The Current Challenges of Further Education in ICT with the Example of the Czech Republic

Lenka Mynaříková* and Lukáš Novotný

Abstract: Schools have an irreplaceable role in preparing the young generation for educational, professional, and social challenges, however, this effort fails if teachers themselves are not equipped with sufficient ICT competencies and do not work on their constant development. The presented quantitative study analyzed how secondary school teachers understand and actively use Information and Communication Technologies (ICT) in their teaching practice and what barriers they encounter in terms of the further education in ICT provided by accredited institutions. In a sample of 1846 Czech teachers who completed an online survey, results showed they lacked both understanding and active use of new technologies, rarely participated in further education, and were unsatisfied with the courses provided to them. Their main barriers to further education were the lack of sufficient technology available in school, insufficient knowledge and skills in ICT, and the lack of support from school management. Unlike in other studies, time was not identified as an important barrier. Possible legislative, educational, and school management consequences regarding the further education in ICT based on the barriers in attending the courses and identified age and gender differences are discussed.

Keywords: ICT competencies; further education; secondary school teachers; knowledge society; post-communist space

1. Introduction

Current trends in digitalization directly affect education and participants in education at all levels, but especially have a major effect on primary and secondary schools, where with current trends and changes, such as the rise of Industry 4.0 with the integration of Internet of Things into everyday society, the requirements for the development of digital competencies in teachers are growing [1,2] reality. Nowadays, especially during the COVID-19 pandemic, teachers at all levels are confronted with rapidly changing demands on their profession, which require a broader and more sophisticated set of skills and competencies than the previous generations experienced, forcing them to use digital technologies daily as not only the preferred, but usually their only means of teaching.

The presented study investigated the relationship between perceived digital competencies, use of Information and Communication Technologies (ICT) in teaching, and the frequency and perceived quality of further education in ICT competencies. Although teachers with a positive attitude toward ICT and with practical skills to use a variety of ICT means are a major factor in implementing ICT into the school curriculum, research has shown that even teachers with sufficient technology skills are not comfortable or prepared to integrate technology into the classroom. There is an obvious gap between being digitally competent for personal purposes and being digitally competent in education to meet the educational goals of students. Even frequent users of ICT are often not sure about how to implement ICT into their specific subjects. Hence, based on the information provided in the theoretic section, we expected that the missing link might be the absence of structured, continuous training in the use of ICT in teaching.
The article has the following structure: general information on the further education in ICT and its benefits for teachers; description of the current state of further education in ICT in the Czech Republic, which we used as a case study for this article; materials and methods; results of the quantitative study; discussion of the results and possible implications; and final considerations and limitations of the study.

2. Theoretical Background

2.1. State of the Art

Research has confirmed that teachers with ICT competencies who have confidence in information technology can be very inspiring for their students and contribute to the personal and professional development of students [3–6]. Studies [7] have suggested that the use of various digital tools and digital education forms in teaching plays an important role in connecting textual and academic meaning with the students’ personal understandings and appropriating of scientific concepts. The omnipresence of ICT requires teachers to continuously develop their ICT competence through further education programs [8–11]. The development of ICT competencies is significantly influenced by their integration into the systematic further education of teachers [12,13], which can significantly increase teachers’ confidence in using ICT in teaching, positively influence teachers’ attitudes to ICT and, above all, to reduce so-called computer anxiety, i.e., fear of using digital technologies and distrust in changing learned standards in general, which is one of the common emotional barriers to the use of ICT in teaching.

In the knowledge society, developed digital competencies are necessary for both private and professional life, and for active participation in society [14–17]. Regarding education, even more important than understanding the digital competence itself is knowing how to effectively develop it [18]. Digital competence is one of the eight key competencies of lifelong learning (defined by European Commission: DIGCOMP) and refers to the confident and critical use of a variety of digital technologies for analyzing and processing information, communication, and basic problem-solving [19]. The Eurydice Report [20] showed that almost all European countries have a specific national strategy related to digital competence. At the time of the study, digital competence was taught through a cross-curricular approach in all but two EU countries at the primary level and in all countries at secondary level—in addition to other approaches used in several countries, such as integrating ICT into particular subjects or teaching it as a separate subject.

Teachers’ ICT competencies include, for example, using ICT to communicate with students, their parents, and other stakeholders; to improve communication strategies; to work with colleagues; to share and exchange knowledge and experience; and also for their professional development [21,22]. Teachers should be able to organize digital content and make it accessible to students, include ICT in teaching, and use it to support and develop students’ cooperation [23]. Recall that there is a very interesting theoretical framework related to theories of acceptance of ICT in teaching [24,25]. Every country in the EU has a framework of teachers’ digital competencies that shows what today’s teachers should understand and be able to do. Currently, most EU countries already accepted the European framework for digital competencies of teachers (DigCompEdu), which is a part of the activities related to the action plan for digital education [26], which was preceded by a number of other related activities [27,28]. Their common goal was and is to strengthen digital competencies in teachers. These are common strategies for the whole of the EU, without considering regional specificities, including some financial underestimations and the position of education and various training policies in Central and Eastern Europe.

Compared to the western European countries, the development of the education system in central and eastern European countries has certain specifics, evident in the slower implementation of ICT in education, but also in the further education of teachers, who still focus more on language courses that were not so accessible to them before and ICT courses are at the edge of their attention [29,30]. Many teachers rely only on self-study, the effectiveness of which fails due to the time demands of the teaching profession,
sulting not only from teaching but also from preparing the classes, performing a number of administrative tasks that teachers have to deal with daily, working with the class and parents of students, and further due to the lack of motivation and support. Ineffective self-study and the lack of concepts of further education in ICT thus widen the gap in the level of digital competencies of teachers in different countries, but also the gap between the digital competencies of teachers and students educated by these teachers. To reduce concerns about unexpected problems in the use of ICT in teaching, it is essential to pay attention to further education in ICT [31]. Based on the results of Scandurra and Calero’s study [32], teachers’ further education is critical in terms of its effect on both teachers’ and their students’ labor market outcomes and skills. The link between teachers’ education and their competencies used in the workplace reflects the effect of the level of further education on the daily use of skills in the labor market. Therefore, the sufficient development of ICT competencies gives both teachers and their students an advantage in the labor market and also helps them achieve professional goals in their workplace. Studies have also noticed that differences in historical and institutional evolution, family, cultural, and social capital are relevant in explaining the development and levels of education and competencies and vary based on the way how countries deal with unequal life chances of individuals participating in education [33].

In general, we observed several important specifics from various comparative research studies of ICT knowledge in the postcommunist space. It should be noted that the intellectual skills of teachers (including Czech ones) are no worse than average in an international comparison. However, also due to the higher average age of teachers in the Czech Republic (currently 46 years, with 39% of Czech primary school teachers and 50% of secondary school teachers being older than 50 years) and due to neglect of further education in ICT (and therefore also nonexistence of career rules), their ICT skills are below average. The situation is similar in other countries, such as Slovakia, Poland, and elsewhere in central and eastern Europe [34–36].

2.2. Further Education in ICT

Further education of school staff, both teaching and nonteaching, should be a part of the development of their digital competencies and should consider the European framework of competencies, DigCompEdu. With the help of this further education, there should be both the modernization of school infrastructure and the modernization of school educational programs, where a procedure for the appropriate integration of various technologies into teaching could be recommended [37]. The framework of digital competencies of teachers highlights activities and skills that may be underestimated or not commonly considered in connection with teaching. It focuses mainly on pedagogical competencies and provides insight into how these competencies are affected by the possibility or necessity of using digital technologies in teaching [38,39].

Schools should focus on planning not only in the field of hardware and software modernization, but especially to continue to develop the education of their teachers and other staff [40,41]. They should realize that ICT is no longer needed only in the teaching of computer science, but partly applies to every subject, so it is necessary to adjust the school curricula. Other subjects, such as the social sciences, which studies [42,43] have described in connection with the development of ICT as so-called “sleeping giants”, adapt to the development of digital technologies much more slowly and it is more difficult for their teachers to accept the importance of ICT in teaching and its positive impact on the quality of teaching and learning outcomes [44,45]. After the reforms of the curriculum, the emphasis is placed on the implementation of ICT in the teaching of all subjects to achieve digital and other competencies. At the same time, however, there is still a separate subject of informatics, which in several other countries, where the integration of ICT into school life has been successful, no longer makes sense [20].

Another area to think about is how to share information from a school outside, for example through websites, but also when sharing information in schools (for example,
the correct and uniform use of cloud services or modern means of communication between teachers and students) [46]. Besides, there should be a sharing of information between other schools about how successful they are, for example in modernizing their school’s educational program, and how the changes are reflected, but also about sharing teaching experiences. ICT can also be used in other areas, for example in inclusion and literacy, languages, etc. As suggested by several studies [47–50], social capital and social networks mediate teachers’ professional development and their teaching practices, and thus have a positive impact on students’ academic achievement.

The last decade has witnessed many shifts in the landscape of education. Education has become and continues to become much more student-centered. Innovative educators are keenly aware of these changes and as such, strive to gain as much knowledge as they can from the latest trends in education. Innovative educators do not view students as passive receptors of information [51], but instead view students as active participants in their learning [52,53]. Innovative approaches to teaching with critical and meaningful integration of ICT competencies through problem-solving learning environments can improve students’ creativity and encourage students to solve real-life problems by using ICT [54], contrary to the traditional teaching approaches which emphasized the “how to answer, not to question” models [55–57]. Innovation in education thus encourages teachers and students to critically observe, research, analyze, and experiment with various tools to test assumptions and uncover something new, with the help of divergent thinking, promoting curiosity, and willingness to take risks and challenge the status quo [58–60].

3. Further Education in the Czech Republic

Further education of teachers is generally a major topic in the postcommunist space [61]. However, it is also a “hot potato”, as finding an effective form of in-service training in systems that invest in education rather below average (in the EU), where the social and pay prestige of the teaching profession is also low and (post) communist patterns of thinking still prevail in many respects, is not easy. These circumstances are often in relatively stark contrast to the progressive efforts of the EU for a certain uniformization of skills and competencies in education (including digitization), reflected in PISA [62,63], which focus, in comparison, on a unified and disciplining view of education and its subjects. This issue is also reflected in the Czech Republic [64], which we chose as a case study for the analysis. It is precisely the example of in-service teacher education in ICT that reflects how the implementation of recommendations and tools from various EU strategies within the framework of European education and innovation policy, or other international organizations, encounters certain barriers. Above all, those are the complete neglect of teaching digital competencies at pedagogical faculties in the professional training of future teachers, who are led to pass on information to students, but not to do it in new, creative, effective ways with the use of ICT. This is also affected by the non-conceptuality of further education organized by the school principal and partly by the demotivation of teachers themselves. Moreover, the problem of demotivation does not only concern older teachers, but increasingly also beginner teachers, who come to schools unprepared to cope with the reality of how current education is significantly affected by inclusion and the related demands on classroom management and educational goals. They also lack the tools to motivate students, and the problem is still supported by the declining authority of the teacher. Thus, in the first years, demotivation, problems in coping with stress, and burnout syndrome can occur. Under these conditions, the challenge for the teacher is the teaching itself, and further education is rather a marginal issue that the teacher wants to invest as little effort as possible in, but that does not reflect the actual educational needs.

The obligation of further education, by which teachers renew, strengthen, and supplement their qualifications during their pedagogical activities, is explicitly stipulated in the Act on Pedagogical Workers for pedagogical staff. Continuous further education of pedagogical staff is the center of the professional development of in-service teachers and should take place systematically and in a coordinated manner for the entire duration of
the professional career of the pedagogical worker. Therefore, it is not expected that the future teacher will acquire all the necessary competencies in tertiary education, but rather will further develop his/her competencies in methodology, didactics, pedagogy, psychology, and specialized activities. Thus, every teacher has the right, but also the obligation, to complete further education so that they can contribute to the improvement in the quality of the education system and to support and implement innovations in education. The Ministry of Education, Youth, and Sports of the Czech Republic stipulates by decree the types and conditions of further education of pedagogical staff and the manner of its completion. Completion of further education may be part of other qualification prerequisites necessary for the inclusion of a pedagogical worker in a certain career level. Further education takes place either institutionally at universities, institutionally in facilities for further education of pedagogical staff (especially at the National Pedagogical Institute of the Czech Republic, or at other organizations accredited by the Ministry of Education), and in other facilities based on the accreditation granted by the Ministry of Education. In the Czech Republic, a pedagogical worker is legally entitled to 12 working days off for self-study. Further education in schools is organized by the school principal according to a plan that he/she determines after prior discussion with the relevant departments. This plan is based on the interests of teachers and the current needs of the school, yet programs for the development of ICT competencies are still on the fringes of interest, although the situation of current education shows that teachers are failing in these competencies.

Despite the number of different courses, the development of teachers’ digital competencies is not carried out systematically. This issue is not only a problem in the Czech Republic, and as confirmed by several studies [65,66], many teachers acquire digital competencies in their free time, regardless of the length of their practice. Related to this are the most important barriers in the development of ICT competencies, these being a lack of time, lack of support from the school management and from colleagues, or computer anxiety [67–69].

4. Materials and Methods

Teachers of any subjects from vocational, technical, and upper secondary schools across the whole Czech Republic participated in the research. Data were collected between January and March 2020 with the help of school psychologists, who asked the teachers from their schools to complete an online questionnaire (described later). Descriptive statistics were used to describe data about the participants. A total of 1846 teachers made up the sample, with 1201 females (65.1%) and 645 males (34.9%), which nearly corresponds with the 60:40 ratio of male to female teachers in the secondary education in the country. As the total population of secondary school teachers in the Czech Republic is approximately 36,783 (data from the Ministry of Education, Youth, and Sports of the Czech Republic from 2018), our sample represented 5.1% of them. The age of respondents varied between 21–81 years (M = 48.43, SD = 10.26). The length of teaching experience ranged between 1 and 54 years (M = 20.49, SD = 10.30). Most of the teachers had a master’s degree (83.3%), 59.5% got their pedagogical qualification as students of pedagogical faculty, followed by 35.5% who got the qualification during additional pedagogical studies. In the sample, 78.6% taught at secondary vocational schools, 12% at technical schools, and 9.4% at upper secondary schools.

A qualitative methodology has been used. Respondents filled out an online survey, which was divided into four sections: (1) demographic information (age, gender, type of school they currently teach at, highest level of education, pedagogical qualification, subjects taught at their current school), (2) questions about perceived digital competencies, (3) questions about the actual use of ICT in teaching (meaning using the ICT in the classroom, for communication with students, and for the preparation of classes), and (4) specifics about the frequency of and satisfaction with further education in ICT. The questionnaire was pretested on a sample of 120 final-year students of pedagogy with a discussion following completing the instrument, so that the students could express their opinions.
on the understandability and reasonability of questions. Responses were processed via IBM SPSS v25. The description of the variables was done in accordance with their nature; the qualitative ones by means of frequency and percentage, and the quantitative ones by means of the mean or the median, and the standard deviation. After checking for outliers (using the graphic test boxplot), missing data, and the assumptions of linearity and normality, Pearson’s correlational analysis of the relations between the variables, t-test and ANOVA comparisons of averages, and regression analyses were conducted. The reliability check of the groups of items was calculated, with the Cronbach’s Alpha score of 0.86.

The sampling error was ±5%, giving a confidence level of 95.5.

The following hypotheses were tested:

**Hypotheses 1 (H1).** The frequency and perceived quality of further education in ICT is associated with gender, age, level of education, and length of teaching experience.

**Hypotheses 2 (H2).** Perceived digital competencies and the use of ICT in teaching are associated with the frequency and perceived quality of further education in ICT.

**Hypotheses 3 (H3).** Respondents experience barriers that prevent them from more frequent further education in ICT.

To address the perceived digital competencies (PDC) and the actual use of ICT means in teaching (ICTuse), the total PDC and ICTuse scores were calculated. A total PDC score consisted of two components: (1) A perceived level of experience in using ICT for preparing offline and online classes; using ICT in offline and online classes; and communicating with students, teachers, or parents (on a scale from 1—advanced user to 4—absolute beginner). (2) Understanding of items related to Web 2.0 and new technologies from five categories of digital competencies (digital communication, digital education, digital safety, software, and hardware), with 9 items in each of them. This second part was inspired by Hargittai’s [46] idea of analyzing internet skills, though the items were updated to correspond with technologies used in the 21st century education and also with the studied area, i.e., using ICTs in teaching. We used the following items: digital communication (social media, WhatsApp, Skype, blog, tweet, podcast, Zoom, networking, videoconference), digital education (Massive open online course/MOOC, video mentoring, TED, personal learning environment, gamification, remote virtual laboratories, educaching, virtual reality, augmented reality), digital safety (cybersecurity, open license, GDPR, digital trace, spam, hoax, phishing, cyberbullying, adware), software (MS Office, Office 365, Google Docs, Cloud service, OneDrive, QR code, online presentation, Kahoot!, Google Classroom), and hardware (netbook, Ultrabook, smartphone, phablet, padphone, smart TV, interactive table, visualizer, eBeam). The total PDC score ranged from 1 (expert) to 6 (absolute beginner), with higher scores meaning lower overall perceived digital competencies.

A total ICTuse score, investigating the actual use of various ICT means (1) in offline and online classes; (2) for the preparation of offline and online classes; and (3) for the communication with students, teachers, or parents, analyzed the frequency of use of different means from four subcategories with 9 items in each of them: social media (Facebook, Twitter, Instagram, Yammer, Google+, LinkedIn, WhatsApp, Skype, Zoom), digital services (OneNote, digital learning materials provided for teachers, digital learning materials created and shared by other teachers, cloud services, graphic editor, PowerPoint, Sway, Prezi, QR codes), digital devices (desktop computer, smartphone, tablet, interactive whiteboard, eBeam, interactive desk, voting device, visualizer, virtual reality glasses), and digital learning forms (electronic publications, electronic study aids, video recordings, audio recordings, webinars, open educational online courses, virtual and remote laboratories, teaching applications, tutored and untutored e-learning via LMS Moodle). Each category was scored on a 4-point scale based on the frequency of use from 1 (always) to 4 (never). A total ICTuse score was computed from the results of all 4 subcategories, with a range from 1 (habitual user) to 5 (habitual user) to 5 (habitual user) to 5 (habitual user) to 5 (habitual user).
participating in the further education more often or at all. The barriers were chosen based on the literature analysis [53,59,60] with the following items: lack of school management support, lack of colleagues support, lack of motivation, lack of time, lack of sufficient technology in school, insufficient knowledge and skills in ICT, ICT is not suitable for taught subject, and distrust in new technologies and approaches. Besides that, the respondents were asked about the quality of their internet connection and about the ownership of internet-accessible devices at home [64,70,71].

5. Results

5.1. The Frequency and Perceived Quality of Further Education in ICT Is Associated with Gender, Age, Level of Education, and Length of Teaching Experience

As seen in Table 1, the majority of respondents attended further education courses in ICT less than once a year, with a significant gender difference for the frequency, \(t(1094.388) = 4.914, p < 0.000\) and the perceived quality of further education in ICT, \(t(1844) = -8.321, p < 0.000\), and also with a significant gender difference for the perceived quality, \(F(4.1762) = 15.976, p < 0.000\), with age groups older than 46 years reporting lower satisfaction with the attended courses. No significant age difference for the frequency of further education was found.

Table 1. The frequency of further education in Information and Communication Technologies (ICT).

<table>
<thead>
<tr>
<th></th>
<th>Male</th>
<th>Female</th>
<th>Active Margin</th>
</tr>
</thead>
<tbody>
<tr>
<td>once a month</td>
<td>19</td>
<td>9</td>
<td>28</td>
</tr>
<tr>
<td>once every six months</td>
<td>81</td>
<td>90</td>
<td>171</td>
</tr>
<tr>
<td>once a year</td>
<td>149</td>
<td>257</td>
<td>406</td>
</tr>
<tr>
<td>less often</td>
<td>396</td>
<td>845</td>
<td>1241</td>
</tr>
<tr>
<td>Active Margin</td>
<td>645</td>
<td>1201</td>
<td>1846</td>
</tr>
</tbody>
</table>

Along with gender and age, other important variables might be the highest level of education and length of teaching experience. The level of education significantly correlated with the frequency of ICT courses, with respondents with higher education attending the courses significantly less often (\(r = 0.057, p = 0.014\)), but reporting higher satisfaction (\(r = -0.049, p = 0.036\)). The satisfaction with further education in ICT also correlated with the length of teaching experience (\(r = 0.057, p = 0.014\)), with teachers with longer experience being less satisfied with the attended courses.

Hypotheses 1 (the frequency and perceived quality of further education in ICT is associated with gender, age, level of education, and length of teaching experience) has been partially confirmed. Results show significant correlation for gender and the highest level of education, with both frequency and satisfaction with further education. Age and the length of teaching experience correlated significantly with satisfaction, but not with the frequency of further education. Except for the gender and age, all correlations were rather weak.

5.2. Perceived Digital Competencies and the Use of ICT in Teaching Are Associated with the Frequency and Perceived Quality of Further Education in ICT

The results (see Table 2) showed that respondents perceived themselves as having rather mediocre PDC (M = 3.11, SD = 1.110) and they reported using ICT for teaching only occasionally (M = 4.29, SD = 0.586). Results for both total scores varied based on the age groups, with higher age groups having higher (i.e., worse) scores. This relationship was significant for both total PDC score, \(F(4.1762) = 25.992, p < 0.000\) and total ICTuse score, \(F(4.1762) = 3.565, p = 0.007\). The same applied for gender differences (see Table 1), with women having significantly higher (i.e., worse) total PDC score, \(t(1844) = -16.148, p < 0.000\) and total ICTuse score, \(t(1844) = -3.257, p = 0.001\).
Table 2. The total perceived digital competency (PDC) and ICTuse scores based on gender.

<table>
<thead>
<tr>
<th>Total PDC Score</th>
<th>Male</th>
<th>Female</th>
<th>Active Margin</th>
<th>Total ICTuse Score</th>
<th>Male</th>
<th>Female</th>
<th>Active Margin</th>
</tr>
</thead>
<tbody>
<tr>
<td>expert</td>
<td>74</td>
<td>17</td>
<td>91</td>
<td>habitual user</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>advanced</td>
<td>294</td>
<td>236</td>
<td>530</td>
<td>frequent user</td>
<td>2</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>intermediate</td>
<td>147</td>
<td>415</td>
<td>562</td>
<td>average user</td>
<td>59</td>
<td>61</td>
<td>120</td>
</tr>
<tr>
<td>beginner</td>
<td>93</td>
<td>324</td>
<td>417</td>
<td>occasional user</td>
<td>372</td>
<td>690</td>
<td>1062</td>
</tr>
<tr>
<td>absolute beginner</td>
<td>37</td>
<td>209</td>
<td>246</td>
<td>rare/non-user</td>
<td>212</td>
<td>450</td>
<td>662</td>
</tr>
</tbody>
</table>

Active Margin = 645 1201 1846

To analyze the linear relationship between teachers’ total PDC and ICTuse scores, a Pearson correlation coefficient was computed, $r = 0.417$, $p < 0.000$, which suggested a significant relationship. Teachers, who considered themselves more experienced ICT users and felt confident in understanding and explaining various ICT concepts also used ICT in teaching more often. Yet, as Table 3 shows, most teachers considered themselves rather occasional users.

Table 3. The correlations matrix for the PDC and ICTuse scores, frequency, and satisfaction with further education.

<table>
<thead>
<tr>
<th>total PDC score</th>
<th>Total PDC Score</th>
<th>Total ICTuse Score</th>
<th>Frequency of Further Education</th>
<th>Perceived Quality of ICT Courses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pearson Correlation</td>
<td>1</td>
<td>0.417 **</td>
<td>0.276 **</td>
<td>0.515 **</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>N</td>
<td>1846</td>
<td>1846</td>
<td>1846</td>
<td>1846</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>total ICT use score</th>
<th>Pearson Correlation</th>
<th>0.417 **</th>
<th>1</th>
<th>0.301 **</th>
<th>0.378 **</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sig. (2-tailed)</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>1846</td>
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</table>

<table>
<thead>
<tr>
<th>frequency of further education</th>
<th>Pearson Correlation</th>
<th>0.276 **</th>
<th>0.301 **</th>
<th>1</th>
<th>0.216 **</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sig. (2-tailed)</td>
<td>0.000</td>
<td>0.000</td>
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<td>N</td>
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<table>
<thead>
<tr>
<th>perceived quality of ICT courses</th>
<th>Pearson Correlation</th>
<th>0.515 **</th>
<th>0.378 **</th>
<th>0.216 **</th>
<th>1</th>
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<tbody>
<tr>
<td>Sig. (2-tailed)</td>
<td>0.000</td>
<td>0.000</td>
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<td>N</td>
<td>1846</td>
<td>1846</td>
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</tr>
</tbody>
</table>

** Correlation is significant at the 0.01 level (2-tailed).

To answer the Hypotheses 2 (perceived digital competencies and the use of ICT in teaching are associated with the frequency and perceived quality of further education in ICT), a correlation matrix was created (see Table 3).

A significant correlation at $p < 0.000$ level was found for all variables. The frequency of further education correlated with both total PDC score ($r = 0.276$) and total ICTuse score ($r = 0.301$) and with satisfaction with courses attended in the past ($r = 0.216$). The perceived quality significantly correlated with both PDC score ($r = 0.515$) and ICTuse score ($r = 0.378$). However, the regression analysis revealed that, despite the significant effect, 29.4% of the total variation in the PDC total score and 19.3% of the total variation in the ICTuse total score could be explained by the frequency of further education in ICT and the satisfaction with attended courses, even though the variables contributed statistically significantly to
the model. Therefore, other independent variables are expected to affect the total PDC and ICTuse scores.

5.3. Respondents Experience Barriers That Prevent Them from More Frequent Further Education in ICT

Considering the number of barriers teachers encounter when trying to educate themselves in ICT, other factors besides the demographic variables need to be investigated. Table 4 below shows what barriers to further education respondents reported most often. The most common barriers were the lack of sufficient technology in school, the perceived insufficient knowledge and skills in ICT, and the lack of school management support. The least mentioned barriers were considering ICT not suitable for the taught subject, distrust in new technologies and the lack of motivation. The results were the same for women and men.

Table 4. Barriers to further education in ICT.

<table>
<thead>
<tr>
<th>Barriers</th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td>lack of school management support</td>
<td>yes</td>
<td>591</td>
</tr>
<tr>
<td></td>
<td>no</td>
<td>342</td>
</tr>
<tr>
<td>lack of colleagues support</td>
<td>yes</td>
<td>582</td>
</tr>
<tr>
<td></td>
<td>no</td>
<td>351</td>
</tr>
<tr>
<td>lack of motivation</td>
<td>yes</td>
<td>342</td>
</tr>
<tr>
<td></td>
<td>no</td>
<td>591</td>
</tr>
<tr>
<td>lack of time</td>
<td>yes</td>
<td>351</td>
</tr>
<tr>
<td></td>
<td>no</td>
<td>582</td>
</tr>
<tr>
<td>lack of sufficient technology in school</td>
<td>yes</td>
<td>779</td>
</tr>
<tr>
<td></td>
<td>no</td>
<td>154</td>
</tr>
<tr>
<td>insufficient knowledge and skills in ICT</td>
<td>yes</td>
<td>722</td>
</tr>
<tr>
<td></td>
<td>no</td>
<td>211</td>
</tr>
<tr>
<td>ICT is not suitable for taught subject</td>
<td>yes</td>
<td>154</td>
</tr>
<tr>
<td></td>
<td>no</td>
<td>779</td>
</tr>
<tr>
<td>distrust in new technologies and approaches</td>
<td>yes</td>
<td>211</td>
</tr>
<tr>
<td></td>
<td>no</td>
<td>722</td>
</tr>
</tbody>
</table>

A specific interest was dedicated to the availability of Internet access and ownership of Internet-accessible devices to use at home. Results showed that 832 (45.1%) respondents had sufficient Internet access at home, while 1014 (54.9%) did not. Besides, 701 (38.0%) respondents owned an Internet-accessible device, while 1145 (62.0%) did not have such a device to prepare their class, communicate with students, etc. An independent-samples t-test was conducted to evaluate whether the frequency of further education in ICT, satisfaction with ICT courses, and PDC and ICTuse scores differed significantly between those who had and did not have sufficient Internet access, and between those who had and did not have an Internet-accessible device at home.

In the case of the sufficient Internet access, the differences were significant for the frequency of further education in ICT, t(1838.557) = 6.170, p < 0.000; satisfaction with the quality of ICT courses, t(1844) = 9.249, p < 0.000; PDC score, t(1844) = 18.401, p < 0.000; and ICTuse score, t(1844) = −5.535, p < 0.000. In the case of the ownership of an Internet-accessible device, the results were significant for the frequency of further education in ICT, t(1530.960) = 2.948, p = 0.003; satisfaction with the quality of ICT courses, t(1844) = −2.630, p = 0.009; and PDC score, t(1558.228) = −2.995, p = 0.003.
An examination of the group means indicated that the sufficient Internet access was linked to higher PDC and ICTuse scores. Respondents with sufficient Internet access attended further education in ICTs less often and were less satisfied with the quality of courses. Respondents who owned an Internet-accessible device at home attended further education in ICTs less often, were more satisfied with its quality, and had lower PDC scores.

Regarding the Hypotheses 3 (respondents experience barriers that prevent them from further education in ICT), the frequency of further education and its perceived quality significantly positively correlated with colleagues’ support ($r = 0.162, p < 0.000$, $r = 0.152, p < 0.000$ resp.), and negatively with motivation to use ICT in teaching ($r = -0.063, p = 0.006$, $r = -0.094, p < 0.000$ resp.), which was expected, since respondents with lower motivation or worse previous experience would attend the courses less often. Based on the regression analysis, the most important predictors of frequent participation in further education in ICT and satisfaction with attended courses were colleagues’ support ($p < 0.000$), motivation ($p < 0.000$), sufficient Internet access ($p < 0.000$), and ownership of an internet-accessible device ($p < 0.01$).

6. Discussion

The goal of the paper was to look at secondary school teachers’ frequency of further education in ICT provided by accredited institutions in the Czech Republic, their satisfaction with the courses, and possible barriers that prevent them from attending the further education in ICT more often. We also looked at the perceived ICT competencies and use of various ICT tools in teaching. From the above results of the survey, we can conclude that teachers are insufficiently educated in the field of ICT, they rather sparingly improve their ICT competencies through further education, they do not have sufficient support from the school management, and their technical background (regarding the ownership of computers and/or sufficient internet connection) is also problematic—in schools and at home. Results are consistent with those from the International Computer and Information Literacy Study (ICILS) 2013 study [72], which showed that participation by teachers in the Czech Republic lay at 36% and was significantly below the ICILS 2013 average. Yet these factors are among the important elements supporting effective ICT implementation in schools. In addition to the already mentioned insufficient support for further education in schools, we can also consider the main obstacles to further education of teachers in the Czech Republic to be its inconceivability, low-quality forms of these educational activities, and low connectivity, especially in peripheral areas of the country. A certain reluctance to learn and further educate in the field of ICT, observable especially in the older generation, can also play a role. This reluctance might be the result of computer anxiety, but a common problem is also the misunderstanding of the possible role of ICT in teaching. It is necessary to overcome the idea typical for Czech schools that ICT is used only in one specific subject and its meaningful use should be reflected in other courses as well (including, for example, history, chemistry, biology, etc.). Overcoming this stereotypical concept is the key to widespread and systematic education in ICT for teachers of all approbations [73–75].

The first hypothesis has been partially confirmed. Our results showed a correlation between in-service teacher education in ICT and gender, age, level of education, and length of teaching experience. The Czech Republic thus shows problems in the further professional development of teachers in ICT, i.e., in one of the basic competencies of the DigCompEd framework of digital competencies of teachers. It does not fail to offer ICT training programs, however, it fails in that it is not possible to sufficiently motivate two groups of teachers to participate in them: female teachers and older teachers (i.e., teachers with longer pedagogical experience). In the case of female teachers, we encounter a long-term problem (not only in the Czech Republic, but also more generally in the postcommunist space) that it is not possible to reconcile the family and work life of (especially) women. It is most likely the need to reconcile multiple roles, primarily childcare [76,77], that may have an impact on the smaller involvement of women in further education in ICT. In the case of
teachers with longer experience, it is probably a problem of motivation to further improve their qualifications. This older generation does not see so much sense in ICT teaching, is not sufficiently convinced of the efficacy and meaningfulness of these forms of teaching, and therefore is not motivated to participate in the further ICT education. Feelings of low self-efficacy can also be a problem for them, i.e., they may not believe in their ability to understand ICT skills and competencies compared to their younger colleagues. Other barriers that we have identified may also play a role in both of these groups (see H3).

Regarding the second hypothesis, the research showed that only about 20% of the perceived ICT competencies and the actual use of ICTs in the teaching praxis can be explained by the participation in the further education and satisfaction with its quality. Thus, 80% can be explained by a variety of other factors, some of which would be probably the barriers described in the next section. As other studies [78] explained, the failure of ICT education programs for teachers is due to multiple factors, including underpreparation of the technological and material resource requirements, failure to motivate teachers, lack of attention to the context in which teachers work, and an underestimation of what is involved in developing knowledge and skills sufficient to change practice. The complexity of incorporating ICT into the teaching practice is described in [79], who showed similar results—what prevents teachers from using ICT is surely inadequate training and professional development, but also that ICT tools provided in school are not in good condition, technical supports need to be improved, and computer labs in schools are not equipped with well-functioning tools.

One of the main problems lies in the inability of the further education to provide information in a way that it can be used not for a general purpose, but specifically in teaching. Other authors [80,81] have found that training options focused more on technological aspects rather than on the didactic integration of ICTs into relevant teaching and learning situations. Even when teachers want to adapt to the new challenges of modern teaching, their effort is hindered especially by the lack of technological and pedagogical training. However, the technological training, which is a more common type in our country, is not enough to create an efficient and necessary tool for promoting the pedagogical use of ICT.

Regarding the third hypothesis, a key problem in the further ICT education of teachers is that it fails to remove some of the barriers that stand in the way of further professional development of teachers in the field of ICT. First, there is insufficient support from colleagues, especially school management. However, this is a fundamental barrier that literally stands in the way of a change in the concept of teaching, especially for the older generation of teachers. In the Czech Republic, the teaching staff is aging rapidly, so the involvement of older teachers in further ICT education is becoming a necessity and at the same time a great challenge. The second point is related to the first. We (not only us) found a lower self-motivation to use ICT. Support at the level of school founders, colleagues, and school management must therefore also be provided to strengthen one’s own motivation. The third problem is the technical parameters, especially the connectivity and equipment of ICT teachers. Not only the digital competencies of teachers, but also their technical equipment are important prerequisites for high-quality digital content. According to the findings of TALIS, less than 40% of teachers use ICT in lessons and only less than 30% of primary school teachers felt ready to use ICT in teaching [82]. In the field of problem solving, Czech teachers lag behind other workers with tertiary education [83]. Without investment in teachers’ hardware and the “fast” Internet, the situation will not improve.

We thus confirmed this hypothesis with the fact that in the conditions of the Czech Republic there are also differences between regions, which generate further inequalities.
7. Final Considerations

7.1. Conclusions and Contributions

The presented results cast a shade on the prospects of further education in ICT. It is also necessary to take into account the fact that the Czech Republic invests almost the smallest share of GDP in education from OECD countries (2.7 percent), which puts us in the same row as other V4 countries—Slovakia or Hungary. We are thus experiencing relatively fundamental changes in society, nature, and technology, which bring unprecedented challenges and opportunities for education, which are already leading to an even more significant transformation of the current role of schools and teachers in the society. However, the Czech education system does not respond sufficiently to these rapid changes, and in comparison with countries such as Finland or Canada, the delay of postcommunist countries, including the Czech Republic, in adaptation to the changing social and educational challenges is increasing. There are many mistakes in the national education system with a major impact on the teaching profession. Only 40 percent of graduates of pedagogical faculties actually go to school after graduation, and according to international surveys [84] 70 percent of teachers are dissatisfied with their profession, mostly because of the stressful nature of the profession and because of the salaries being still below average. The only positive thing in the current situation is that the public finally perceives education as a long-term problem. The relatively high literacy of the population or the existence of an extensive network of public schools can be seen as a significant positive factor for the reform of education.

However, based on the data presented above, some measures are needed in the following areas:

(1) Measures of a legislative nature—the law around pedagogical staff needs to be amended to create conditions that allow those who want to teach to actually enter teaching practice under appropriate pay conditions. For these measures, it is necessary to look more intensively for examples of good practice abroad and to make decisions based on relevant data. This also applies to in-service teacher training—again ideally based on the examples of good practice. The problem of connectivity is also related to in-service teacher training, especially in peripheral areas. Quality signal coverage is an important prerequisite for online teacher education so that they can work from home to improve their skills and competencies.

(2) Measures considering the nature of the content of further education—our research has shown that age and gender specifics need to be taken into account. Especially the older generation, who did not even go through the basics of digital literacy during their education at pedagogical faculties, is completely disoriented and is often afraid of using ICT in teaching. Teachers in the research sample also point out that the forms of further education available to them in the Czech Republic are not of good quality. For further education to be effective, teachers must see a personal and professional meaning in it, and not see it only as a necessity. Today, teachers are not meaningfully motivated for further education, they even lack the technical equipment in schools. The big paradox in the field of in-service teacher education in the field of ICT is, above all, the fact that there is little education, especially for older teachers with longer experience, who are characterized by poorer digital literacy. The motivation of this age group to strengthen digital skills is also a great challenge for the Czech education system. Teachers’ dissatisfaction with the quality of completed education in ICT, which is highly related to the willingness to complete such education, may also be the result of the absence of involvement of modern teaching methods, which teachers would perceive as really beneficial. These include, for example, trends in the involvement of gamification in education, where game elements in learning have a significant effect on teachers’ motivation to transfer the knowledge and skills they had acquired during the learning process into their teaching practices to benefit their students [83,84]. Teachers need not only to learn new skills but also to learn and find new ways to encourage their students to use technology to explore, analyze, and
evaluate sources of information and creatively use them. Gamification is one of the possible methods through which to reach this goal.

(3) Measures considering the nature of the teaching profession—an important area of support for further education in ICT is the approach of school management to the development of teachers, not only in ICT but also in general. If teachers rely mainly on self-study in their free time, increasing ICT competencies is not an attractive goal for them—together with other time-consuming activities, such as teaching preparation, communication with students and their parents, and also raising qualifications in their specific subject, the development of ICT competencies becomes rather a burden. This applies to beginning teachers who, after school, encounter the reality of the teaching profession, which, despite the eyes of a section of the public, is high-risk, significantly related to the development of stress, depression, or cardiovascular disease [85–87]. However, even the experienced teachers face a similar situation, as they have become accustomed to a way of teaching the class that has worked for them and without the support of management and colleagues, they have no incentive to change it [88,89]. Also, the growing importance of work–life balance leaves less space for attending more than necessary further education courses, especially without setting the right conditions for further education by the school management. Teachers in the Czech Republic are among those significantly less satisfied with their profession in Europe [90], so in their further education, it is necessary to work sensitively not only with the barriers to the development of ICT competencies, but also with the factors that contribute to possible professional dissatisfaction and thus increase the risk of developing stress, professional burnout, and leaving the profession.

7.2. Limitations and Future Agenda

The presented research carries with its limitations given the size and nature of the sample. The sample size needed for the 95% confidence interval would be 6245, thus we would need more data to be sure about the most important factors facilitating further education in ICT. Also, the teachers in the sample worked at secondary school only, so we have no data available on the digital competencies of elementary school teachers and we can only guess they would reach lower or similar levels. With more data being still collected, we can use the current results to expand further research and help identify problematic areas of the further education of teachers in ICT.

The data were collected in January 2020, thus they do not reflect the impact of the COVID-19 pandemic on the ICT competencies of teachers, the perceived competencies, the actual use of ICTs, or the barriers that teachers encounter. All three areas analyzed in this paper would have probably a different outcome to a various degree. The intensity of social, educational, and economic changes happening due to COVID-19 has been already described in current studies that are emerging constantly. As described by Dhawan [91], teachers of all stages around the world experienced an overnight shift of normal classrooms into e-classrooms, and thus had to shift their entire pedagogical approach to tackle new conditions and adapt to the changing situations. We already completed a second round of our study with the same sample in January 2021, allowing us to continue with our research in a few directions in the future. It is important to analyze the current state of ICT competencies and the current challenges teachers encounter during distant education. Also, during the pandemic, teachers have had a better opportunity to identify their limitations within the use of ICTs, thus they have a better understanding of the importance of further education in ICT, but they also know more precisely what they need from such an education. Further, it is necessary to look not only at the competencies of teachers, but also analyze how students see their teachers’ competencies used in teaching, and how they help students achieve their educational goals. In the future studies, it is important to look more into the use of ICTs not only in teaching subjects such as mathematics, history or languages, but also in promoting important social skills and competencies in students, which can contribute to the formation of citizens who will demand new knowledge, and in which initiative, teamwork, and social skills will be required [92]. Regarding the barriers teachers may encounter, their further
education should not be limited only to gaining new knowledge, but also learning how to overcome these barriers, motivate themselves to constantly learn new skills and improve them, and deal with negative emotion that may appear due to the lack of support from their surroundings or lack of self-esteem regarding the ICT competencies. New approaches can be used in this area, as, for example, neuroeducation is becoming one of the new interesting strategies that can contribute to the managing of emotions and motivation and help both teachers and students [93].

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