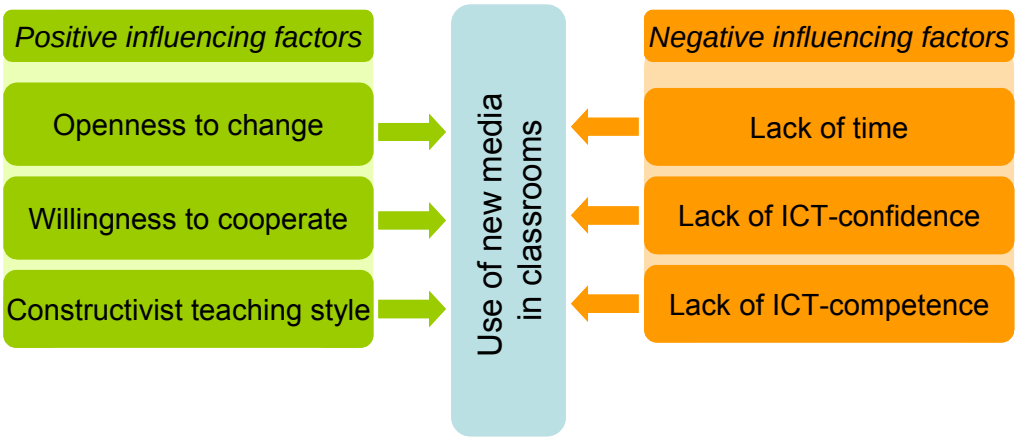

Figure 1: Teachers' characteristics influencing the use of new media in classrooms

In order to test this model we hypothesize:

- Hypothesis 1: "Openess to change", "Willingness to cooperate" and "Constructivist teaching style" will correlate significantly and positively with "Use of new media in classrooms".
- Hypothesis 2: "Lack of time", "Lack of ICT-confidence" and "Lack of ICT-competence" will have a negative impact on the degree of "Use of new media in classrooms".

Furthermore we performed an exploratory investigation:

- Which variables appropriately explain the dependent variable "Use of new media in classrooms"?

3. Method

3.1 Design and participants

We contacted and informed principals from vocational training schools in Switzerland and Austria about this study and asked them to motivate teachers to participate. Although school principals were cooperative, it turned out to be very difficult to motivate teachers to participate. An online questionnaire was available between March and May 2005. Fifty-two teachers (5 women and 47 men) from four schools in Austria and seven vocational training schools in Switzerland responded to the questionnaire. The average age of the teachers was 48 years (*SD=7.01*) ranging form 36 years to 62 years. They taught in their current schools for about 14 years (*SD=8.79*). Teachers used the computers privately as well as in they're vocational setting on average for more than 16 years (*SD=5.59*). Teachers rated their computer experience on a scale ranging from 1=no experience to 100=very good experience. Teachers' computer experience was estimated slightly above average, with *M=64.53* (minimum experience=10, maximum experience=90, *SD=21.17*).

3.2 Instrument

We developed an online questionnaire which comprised 31 closed and open-ended questions. Besides the demographic data, seven variables were operationalised for the current study, based on the model of teachers' characteristics described earlier. Teachers rated each of these questionnaire items on a four-point Likert-scale. The other variables of the questionnaire were used to collect data for a descriptive analysis of the current use of new media in classrooms. In the following section, the variables are described in more detail. Wherever possible we used already existing items from previous studies examining classroom media use.

Dependent scale - "Use of new media in classrooms": This scale determined the actual use of different new media teaching in classrooms, such as simulations, computer games, office and Internet programs etc. This scale was adapted from Stein (2002) (12 items, for each scale we calculated Cronbach's α; (.81), values ranged from 0=never used to 3=very often used).

The independent, scale "Constructivist teaching style" analysed the extent to which teachers used a pupil-oriented, constructivist teaching style. According to the findings in the literature (Becker, 2000, Veen, 1993), teachers following a more constructivist teaching style were more likely to use ICT in the classroom. Teachers indicated to which extend they used different teaching and learning techniques in their classroom, such as ex-cathedra teaching, pupil-oriented teaching, group work, problem-oriented teaching, etc. (11 items adapted from interim report of Mandl et al., (2003), Cronbach's α=.81, values ranged from 1=no pupil-oriented, constructivist teaching style to 4=pupil-oriented, constructivist teaching style).

The scale "Willingness to cooperate" measured cooperative behaviour that teachers exhibited in everyday school life, such as exchanging teaching material and discussing teaching goals and problems (3 items adapted from Ehmke et al., 2004, Cronbach's α=.72, values ranged from 1=no willingness to cooperate to 4=high willingness to cooperate).

The scale "Openness to change" addressed the willingness of teachers to change their teaching practices. Items of this scale included statements like "My role as a teacher makes it necessary to support the use of new media in classrooms" (5 items adapted from Ehmke et al., 2004, Cronbach's α=.83, values ranged from 1=no openness to change to 4=high openness to change).

Rating the scale "Lack of time" teachers indicated how much time they had available to prepare and research (multimedia) materials for lessons to make full use of ICT. Items included statements like time spent after the lessons for preparation and wrapping up teaching material, etc. (7 items adapted from Ehmke et al., 2004, Cronbach's α=.71, values ranged from 1=time available to 4=lack of time).

The scale "Lack of ICT-confidence" measured the extent to which teachers considered themselves well skilled in using ICT. Statements like "When problems occur while using ICT, I am confident to solve these problems" were included into this scale (9 items adapted from Ehmke et al., 2004, Cronbach's α=.83, values ranged from 1=ICT-confidence to 4=lack of ICT-confidence).

To attain a high level of competence in ICT teachers need to be provided with effective training. Items of the scale "Lack of ICT-competence" addressed aspects like keeping pedagogical and didactical standards of knowledge up to date, regularly participating in trainings, etc. (13 items adapted from Ehmke et al., 2004, Cronbach's α=.71, values ranged from 1=ICT-competence to 4=lack of ICT-competence).

In addition to the scales based on the teacher characteristics' model described above, we collected information on the kind of media teachers actually used in the classroom. Therefore, we also asked teachers to indicate how often they used traditional media like chalkboard, schoolbooks, worksheets, slides, etc. (7 items, Cronbach's α=.60, values ranged from 0=never used to 3=very often used).

4. Results

4.1 Use of media in the classroom

The results of our study concerning the use of traditional as well as new media in the classroom showed that vocational training teachers mainly used traditional media in the classroom. They mostly used worksheets (*M=2.55, SD=.58*) and slides (*M=2.08, SD=.79*) and often chalkboards and schoolbooks. Use of workbooks and videos was seldom. The teachers did not use audiotapes during their lessons (see Figure 2).

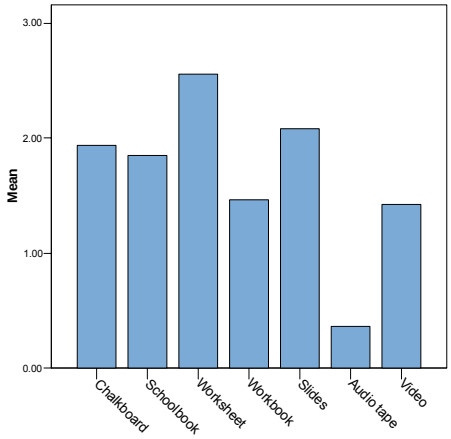

Figure 2: Average use of traditional media in classrooms (0=never, 3=very often)

Compared to the use of traditional media, teachers appeared to make rather restricted use of new media (see Figure 3). No use was made of: chat, web logs and audio- / video-conferencing tools. Computer games, training programmes, programming tools and newsgroups were seldom used (all means<1). Sometimes teachers used simulations (M=.90, SD=.84), referencing tools (M=1.09, SD=.74) and email (M=.82, SD=.85) during their lessons. Office software (M=1.23, SD=.92) and internet browsers (M=1.25, SD=.90) were used more often.

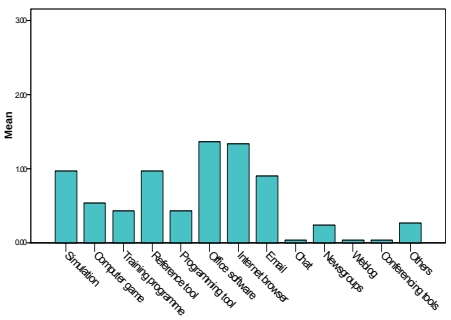

Figure 3: Average use of new media in classrooms (0=never, 3=very often)

When comparing these usage patterns with the teachers' private use of computers, it turned out that they used particular computer programmes far more often on a private basis. Specifically, they used office software (M=2.54, SD=.70), internet browsers (M=2.58, SD=.83) and email (M=2.50, SD=.83) on a daily base (0=no use, 3=daily use).

4.2 Variables influencing the use of new media in classrooms

Pearson's correlations were calculated to analyse relationships between variables. The results presented in Table 2 confirmed our hypothesis. All independent variables show statistically significant correlations with the dependent variable "Use of new media in classroom". Further, our assumptions about positive and negative influence of the independent variables on the variable "Use of new media in classrooms" were also been confirmed. The variables, "Constructivist teaching style", "Willingness to cooperate" and "Openness to change" all have positive correlation coefficients, whereas the variables "Lack of ICT-Competence", "Lack of time", and "Lack of ICT confidence" show negative correlation coefficients.

Table 2: Correlation between variables (** Correlation is significant at the 0.01 level, 2-tailed; * Correlation is significant at the 0.05 level, 2-tailed)

		Use of new media	Constr.	Will. to coop.	Open. to change	Lack of ICT-comp.	Lack of time
Use of new media in classrooms	Pears. Corr.	1					
	N	52					
Constructivist teaching style	Pears. Corr.	**.522(**)**	1				
	N	52	52				
Willingness to cooperate	Pears. Corr.	**.362(**)**	.146	1			
	N	52	52	52			
Openness to change	Pears. Corr.	**.620(**)**	.256	**.281(*)**	1		
	N	51	51	51	51		
Lack of ICT-competence	Pears. Corr.	**-.588(**)**	**-.345(*)**	-.190	**-.634(**)**	1	
	N	52	52	52	51	52	
Lack of time	Pears. Corr.	**-.575(**)**	**-.511(**)**	-.234	**-.342(*)**	**.588(**)**	1
	N	51	51	51	51	51	51
Lack of ICT-confidence	Pears. Corr.	**-.513(**)**	-.196	**-.342(*)**	**-.670(**)**	**.417(**)**	.085
	N	51	51	51	51	51	50

Second, we performed an exploratory investigation to identify variables explaining best the dependent variable "Use of new media in classrooms" using standard multiple regression test. Along with the dependent variable, the independent variables "Constructivist teaching style", "Willingness to cooperate", "Openness to change", "Lack of ICT-competence", "Lack of time", and "Lack of ICT-confidence" were included into the analysis.

The coefficient of determination (adjusted R^2) for the model regression is .58, indicating that 58% of the variance in the dependent variable "Use of new media in classrooms" was explained by the independent variables. The multiple regression coefficient R for regression was significantly different from zero (R(a)=.79, R^2=.63), F(6, 43)=12.27, p<.001.

The variables "Constructivist teaching style" (p<.05) and "Lack of time" (p<.05) showed the best explanatory value. The variables "Openness to change" (p=.06) and "Lack of ICT-confidence" (p=.07) came very close to the 0.05 statistical significance level (see Table 3).

Table 3: Results of the standard multiple regression analysis ((a) DV: Use of new media in classrooms)

Model	Unstandardised coefficients		Standardised coefficients	T	One-tailed Sig.
	B	Std. error	Beta		
(Constant)	-1.90	.32		-5.86	.00
Constructivist teaching style	.20	.10	.22	2.00	.02
Willingness to cooperate	.10	.08	.13	1.30	.10
Openness to change	.15	.09	.23	1.57	.06
Lack of ICT-Competence	-.09	.13	-.10	-.72	.24
Lack of time	-.17	.09	-.27	-1.99	.02
Lack of ICT confidence	-.15	.09	-.20	-1.50	.07

Conclusions

In this study we performed an online survey of teachers in Austria and Switzerland, collecting data about the use of traditional as well as new media in classrooms and in private settings. We developed and empirically tested a model, identifying teachers' characteristics that have either positive or negative effects on the use of new media in the classroom.

Compared to traditional media, teachers appeared to make restricted use of new media in the classroom. Office software and internet browsers were the only applications used to some extent. Different usage behaviour was found for private use of new media. Teachers used office software, internet browsers and email on a daily base. These results lead to a reinterpretation of previous research findings (cf. \(Becta, 2004) which highlighted the importance of teachers access to ICT at home. This access was assumed to allow them to utilize the technology in their work. In our study, teachers had personal access to ICT and used it, but were reluctant to use it in their work.

We carried out Pearson correlations to evaluate whether the factors in the model had a positive or a negative influence on teachers' classroom media use. The hypothesized correlations between our variables were all statistically significant. Specifically, all six variables were significantly correlated with the dependent variable "use of new media in classrooms". This result supported our hypothesis concerning positive and negative relationships between variables. Additionally to descriptive statistics (Smeets et al., 1999, Pelgrum, 2001) our study provided information concerning the strengths of interrelation between subjective attitudinal measures and behaviour – the actual use of new media. Further, our data confirmed relationships between the independent variables, which are in line with the findings of Ertmer (1999, cited from Becta, 2004).

In a second, exploratory investigation, we performed OLS regression analysis to investigate, which of the factors in our model are of predictive value with respect to the dependent variable "Use of new media in classrooms". Our findings showed that the variable "constructivist teaching style" was of particular explanatory value. This suggests that teachers who adopt a pupil-oriented, constructivist teaching style are more likely to make use of new technology in classrooms. In his study Becker (2000) also concluded that: "Computer-using teachers […] are distinctly more constructivist than non-using teachers" (p. 12). On the basis of our finding, we suggest that it is not enough to train teachers in ICT-skills but combine this with pedagogical trainings, providing information about the use of new media in a constructivist way.

The variable "Lack of available time" was identified as a second important factor influencing the "Use of new media in classrooms". According to Manternach-Wigans (1999) "Teachers are very concerned about the lack of time for technology. They say they need more time to learn computer basics, time to attend technology training sessions, time to figure out how to integrate technology in the classroom, and time in the classroom to use technology" (p.28). Similar results have been found in other studies (Fabry and Higgs, 1997, Preston et al., 2000). Snoeynik and Ertmer (2001, cited from Becta, 2004) suggest that non-contact time for teachers to undertake ICT training during school hours should be provided. Other measures might include: support for teachers to prepare and search (multimedia) materials for lessons, as well as to learn new hardware and software skills, for example providing access to and sharing of online resources. Further, novel employment and teaching policies, with time explicitly allocated to the preparation of materials in "new media form" in the teachers' schedule could be provided. Dissemination of targeted software tools that

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facilitate the authoring / assembly process are necessary.

In synthesis, this study has shown that teachers actually use ICT to a large extends in private settings, but many are still reluctant to use technology in school. Appropriate support (technical as well as pedagogical) in schools should be provided to decrease this fear.

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