# Predictors of ICT Use in Teaching in Different Educational Domains

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**Abstract**

This study explored the implementation of the information and communication technology (ICT) into teaching and learning processes in three educational domains (STEM, language education, and other humanities and social sciences). Specificaly, the aim of the current study was to explore the effects of teachers' attitudes towards ICT use in classroom, self-efficacy in the ICT use, and perceived school-level barriers on teachers' ICT use as well as possible domain specific differences in the assessed variables. The data were collected as a part of a larger study conducted within the first phase of the "e-Schools" pilot project (CARNet). An online survey methodology was employed involving a sample of nearly all teachers in 13 middle (N=256) and 7 high schools (N=275). The results revealed that perceived self-efficacy in ICT use proved to be the best predictor of the use of ICT based activities regardless of the domain. Perceived benefits of ICT use significantly predicted the use of ICT in STEM and humanities and social sciences, while school-level barriers negatively predicted ICT use in STEM and in language education. Comparison of educational domains showed that STEM teachers saw more benefits of ICT use in teaching than teachers in humanities and social sciences. STEM teachers perceived themselves as more competent in ICT use compared to other two groups. They also reported that they use ICT more often in lesson preparation and in classroom activities. However, teachers' perception of possible risks and barriers of ICT use in education did not differ in three educational domains.

**Keywords:** ICT in education, teachers, attitudes towards ICT, self-efficacy, barriers for ICT use

## Introduction[1]

### ICT in education

The development of Information and communication technologies (ICT) over the last 30 years has been tremendous. This progress brought notable transformations in many domains of our lives, both private and professional. Consequently, it has also become increasingly important in educational systems worldwide. Balanskat, Blamire, and Kefala (2007, p.11), argued ten years ago that "the use of ICT in education and training has been a key priority in most European countries during the last decade, but progress has been uneven". Similar conclusions can be brought from a more recent review (Wastiau, Blamire, Kearney, Quittre, Van de Gaer, & Monseur, 2013).

In order to effectively integrate ICT into their teaching practices teachers should adopt a new definition of effective teaching that, according to Ertmer and Ottenbreit-Leftwich (2010), should incorporate the notion of using technology for improvement of teaching and learning practices. However, studies have shown that teachers are changing teaching practices with ICT slowly and reluctantly (Baggott La Velle, McFarlane, & Brawn, 2003; Orlando, 2014). That is not surprising given that integration of ICT in teaching and learning is a complex process that can be challenged by various obstacles.

[1] **Aknowledgement:** This study has been conducted as a part of the project: "e-Schools: Establishing a System for Developing Digitally Mature Schools (pilot project)", coordinated by Croatian Academic and Research Network - CARNet

**Barriers to the Successful Implementation of ICT in Teaching Practices**

Researchers and educators have identified diverse obstacles or barriers to the successful integration of ICT into education and classified them into different categories or levels (Balanskat et al., 2007; Becta, 2004, Bingimlas, 2009, Ertmer, 1999). For example, Balanskat et al. (2007) differentiate tree levels of barriers to the ICT uptake in classroom: teacher-level barriers, school-level barriers and system-level barriers. Teacher level barriers refer to teachers' poor ICT competence, low motivation and lack of confidence in using new technologies in teaching. They are related to the quality and quantity of teacher training programmes. School-level barriers refer to limited access to ICT, poor quality and inadequate maintenance of hardware as well as unsuitable educational software. Furthermore, school level barriers also might be related to schools' limited experience with projects and project-based learning as well as to absence of ICT dimension in schools' strategies. System-level barriers relate to wider educational system that might be rigid and hinder the integration of ICT into learning and teaching practices. Bingimlas (2009) reviewed teacher- and school-level barriers and identified lack of teacher confidence and lack of teacher competence as strong teacher-level barriers, as well as resistance to change and negative attitudes. On school-level, most prominent barriers were lack of time, lack of effective training, lack of accessability to ICT resources, and lack of technical support. Since some variables, such as lack of teacher confidence in their competence for ICT use and resistance to change that reflects in negative attitudes towards ICT use in classroom seem to be more important than others (Bingimlas, 2009) we will explain them further in following sections.

**Attitudes**

The existing research on teachers' attitudes towards ICT use in teaching and learning confirmed their important impact on successful integration of ICT into education (Ertmer, 2005; Fu, 2013). Teachers' favourable perceptions about technology in education were found to be positively related with teachers ICT use in daily teaching practice, as well as with the frequency of students' ICT use for learning (European Commission, 2013; Palak & Walls, 2009).

Teachers' attitudes towards ICT use in education may enable or hinder their actual ICT use depending on how the teacher view the impact of ICT use on students' learning and achievements (Drent & Meelissen, 2008). Large-scale studies have shown that teachers generally agree about the relevance of ICT use and its substantial contribution in teaching and learning (European Commission, 2013; Fraillon, Ainley, Schulz, Friedman, & Gebhardt, 2014). In a study on the professional reasoning teachers rely on regarding their ICT use within their teaching practice, Heitink, Voogt , Verplanken, van Braak and Fisser (2016) found that teachers reasons for using technolgy mostly addressed making learning attractive for students, supporting educational goals and facilitating the learning process.

Literature on the impact of preparation programs and courses on teachers' perceptions and attitudes suggest that these interventions may produce favourable changes in teachers' attitudes making them more likely to believe that technology can assist in learning and to recognize its importance (e.g., Doering, Hughes & Huffman, 2003). However, in order to support teachers' positive attitudes towards technology, as well as their use of ICT in teaching and learning, educational programs have to provide authentic, practical examples of teaching with technology (Ertmer & Ottenbreit-Leftwich, 2010).

**Self-efficacy**

As an perceived expectancy about one's capabilities to learn or perform a given task, self-efficacy determines the choice and performance of activities (Bandura, 1997). Compared to the concept of general self-esteem, self-efficacy toward a specific behavior proved to be a stronger predictor of actual behavioral choices and performance. Moreover, a distintion has been made between a domain-specific self-efficacy and a more general self-efficacy. The more domain or tasks specific self-efficacy has a greater potential in predicting outcome at stake.

In respect of teachers' ICT use in teaching and learning, the concept of ICT self-efficacy is introduced. ICT self-efficacy reffer to positive experiences and confidence using digital technologies which shapes how individuals feel about their ability to perform ICT-related tasks (Compeau & Higgins, 1995). Higher levels of ICT self-efficacy has been shown to be predictive for teachers' choices regarding ICT use and adoption in general (Buabeng-Andoh, 2012). Recent studies emphasize the importance of distinguishing between being confident about using ICT on your own (i.e., self-efficacy in basic ICT) and being confident about using ICT for teaching or didactical purposes (i.e., using ICT to enhance online collaboration among students) (Krumsvik, 2011). In a study on the relationship between teachers' self-efficacy, their digital competence, strategies to evaluate information, and use of ICT, Hatlevik (2016) addressed teachers' self-efficacy in basic ICT and their self-efficacy in online collaboration. Findings indicated a high correlation between teachers reporting confidence in solving

basic ICT tasks and reporting self-confidence using ICT with students in online collaboration, suggesting the importance of the self-efficacy in basic ICT for the development of self-efficacy to use ICT for teaching purposes. Self-efficacy in basic ICT and strategies to evaluate information predicted teachers' digital competence, while both self-efficacy in online collaboration and digital competence predicted variation in teachers' use of ICT.

Further, the existing evidence suggests that teachers' ICT self-efficacy and attitudes towards technology in education are mutually related to their ICT use in teaching and learning (Ertmer, 2005; Papasterigiou, 2010). In a study on the factors influencing the ICT integration, Sang, Valcke, Braak, and Tondeur (2010) showed that although teachers' attitudes towards ICT use were found to be the strongest predictor of technology integration, more confident teachers were more capable of and interested in using computers in real classrooms. On the other side, in a study on Swedish teachers' attitudes to and beliefs about using ICT in education, Player-Koro (2012) found that despite that self-efficacy and attitudes were mutually related to ICT use, a strong sense of self-efficacy in using computers in education influenced the use of ICT the most.

**ICT Implementation in Different School Subjects and Educational Domains**

Some studies show that implementation of ICT in teaching is more congruent with some school subjects and domains than others, and that teachers have been reluctant to accept a technology that seems incompatible with their subjects (sub)culture (Goodson & Mangan, 1995; Hennessy, Zhao & Frank, 2003). Goodson and Mangan (1995, p. 615) refer to 'subject area subcultures', as „the general set of institutionalised practices and expectations which has grown up around a particular school subject, and which shapes the definition of that subject as both a distinct area of study and as a social construct." In other words, each subject community shares similar tools and resources, approaches to teaching and learning, beliefs and expectations (Hennessy at al., 2003). These characteristics are not necessarily limited to specific school subjects, but refer to broader educational domains or fields (e.g. social studies, art, technological studies; as described in Goodson & Mangan, 1995).

Therefore, subject culture shapes also teachers' perception of ICT integration in the classroom and their attitudes about ICT in education. In some subjects or domains ICT is perceived as adding new value to teaching and learning and as being advantageous and meaningful, in others it is seen as being "just another tool" (Goodson & Mangan, 1995, p. 624), and in some subjects and domains ICT is perceived as detraction from teaching and learning basic skills in the subject (Hennessy et al., 2003). Some teachers even perceive that (over)use of ICT could lead to losing core features and values of subject culture. Therefore, teachers will be hesitant to change teaching practices if integration of technological innovations poles apart from attitudes and practices of their colleagues teaching in the same educational domain.

Studies show that different subject domains differ in their (sub)cultures. John and Baggott la Velle (2004) argue that science has been associated with new technologies for a long time, and that it has been one of the first subjects in which technology has been integrated. Mathematics has been also related to new technologies and in John and Baggott la Velle's study (2004) mathematics teachers were comfortable with ICT and open to ICT's transformative possibilities. Music and English (mother language) subjects have had weaker affiliation with new technologies, although teachers were positive about ICT potential. However, they perceived ICT as a potential challenge to core values of their subjects. History teachers have been most reluctant to use technology and they also felt (like English teachers) that humanistic nature of their subject might be threatened. Similarly, Hennessy et al. (2003) found that English teachers were more hesitant and anxious, and they showed lower levels of integration of ICT in teaching and learning practices, compared to science and mathematics teachers. Mathematics teachers were least reluctant to ICT implementation, but science teachers saw more educational benefits compared to other teachers.

Balanskat et al. (2007) cited Eurobarometer Benchmarking survey that showed that teachers teaching science, mathematics, and computer science and who are active in vocational education are the most intensive users of the computer in class (more than 50% of their lesson), compared literature and language teachers (who use it only 5% of their lessons), primary education teachers (17%), humanities and social science teachers (13%) and physical and artist/crafts education (16%).

However, more recent study by Karaseva, Pruulmann-Vengerfeldt, and Siibak (2013) showed that, in an sample of Estonian elementary school teachers, humanities teachers were more open about using the technologies and employed more various and student-centred learning activities, compared to science teachers that mainly relied on a teacher-centred instructional style. Similarly, Howard, Chan and Caputi (2015) examined the relationship between three subject areas

(English, mathematics, science) and teachers' beliefs as one of the factors influencing secondary-level teachers' technology integration. Teachers' beliefs about how technology supports learning and about the importance of ICT were analyzed. The findings indicated that English teachers held the strongest belief that ICTs supported learning, while science teachers reported stronger agreement than mathematics teachers regarding this belief. Compared to mathematics and English teachers, science teachers reported decline in their beliefs about the importance of ICT and were the only group of teachers reflecting a significant change in belief. Thus, these findings demonstrated that subject areas are not homogenous and they have unique trajectories over time in a technology-related initiative (Howard et al., 2015).

More comprehensive study, The Survey of Schools: ICT in Education, conducted by European Schoolnet (2014) revealed that European teachers of 8 and 11-grade students in general education mostly used different ICT-related activities during lessons only several times a month. Although differences among teachers in different domains were not large, the frequency of ICT use in classes depended on school subjects. The results showed that science teachers used ICT-based activities more frequently than mathematics and language classes. Mathematics and science teachers expressed similar levels of confidence in their operational ICT skills that were higher than confidence levels of language teachers. Teachers of different subjects also differed in perception of obstacles to the use of ICT activities in the classroom. However, they shared similar positive attitudes towards the use of ICT in the classroom and they all agreed that ICT has the positive effects on students' higher-order thinking skills, motivation, achievement, and competence in transversal skills.

To conclude, most of the teachers have mainly positive attitudes towards ICT use in learning and teaching, but they have still been reluctant in the implementation of ICT in their teaching practices. They perceive different barriers and obstacles that impede their use of ICT in the classroom. The effects of school-level and especially teacher-level barriers to ICT implementation in classroom have been examined a lot, but less attention has been dedicated to comparison of these variables in different educational domains. Studies conducted so far have not yielded unambiguous findings.

**The Present Study**

In Croatia, substantial efforts have been made to integrate ICT in the elementary and high-schools within the e-Schools program that is coordinated by the Croatian Academic and Research Network - CARNet. The e-Schools program is aimed at introducing ICT into the school system, naimly into 7th and 8th grades of elementary school that correspond to middle school, and 1st and 2nd grades of high-school, in the 2015-2022 period. Currently, the s-Schools pilot project (full name: "e-Schools: Establishing a System for Developing Digitally Mature Schools [pilot project])" has been implemented (2015-2018). The overall goal of the e-Schools program is to help strengthen elementary and middle school education system with the final aim of preparing students for future. One of the main direct objectives of the program is to develop digitally competent teachers prepared for the integration of ICT innovations in their own teaching practices. E-Schools "envisage a gradual, voluntary transition to digital content, in which teachers will have the decisive role, as key stakeholders of each educational process, both in the past and in the future" (CARNet, 2017, retrieved from https://www.e-skole.hr/en/e-schools/find-out-more/why-e-schools/).

In order for teachers to successfully embrace technology into teaching process they have to overcome different barriers. Therefore, it is important to explore the barriers those teachers confront in their schools, especially on teacher and school levels (Bingimlas, 2009). In the present study we focused on some specific teacher-level barriers that seem to be most important (teachers' attitudes towards ICT and self-efficacy in ICT use), as well on school-level barriers that might hinder successful implementation of ICT in learning and teaching practices.

E-Schools program is aimed mainly on STEM domains, as target beneficiaries of digital educational content and teaching scenarios that will be created within the program are middle and high-school students and teachers of STEM subjects (chemistry, biology, physics and mathematics). Hence, it was of our interest to explore the effects of their attitudes towards ICT use in classroom, their self-efficacy in the ICT use, and perceived school-level barriers on their ICT use for lesson preparation and classroom activities, as well as to compare them to attitudes and perceptions of teachers in other educational domains, such as humanities and social sciences. The assessment took place before the teachers had the opportunity to implement particular activities, digital content, and technology that has been developed and implemented during the pilot project. As such it might be informative for policy makers as it has focused on identifying potential barriers to meaningful ICT integration in teaching practices in different educational domains.

## 2. Methods

### 2.1. Participants

The sample consisted of 534 teachers (77.3% female) from 13 elementary (7th and 8th grade that corresponds to middle school, n = 259) and 7 high schools (1st and 2nd grade, n = 275) in Croatia. Teachers' mean age was 42.60 years (SD = 11.47).

In Table 1., demographic characteristics of the sample, giving both numbers and percentages of teachers in each category of gender, school level and teaching experience, as well as range, mean and standard deviations for participants' age, are presented separately for STEM, language education and other humanities and social sciences domain.

Table 1. Demographic characteristics of the sample

| | STEM | | | Language education | | | Humanities and social sciences | | |
|---|---|---|---|---|---|---|---|---|---|
| | N | % | | N | % | | N | % | |
| Gender | | | | | | | | | |
| Male | 62 | 30.2 | | 19 | 10.2 | | 40 | 28.0 | |
| Female | 143 | 69.8 | | 167 | 89.8 | | 103 | 72.0 | |
| School level | | | | | | | | | |
| Middle school | 100 | 48.8 | | 93 | 50.0 | | 66 | 46.2 | |
| High school | 105 | 51.2 | | 93 | 50.0 | | 77 | 53.8 | |
| Teaching experience | | | | | | | | | |
| Less than 10 years | 89 | 43.4 | | 71 | 38.2 | | 56 | 39.2 | |
| 10-20 years | 53 | 25.9 | | 51 | 27.4 | | 46 | 32.2 | |
| More than 20 years | 63 | 30.7 | | 64 | 34.4 | | 41 | 28.6 | |
| | Range | M | SD | Range | M | SD | Range | M | SD |
| Age (years) | 24-66 | 43.05 | 11.72 | 26-64 | 42.08 | 11.26 | 25-65 | 42.52 | 11.37 |

### 2.2. Measures

#### 2.2.1. Attitudes towards ICT use in teaching and learning

Two scales were used to assess teachers' attitudes towards ICT use in teaching and learning. The perceived Benefits of ICT use in teaching and learning scale included fourteen items (Cronbach's alpha = .89) reflecting relevance of ICT use in teaching and learning and its positive impact on students' learning and motivation (e.g., "Students gain better understanding in what they are learning"). The perceived Risks of ICT use in teaching and learning scale included eleven items (Cronbach's alpha = .83) referring to a negative consequences of ICT use in teaching and learning (e.g., "ICT tempts students to learn superficially"). The response format for both scales consisted of a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree).

#### 2.2.2. ICT self-efficacy

Teachers' self-efficacy in using ICT was measured using a seven-item scale (Cronbach's alpha = .91). The scale assessed the extent to which teachers perceive themselves able to competently use ICT in everyday instructional practice (e.g., "I am skilful in creating digital educational content for the subject I teach"). Participants rated their level of agreement with statements on a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree).

#### 2.2.3. School-level barriers to using ICT in teaching and learning

Teachers' perception of school-level barriers to ICT use in teaching and learning was assessed with six items (Cronbach's alpha = .87) reflecting a set of factors which adversely affects ICT use (e.g., equipment issues, school time and space organisation, accessibility to ICT, insufficient technical and pedagogical support). Items were rated on a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree).

#### 2.2.4. ICT use in teaching and learning

The scale used for the assessment of teachers' ICT use consisted of fifteen items (Cronbach's alpha = .93) asking about the frequency of a set of ICT based activities related to lesson preparation (e.g., „I use ICT to prepare exercises and tasks for students"), as well as a set of ICT based teaching activities with students in the classroom (e.g., problem solving activities, searching for additional information on internet, working in groups, exercises and practice, students presentations). For each activity, the participants had to specify how often they do it on a five-level scale with 1 meaning never; 2: several times a month; 3: once to twice a week; 4: more than twice a week; and 5: every day.

### 2.3. Procedure

The data were collected as a part of a larger baseline study conducted within the first phase of the "e-Schools" pilot project (Croatian Academic and Research network - CARNet). An online survey methodology was employed. The online questionnaire was group administered to teachers in their schools by school coordinators. Personal background data were also collected. The group session lasted approximately 45 minutes. Although the study was not anonymous, confidentiality was guaranteed to participants.

## 3. Results and Discussion

Correlations between teachers' attitudes towards ICT use, ICT self-efficacy, perception of school-level barriers to ICT use in teaching and learning and reported use of ICT based activities is shown in Table 2.

Table 2. Correlation between teachers' attitudes towards ICT use, ICT self-efficacy, school-level barriers and use of ICT

| | Risks of ICT use | ICT self-efficacy | School-level barriers | Use of ICT based activities |
|---|---|---|---|---|
| Benefits of ICT use | -.24** | .35** | .02 | .34** |
| Risks of ICT use | | -.27** | .20** | -.20** |
| ICT self-efficacy | | | .01 | .61** |
| School-level barriers | | | | -.06 |
| Use of ICT based activities | | | | |

Note. ** p < .001.

Teachers' use of ICT based activities was related to ICT self-efficacy and teachers' attitudes toward ICT use. Benefits of ICT use were positively reated to percieved ICTself-efficacy, while risks of ICT were positively related to school-level barriers and negatively to self-efficacy and reported use of ICT based activities. Surprisingly, self-efficacy did not correlate with perceived school-level barriers. Althouhg some autors (Becta, 2004; Bingimlas, 2009) argue that teachers' confidence in ICT use is closely related to several other barriers, such as technical problems and lack of access to ICT recources, that relation was not evident in our findings. However, our results show that self-efficacy was related to attitudes towards ICT and it highly correlated with reported use of ICT.

In order to test if the teachers' attitudes towards ICT use, ICT self-efficacy, and perception of school-level barriers to ICT use in teaching and learning significantly predicted their use of ICT based activities, separate simple linear regression analyses were performed for each of the educational domain. The results are shown in Table 3.

Table 3. Summary of simple regression analyses for variables predicting teachers' use of ICT based activities in three educational domains.

| | STEM n = 205 | | | Language education n = 186 | | | Humanities and social sciences n = 143 | | |
|---|---|---|---|---|---|---|---|---|---|
| | B | SE B | β | B | SE B | β | B | SE B | β |
| Benefits of ICT use | 0.31 | 0.10 | .18** | 0.14 | 0.08 | .11 | 0.20 | 0.10 | .14* |
| Risks of ICT use | -0.08 | 0.10 | -.05 | 0.11 | 0.08 | .08 | -0.06 | 0.10 | -.04 |
| ICT self-efficacy | 0.49 | 0.06 | .49** | 0.48 | 0.05 | .60** | 0.49 | 0.06 | .57** |
| School-level barriers | -0.12 | 0.06 | -.13* | -0.10 | 0.05 | -.12* | 0.05 | 0.05 | .06 |
| R2 | .37 | | | .41 | | | .43 | | |
| F | 29.04** | | | 31.69** | | | 25.75** | | |

Note. * p < .05 ** p < .001.

The results of the regression analysis employed in a subsample of teachers in STEM domain indicated that the examined predictors explained 37% of the variance. The strongest positive predictor of use of ICT based activities was ICT self-efficacy, followed by the perceived benefits of ICT use. Teachers' perception of school-level barriers to using ICT in teaching in learning negatively predicted their ICT use.

Teachers' use of ICT based activities in the domain of language education was positively predicted by teachers' reported levels of ICT self-efficacy and negatively by their perception of school-level barriers to using ICT. The predictors explained 41% of the variance of language education teachers' use of ICT based activities.

Similar proportion of explained variance of the criterion variable was found in a subsample of teachers in other humanities and social sciences educational domain. Teachers' use of ICT based activities in this domain was positively predicted by the perceived benefits of ICT use, as well as by the level of their ICT self-efficacy.

In sum, the results revealed that the strongest positive predictor of use of ICT based activities in all educational domains was ICT self-efficacy. That result supports the findings of previous studies that emphasize the importance of teachers' confidence in using ICT (e.g., Balanskat et al., 2007; Becta, 2004), or their levels of computer self-efficacy (e.g., Buabeng-Andoh, 2012). Wastiau et al. (2013) also concluded that teachers who are confident in their digital skills and positive about ICT's impact on learning organise more frequent ICT-based activities with their students. Furthermore, the obtained findings are in line with the conclusion Player-Koro (2012) made about the stronger influence of ICT self-efficacy compared to the influence of teachers' attitudes towards technology on their ICT use in teaching practice. Self-efficacy can be developed though positive personal and vicarious experiences with technology, so teachers should be introducted to technology in small steps, providing them with opportunities to experiment and try new ideas (Ertmer, & Ottenbreit-Leftwich, 2010).

In our study, variables other then ICT self-efficacy i.e. perceived barriers and enablers only weakly predicted perceived use of ICT in classroom. Perceived benefits of ICT use significantly predicted the use of ICT in STEM and humanities and social sciences, while school-level barriers negatively predicted ICT use in STEM and in language education. Interestingly, perceived risks of ICT use did not have effect on ICT employment for lesson preparation and for ICT-based activities in classroom. Although all variables relating to successful implementation of ICT in education should be mutually related, as described for example in Becta (2004) or Bingimlas (2009), it seems that in some educational domains certain factors have a more important role in ICT adoption by teachers. The observed differential predictions of teachers' ICT use based on perceived benefits of ICT use and the perception of school-level barriers to ICT use in three educational domains, correspond to the existing research showing that when it comes to technology integration in education, subject areas and educational domains are not homogenous (e.g., Howard et al., 2015). In line with the evidence on the adverse effect of barriers to the ICT uptake in classroom (Balanskat et al., 2007), teachers' perception of school-level barriers proved to be negative predictor of using ICT based activities in STEM and language education domain. Although supporting teachers in how to use the potentials of ICT in teaching and direct experience of how to handle ICT in classrooms is needed to enhance successful uptake of new technologies by teachers (Ertmer & Ottenbreit-Leftwich, 2010), somewhat differential approaches could be fostered in different educational domains. Removing school-level barriers might not be a decisive factor, but could positively affect ICT uptake by STEM and language education teachers. Stressing benefits and usefulness of ICT use might be especially important for STEM teaches, and even for humanities and social sciences teachers as positive attitudes seem to be predictive of ICT uptake in those domains.

The effects of educational domains on teachers' attitudes towards ICT use, ICT self-efficacy, perceived school-level barriers to using ICT and use of ICT based acitivities were analyzed with univariate ANOVAs (Table 4.). Significant effects were followed up with multiple comparison tests using Fisher's LSD method.

Table 4. Mean differences on attitudes towards ICT use, ICT self-efficacy, school-level barriers to using ICT and use of ICT based activities between three educational domains.

| | STEM n = 205 | | Language education n = 186 | | Humanities and social sciences n = 143 | | | |
|---|---|---|---|---|---|---|---|---|
| | M | SD | M | SD | M | SD | df | F |
| Benefits of ICT use | 3.35a | .49 | 3.25 | .54 | 3.21a | .49 | 2. 531 | 3.24* |
| Risks of ICT use | 3.20 | .51 | 3.25 | .55 | 3.23 | .50 | 2. 531 | 0.42 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| ICT self-efficacy | 3.78 ab | .83 | 3.38a | .90 | 3.32b | .79 | 2. 531 | 16.46** |
| School-level barriers | 3.32 | .85 | 3.35 | .88 | 3.17 | .90 | 2. 531 | 1.83 |
| Use of ICT based activities | 2.50ab | .83 | 2.29a | .72 | 2.18b | .68 | 2. 531 | 8.42** |

Note. * p < .05 ** p < .001. Educational domain means within a row with the same subscripts differ significantly at the p < .05 or p < .001 level (Fisher's LSD test).

Educational domain had a significant effect on the perceived benefits of ICT use in teaching and learning, F(2, 531)= 3.24, p < .05. Post-hoc testing indicated that teachers in STEM domain reported significantly higer perception of potential benefits of ICT use than teachers in humanities and social sciences educational domain. Teachers in language education reported similar levels of perceived benefits of ICT use as the teachers in the remaining two groups. The differences on perceived risks of ICT use in teaching and learning between teachers in the examined educational domains were not significant, F(2, 531) = 0.42, p = n.s. Likewise, teachers in different domains did not differ in terms of their perception of school-level barriers to using ICT in teaching and learning, F(2, 531) = 1.83, p = n.s.

Further, educational domain had a significant effect on teachers' perceived self-efficacy in using ICT, F(2, 531) = 16.46, p < .001. Multiple comparisons showed that, compared to teachers in language education and other humanities and social sciences domain, teachers in STEM domain had higher levels of self-efficacy in using ICT in their daily work. Similarly, a significant effect of educational domain on teachers' self-reports on use of ICT as a teaching and learning tool was found, F(2, 531) = 8.42, p < .001. Teachers in STEM domain reported significantly higher frequency of ICT use than teachers in the remaining educational domains.

These results correspond to contemporary research notion that some educational domains are more likely to integrate ICT in teaching and learning than others and that they might have unique trajectories over time in the process of ICT integration in education (Howard et al., 2015). Although some of the more recent studies (Karaseva et al., 2013; Howard et al. 2015) show that humanities teachers were more open and supportive about using ICT in teaching practices compared to teachers of STEM domains, the results of our study are more in line with traditional notions that mathematics and science have been more closely related to new technologies (John & Baggott la Velle, 2004). Our results revealed that teachers in the STEM domain perceived themselves as more competent in ICT use compared to other two groups and also reported that they use ICT more often in lesson preparation and in classroom activities. The observed pattern of results in STEM domain is not surprising given the well established finding on favourable impact of both, the levels of ICT self-efficacy and positive attitudes, on teachers' choices regarding ICT use and adoption in general (Buabeng-Andoh, 2012).

Similar results were found in European Schoolnet study (2014) in which science and mathematics teachers expressed higher levels of confidence in ICT skills than language teachers, and science teachers employed ICT-based activities most frequently. However, the results of our study also indicated that some differences could be noted between teachers in langugue education domain and teachers in other humanities and social sciences. Teacher in other humanities and social sciences (e.g. history, geography, philosophy, psychology, sociology…) reported the lowest levels of ICT self-efficacy and the least frequent use of ICT in teaching practices. ICT use in teaching social sciences subjects has been rarely explored, although some studies show that use of technology is rare among social studies faculty members and that more practical examples of technology integration in teaching practices should be provided (Bolick, Berson, Coutts, & Heinecke, 2003). Likewise, some studies exploring ICT uptake by humanities teachers showed that they have been quite reluctant to use technology (e.g. history teachers in study of John and Baggott La Velle [2004]). However, as previously mentioned, newer studies point to opposing conclusions (Karaseva et al., 2013).

Differences between different educational domains in attitudes towards ICT use in education obtained in our study were not as obvious as obtained differences in ICT self-efficacy and ICT use. Although STEM teachers saw more benefits of ICT use compared to humanities and social sciences teachers, teachers' perception of possible risks of ICT use in education did not differ in three educational domains. Likewise, teachers' perceptions of school-level barriers were similar regardless of domain. Compared to the remaining, internal, teacher-level factors influencing the use of ICT that were examined in the current study, perceived barriers were external, school-level factor. It is possible that teachers were therefore exposed to similar school-level barriers and thus were more likely to perceive barriers similarly regardless of their teaching domain. Athough these two types of factors are generally related to each other (Tezci, 2011) in our study teachers' perceptions of school-level barriers were not related to their perceived benefits of ICT use and ICT self-efficacy.

As a whole, this study findings point in the same directions as previous research by showing that favourable attitudes towards ICT use in teaching practices and higher ICT self-efficacy both positively predict teachers' ICT use in daily teaching practice. Teacher perceived self-efficacy, that is not necessarily related to perceived school-level barriers, seemed to be of particular importance. Also, the results of the present study contribute to the relatively sparse evidence on educational domain specificities of ICT integration in teaching and learning.

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