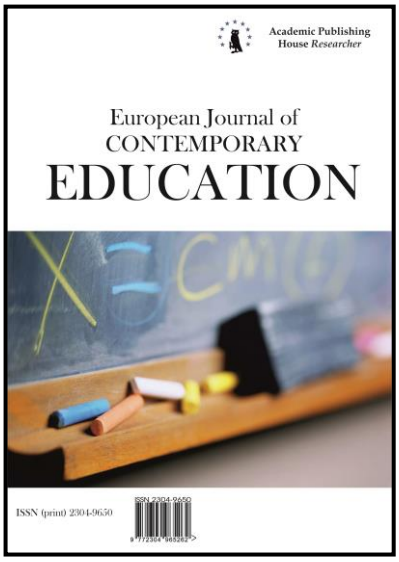
Published in the Slovak Republic
European Journal of Contemporary Education
E-ISSN 2305-6746
2019, 8(2): 378-393
DOI: 10.13187/ejced.2019.2.378
www.ejournal1.com



Teachers' Professional Digital Literacy Skills and Their Upgrade

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Abstract

In the paper there are presented results of a research inquiry of current state and perspectives of primary and lower level of secondary school teachers´ professional development (ISCED1 – ISCED3) in Slovakia with a focus on improvement and further development of their didactic technological competences. In frame of the presented reseach significance of the use of the digital means and various interactive educational activities in teaching processes to increase the efficiency of education was assessed. This significance was assessed from the point of view of different aspects of the education process. Analysis of the specified aspects of the teaching process, from the point of view of which the contribution of the use of the digital means in teaching processes, was done on the baises of a screening of teachers´opinions, in dependance on the segmentation factors sub-category of the teaching staff and length of teaching practice of the teacher.

Keywords: teacher training, teacher continuous education, teacher professional profile, didactic technological competences, digital technologies.

1. Introduction

Research done over the last 40 years about the impact of computer and digital technologies on teaching and learning processes and sttudents` learning achievements proves their positive influence on various aspects of education. As it is presented in the literature review study commissioned by the Scottish Government (2015) there are many research projects which indicate that digital didactic means can support and contribute to specific educational priorities as raising attainment, tackling inequalities and promoting inclusion, improving transitions into employment, inhancing parental engagement, and improving the efficiency of the education system. More qualitative studies have identified how improvements in attainment are achieved. From a wide study of primary and secondary schools in England that were early adopters in using digital

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learning and teaching, Jewitt *et al.* (2011) concluded that using digital educational resources provided learners with more time for active learning in the classroom; with more opportunity for active learning outside the classroom, as well as providing self-directed spaces, such as blogs and forums, and access to games with a learning benefit; with opportunities to choose the learning resources; the resources provided safer spaces for formative assessment and feedback. Beside that technology engages and motivates young people (Higgins et al., 2012). Research done by Chien et al. (2014) has shown that students in school are having high expectation on ICT integration in classroom as the new generation are born and grown with technologies and could be define as the digital – native phenomenon. The younger the students, the higher their expectation are on ICT integration in classroom (Ghavifekr, Rosdy, 2015). To the integration of mobile technologies and web applications into education a number of other other researches point, too (Aljraiwi, 2017; Karsenti,Fievez, 2013; Montrieux et al., 2015; Kongsgården, Krumsvik, 2016).

The European Union is also aware of the need to synchronize education with the social and cultural context of the reality we are living in. This is why it places considerable emphasis on the use of technology in education, as the social and cultural bases of education are strongly influenced by the rapid development of new technologies and the broad infiltration of information and communication technologies into each area of human life (EU, 2001; Králik, Tinley, 2017; Ambrozy et al., 2017).

At the same time to the above mentioned, we have to be aware of the fact that the key factor to achieve any benefit resulting from the implementation and use of any technology at school are teachers (Černochová 2003; Chen et al., 2009; Ghaith, Yaghi, 1997; Groff, Mouza, 2008). Use of digital didactic means in teaching (e.g. tablets or interactive boards) brings a meaningful pedagogical change to the classical classroom learning (Lewin et al., 2008) but positive effects of the use of these means are depending on teachers´ professional skills to use these means in school subjects they teach appropriately. Research from the authors Skutil et al. (2017) shows that most teachers use technology to extend visual perceptions (48 %) or as a supplement to interpretation as a backdrop (38 %). Other researches show that in relation to the teachers´ professional performance technology has become a carrier or source of interpretation and testing tool (Krumsvik et al., 2013; Krumsvik et al., 2016).

Integrating innovative technology during classroom practices inevitably demands teachers to acquire new technological and pedagogical skills (Clark, Luckin, 2013). According to research of Montrieux et al. (2015), teachers need skills to be able to transform the learning content, the so-called Technological Pedagogical Content knowledge (TPACK) (Koehler, Mishra, 2009). It is not whether technology is used (or not) which makes the difference, but how well the technology is applied by teachers to support teaching and learning processes. Definitelly it is the teacher who ultimately influences the enhancement of the learning environment and how the studies show (O'Malley et al, 2013), the better training in this field teachers undergo, the greater achievements they will obtain.

2. Background of the research and its goals

Didactic technological competences have been an integral part of the professional competence profile of a teacher, abstractedly from the subject the teacher has been teaching. In general, these competences can be defined as teacher´s skills to use material and technical teaching means in teaching processes of the school subject s/he teaches. It is clear that content of these competences has been time depending and while in the past it was changing only slowly, currently, under the influence of the rapid development of the digital technologies, it is changing very fast. With respect to the newest digital technologies, didactic technological competences of a teacher can be defined as her/his professional digital literacy skills to use digital teaching tools and their applications in real practice of education of the taught subject.

Main goal of the presented research was to identify requirements and needs of the practicing (in-service) teachers´ for upgrading their professional digital literacy skills (i.e. their didactic technological competences). The identification of the requirements and needs was based on the screening survey of the teachers' opinions about significance of the use of various interactive means in teaching process for selected specific aspects of education. Additional to that, also monitoring of the ways the teachers use interactive educational activities and digital means in their teaching practice was included into the screening survey.

3. Research sample and methodology of the research

Research sample of the carried out screening survey consisted of 173 teachers – participants of teacher continuous education. These were primary and secondary school teachers representing primary and secondary schools in three of eight regions of Slovakia (Nitra region, Trnava region and Bratislava region). A detailed description of the research sample is summarized in Table 1. As main characteristics to describe composition of the research sample were used the factors gender, lengths of the teacher´s teaching practice and category and sub-category of the teaching staff to which the concerned teacher belongs according to the legislation rules. Slovak legislation (Law No. 317/2009 on Teaching Staff and Specialists and its Amendments) distinguishes 7 categories of the teaching staff, which are teacher, vocational education teacher (supervisor), governess, teacher assistant, foreign lecturer, sport school/classroom trainer, accompanist, and in relation to the regional schools (ISCED1 – ISCED3) it categorizes teachers in three sub-categories, which are (a) *primary education teacher*, (b) *lower secondary education teacher* and (c) *upper secondary education teacher*.

Table 1. Description of the research sample

Factor	Factor category value	Absolute number	Relative number
Gender	male	15	8.67 %
	female	158	91.33 %
Length of teaching practice	up to 5 years (including)	46	26.59 %
	from 5 up to 20 years (incl.)	87	50.29 %
	more than 20 years	40	23.12 %
Category of the teaching staff	teacher	156	90.17 %
	governess	17	9.83 %
Sub-category of the teaching staff	teacher of primary level of education (ISCED 1)	68	43.59 %
	teacher of lower level of secondary education (ISCED 2)	69	44.23 %
	teacher of upper level of secondary education (ISCED 3)	19	12.18 %

As Table 1 shows, from the total number of the 173 research sample members 68 of them were teachers of primary level of education (ISCED 1), 69 were teachers of lower level of secondary education (ISCED 2) and 19 of them were teachers of upper level of secondary education (ISCED 3). It can be also seen that a half of the research sample (50.29 %) were teachers with pedagogical practice from 5 to 20 years.

To screen the teachers´ opinions about significance of the use of various interactive means in teaching process for selected specific aspects of education and to monitor the ways in which the teachers use interactive educational activities and digital means in their teaching practice a questionnaire was created, which the members of the research sample – the groups of the primary and secondary school teachers attending the teacher continuous education – were asked to fulfil.

In the questionnaire the respondents of the screening survey (members of the research sample) expressed their opinions and assessments to the use of various interactive educational activities and digital means in teaching processes taking into consideration different aspects of the teaching process. The assessment was done through a four-point scale, i.e. by assessments from 1 to 4 points (1 – *insignificant, unimportant, without any influence,* 2 – *rather insignificant, rather unimportant, rather without influence*; 3 – *rather significant, rather important, rather with influence*, 4 – *significant, important, with influence*). A choice of the neutral, emotionally indifferent attitude towards the given questions/statements was not included because we wanted

to force the respondents to express themselves clearly and exactly. Each respondent`s response to the particular ordinary items was recorded, i.e. we recorded the scale values by which the respondent evaluated impact of the interactive educational activities and digital means on the selected aspects (components) of the teaching process (the level of his/her agreement or disagreement with the given statements on the observed phenomena, or the positive or negative assessment stated at the particular item). The selected aspects of the teaching process are presented in Table 2. De facto in Table 2 presented thirteen aspects C1 – C13 represent the particular questionnaire items.

Table 2. Overview of the teaching process aspects in relation to which contribution of the use of the interactive education activities and digital means to increase teaching efficiency was observed

Aspect	Observed phenomenon
C1	*increase of pupils ` motivation*
C2	*increase of pupils ` interest in the taught subject*
C3	*increase of pupils ` activity during the lesson*
C4	*development of pupils ` creativity*
C5	*pupils ` easier understanding of the presented new subject matter*
C6	*longer-term retention of the presented subject matter*
C7	*increase of the pupils ` skills to apply the acquired knowledge in practical task solving*
C8	*increase of the taught subject popularity (favour)*
C9	*increase of pupils ` mutual co-operation*
C10	*increase of pupils ` "spirit of competitivity"*
C11	*positive influence on pupils ` disciplined behaviour*
C12	*increase of the positive classroom climate*
C13	*development of pupils ` digital literacy*

In the next questionnaire item the respondents were to mark from the offered item menu maximum three from seven software applications (or from six given as the seventh alternative answer was open-ended giving the respondents a possibility to state some other, by them used, software product), which they use most often to create their own interactive educational activities for their pupils. In the menu following software applications were listed:

a) ActivInspire
b) Flow!Works
c) SMART Notebook
d) Prezi
e) Mindomo
f) FreeMind

In relation to the „most often used" applications they were asked to specify „rank" of these three most often used means (by marking their position I, II, III, where I was for the most often used one).

Of course, we were aware of the fact, that not all teachers create their own teaching materials of this kind. To avoid any misleading, untrue responses of the respondents, additionally to the above-mentioned possibilities of the responses (a – f), there were included three another alternative possibilities (g –i) to respond to this question, and these were:

g) I do not create my own interactive educational activities for pupils but I use some taken over from open sources or from my colleagues.

h) I do not create my own interactive educational activities for pupils but I take over some from open sources or from my colleagues and modify them.

i) I do not create any interactive educational activities and I neither use any.

The questionnaire was designed with the view of enabling to transfer teaching qualitative aspects, related to the use of selected software applications and digital teaching objects, into the quantitative ones, what opens broader evaluation possibilities based on the use of different

methodologies of the quantitative oriented research (Alt, 2018; Bray, Tangney, 2017; Aleandri, Refrigeri, 2014; Brooks et al., 2014).

At the same time with the development of the questionnaire, questionnaire administration and evaluation rules were elaborated, too.

The questionnaire administration lasted from October 2018 till February 2019. The total number of the addressed teachers, participants or the continuous teacher education was 210, but from this number only 173 responded or fulfilled the distributed questionnaire completely. So the questionnaire response rate was 83.3 %, what also proves topicality and usefulness of the solved issue.

4. Data processing

Evaluation of the teachers' assessments of the use of the interactive educational activities and digital means in teaching processes to increase its efficiency was analysed according the sub-categories the teachers belong to and according the length of their teaching practice. So we had to analyse divergences of the average values of the scores of the respondents assessments given the aspects C1 – C13 aimed at assessment of the significance of the use of various interactive educational activities and digital means in teaching processes to increase its efficiency in dependence to the factor SUB-CATEGORY OF THE TEACHING STAFF and the factor LENGTH OF TEACHING PRACTICE.

The above mentioned means that in frame of the statistical processing of the collected research data, 13 particular null hypotheses, connected with the 13 aspects C1 – C13 presented in Table 2 (components of the teaching process), were tested. Ones they were tested in dependence on the factor SUB-CATEGORY OF THE TEACHING STAFF and the second time in dependence on the factor LENGTH OF TEACHING PRACTICE.

In general the null hypothesis (representing all 13 particular hypotheses) for the case of testing the first dependence was:

Ho: Respondents' assessments of the significance of the use of various interactive educational activities and digital means in teaching processes for the selected specific aspect of education C_i (i = 1 – 13) C does not depend on the level of the factor SUB-CATEGORY OF THE TEACHING STAFF.

And the null hypothesis (again representing relevant 13 particular hypotheses) for the case of testing the second dependence was:

Ho: Respondents' assessments of the significance of the use of various interactive educational activities and digital means in teaching processes for the selected specific aspect of education C_i (i = 1 – 13) C does not depend on the level of the factor LENGTH OF TEACHING PRACTICE.

The particular null hypotheses in both cases were tested on the 5 % significance level through both parametric and nonparametric tests.

As to the questionnaire item C14, collected data at this item were evaluated based on the absolute and relative frequencies recorded at particular alternative responses both in differentiation of the stated rank as well as without this differentiation (i.e. based on the cumulative frequencies of the recorded responses without their differentiation into the groups according the stated ranks).

5. Results and discussion

Dependence of the research data on the factor SUB-CATEGORY OF THE TEACHING STAFF

At first we tested dependence of the respondents' assessments of the given aspects of education C1 – C13 on the segmentation factor of the respondents which was SUB-CATEGORY OF THE TEACHING STAFF.

The general null hypothesis to test the dependence of the research data on the factor SUB-CATEGORY OF THE TEACHING STAFF was

Ho: Respondents' assessments of the significance of the use of various interactive educational activities and digital means in teaching processes for the selected specific aspect of education C_i (i = 1 – 13) C does not depend on the level of the factor SUB-CATEGORY OF THE TEACHING STAFF

and in frame of this general hypothesis 13 particular null hypothesis for the teaching aspects C1 – C13 (components of the teaching process) given in Table 2 were tested in successive steps.

Following results of one-way ANOVA as well as its nonparametric alternative Kruskal-Wallis ANOVA null hypotheses were not rejected in case of the variables (aspects) C1 (*increase of pupils` motivation*), C2 (*increase of pupils` interest in the taught subject*), C3 (*increase of pupils` activity during the lesson*), C4 (*development of pupils` creativity*), C7 (*increase of the pupils` skills to apply the acquired knowledge in practical task solving*), C8 (*increase of the taught subject popularity/favour*), C9 (*increase of pupils` mutual co-operation*), C10 (*increase of pupils` "spirit of competitivity"*) and C13 (*development of pupils` digital literacy*), i.e. these variables do not depend on the factor SUB-CATEGORY OF THE TEACHING STAFF. Statistical dependence was proved only for the items C5 (*pupils` easier understanding of the presented new subject matter*), C6 (*longer-term retention of the presented subject matter*), C11 (*positive influence on pupils` disciplined behaviour*) and C12 (*increase of the positive classroom climate*). Descriptive statistics of the final score of the respondents assessments given to these variables (aspects C5, C6, C11, C12) are presented in Table 3 which comprises more detailed statistical view on the examined issues in dependence on the segmentation of the respondents – teachers into one of the four above-mentioned categories, (*primary education teacher* (a), *lower secondary education teacher* (b) and *upper secondary education teacher* (c)). Moreover in the table there are presented also descriptive statistics (values of the mean, standard deviation, standard error of the mean estimate and 95 % confidence interval for the average value of the scale of the final score) of the given factors overall, i.e. for the whole research sample, without any segmentation of the respondents on the factor SUB-CATEGORY OF THE TEACHING STAFF (TS-Cat).

Table 3. Descriptive statistics of the aspects (components of education) C5, C6, C11 and C12

Aspect **C5**	Factor value	N	Mean	Standard deviation	Standard error	Confidence Interval for the Mean	
						-95.00 %	+95.00 %
Total		173	3.329	0.611	0.046	3.238	3.421
TS-Cat	a	85	3.459	0.524	0.057	3.346	3.572
TS-Cat	b	69	3.203	0.632	0.076	3.051	3.355
TS-Cat	c	19	3.211	0.787	0.181	2.831	3.590

Aspect **C6**	Factor value	N	Mean	Standard deviation	Standard error	Confidence Interval for the Mean	
						-95.00 %	+95.00 %
Total		173	3.225	0.674	0.051	3.124	3.327
TS-Cat	a	85	3.388	0.599	0.065	3.259	3.518
TS-Cat	b	69	3.072	0.649	0.078	2.917	3.228
TS-Cat	c	19	3.053	0.911	0.209	2.613	3.492

Aspect **C11**	Factor value	N	Mean	Standard deviation	Standard error	Confidence Interval for the Mean	
						-95.00 %	+95.00 %
Total		173	2.699	0.910	0.069	2.563	2.836
TS-Cat	a	85	2.965	0.837	0.091	2.784	3.145
TS-Cat	b	69	2.449	0.916	0.110	2.230	2.670
TS-Cat	c	19	2.421	0.902	0.207	1.987	2.856

Aspect **C12**	Factor value	N	Mean	Standard deviation	Standard error	Confidence Interval for the Mean	
						-95.00 %	+95.00 %
Total		173	2.821	0.920	0.070	2.683	2.959
TS-Cat	a	85	3.000	0.873	0.096	2.812	3.188
TS-Cat	b	69	2.623	0.925	0.111	2.4009	2.845
TS-Cat	c	19	2.737	0.991	0.227	2.259	3.215

Results of the dot estimation of the average scores of the assessments of the particular aspects` significance show that the group of the respondents – *primary education teachers* (a) in comparison to other two group of the respondents, *lower secondary education teachers* (b) and *upper secondary education teachers* (c), responded to all of the four tested education components (C5, C6, C11 a C12) more positively. Average values of the scores of the respondents' assessments of the C5, C6, C11 and C12 education components significance are from the scale range 2 (*rather insignificant*) – 4 (definitely *significant*) from the maximal scale value 4, while majoritarian part of these components (aspects) was evaluated by the respondents on the level *rather significant* (scale value 3). The tabulation (Table 3) of the results of the respondents' assessments of the level of the influence of the use of interactive educational activities and digital means on the specific aspects of education C5, C6, C11, C12 shows that the lowest average score was recorded in case of the aspect C11 at which the respondents expressed their opinions on the positive influence of the use of interactive educational activities and digital means on pupils` disciplined behaviour. According to the group of the respondents – *upper secondary education teachers* (c) the intervention of the interactive educational activities and digital means into the education process has not any adequate influence on the positive behaviour affecting at teaching time (2.42). The achieved results have been quite surprising as there were expected more positive opinions of the respondents in the context of the observed means influence on this aspect of education. However the obtained result can be a consequence of the age category of the upper secondary school pupils and the relevant ways of teaching the teachers use in relation to this age category of the educants.

On the contrary, the highest average score was recorded at the aspects C5 (3.46) and C6 (3.39) in case of the group of the respondents – *primary education teachers*. The results indicate that the teaching has an object-lesson and attractive character for the pupils of the respective age category (based on the given possibility to enter actively into the object lesson teaching to both the teacher and the pupils).

In general quite satisfactory finding is the fact that the average score values obtained at the particular groups of the respondents for all the items was not bellow the scale value 2.

Final standard deviation values of the respondents' assessments of the particular aspects C5, C6, C11 and C12 are not much different. The confidence interval estimation for the mean score values of the particular aspects ranged from the value 1.99 even to the value 3.59. In frame of the used scale this means evaluation of the significance of the intervention of the interactive educational activities and digital didactic means in the teaching process in range from *rather insignificant* up to definitely *significant*.

To look at the obtained statistical results in more detail, the most heterogeneous responses were recorded at the aspect C12 in case of the group of the respondents – *upper secondary education teachers*. The achieved standard deviation value 0.99 means the greatest heterogeneousness of this group of the teaching staff in their statements related to the significance of the pedagogical intervention of interactive educational activities and attractive electronic teaching materials into the upper secondary education (ISCED 3) to increase the positive classroom climate during the lesson. All the same a higher heterogeneousness of the responses occurred also in case of the assessment of the aspect C12 (standard deviation 0.93) and C11 (standard deviation 0.92) done by the *lower secondary education teachers*. Based on the interval estimation of the means, the score average values of the responses to these components ranged from the value 2.56 even to the value 3.21 (aspect C12 assessed by the respondents – *upper secondary education teachers*), from 2.40 to 2.85 (aspect C12 assessed by the *lower secondary education teachers*), from 2.23 to 2.67 (aspect C11 assessed by *lower secondary education teachers*).

The lowest value of the standard deviation (0.52 and 0.60 respectively) was found out at the assessments of the aspects C6 (range 3.26 – 3.52) and C5 (range 3.35 – 3.57) done the group of the respondents – *primary education teachers*. This means the lowest variability of the given statements to the specified teaching aspects given by the sub-category of the teaching staff *primary education teachers*. In case of the given group at assessments of these aspects there was recorded also the lowest value of the average score (C5 – 3.46; C6 – 3.39).

After the rejection of the null hypothesis, we were interested whether there are or there are not statistically significant differences among the assessments of the aspects C5, C6, C11 and C12 stated by the particular groups of the respondents in dependence on the factor SUB-CATEGORY

OF THE TEACHING STAFF, and if yes, then between which levels (particular sub-categories) of this factor they occur.

Identification of the homogeneous groups in dependence on the factor SUB-CATEGORY OF THE TEACHING STAFF was done by means of the multiple comparison of the particular couples of the teaching staff sub-categories. In frame of each of the tested components C5, C6, C11 a C12 two homogeneous groups were identified. Overview of the relevant results is presented in Table 4.

Table 4. Identification of the homogeneous groups

Factor TS-Cat	Aspect C5 Mean	1	2	Factor TS-Cat	Aspect C6 Mean	1	2
b	3.20	****		c	3.05	****	
c	3.21	****	****	b	3.07	****	
a	3.46		****	a	3.39		****

Factor TS-Cat	Aspect C11 Mean	1	2	Factor TS-Cat	Item C12 Mean	1	2
c	2.42	****		b	2.62	****	
b	2.45	****		c	2.74	****	****
a	2.96		****	a	3.00		****

Based on the multiple comparison (Table 4) statistically significant differences were identified between the categories of the teaching staff *primary education teacher* (a) and the rest of the categories, i.e. *lower secondary education teacher* (b), *upper secondary education teacher* (c), in case of the items C6 and C11. In case of the items C5 and C12 statistically significant differences were identified only between the categories of the teaching staff *primary education teacher* (a) and *lower secondary education teacher* (b) of the factor SUB-CATEGORY OF THE TEACHING STAFF. Statistically significant differences among the assessments of the respondents to the given components in frame of the particular homogeneous groups were not proved. In frame of the identified homogeneous groups the respondents of the particular group (teaching staff sub-category), regardless of the factors GENDER, LENGTH OF TEACHING PRACTICE, CATEGORY OF THE TEACHING STAFF – *teacher* or *governess*, responded to each of the four observed aspects (education components C5, C6, C11, C12) more or less identically. At each of the four observed aspects the group of the respondents of the SUB-CATEGORY OF THE TEACHING STAFF *lower secondary education teacher* (b) achieved the total mean even identical to the final mean of the group of the respondents of the SUB-CATEGORY OF THE TEACHING STAFF *upper secondary education teacher* (c).

With respect to the identified normality variance, assumption of the variance equality for one-way ANOVA was tested by means of the non-parametric Levene's test. Results of this test did not proved failure of the assumption of the variance equality for any of the observed items C1 – C13.

Not to decrease standard of the statistical test proofs in relation to the obtained research data, there was applied also a non-parametric alternative to one-way ANOVA, which is Kruskal-Wallis ANOVA. As the results were the same, they can be taken as robust.

Test results of the aspects C5, C6, and C11, C12, i.e. of the relevant given aspects of the teaching process, according to the factor SUB-CATEGORY OF THE TEACHING STAFF are visualised at the graphs of the mean and interval estimation (Figure 1 and Figure 2). As the range of the interval estimation of the scale value mean for the aspect C5 (*pupils` easier understanding of the presented new subject matter*) shows (Figure 1), the most homogeneous assessments of the respondents were recorded at the group of the respondents – *primary education teachers* (a). On the contrary, *lower secondary education teachers* (b) and *upper secondary education teachers* (c) assessed the given aspects comparatively heterogeneously. Similar situation can be seen also in case of the teachers' reactions related to the aspect C6 (*longer-term retention of the presented subject matter*).

Results of the repeated measure analysis (Table 4) confirmed statistical significance of the assessment differences among the categories *primary education teacher* (a) and *lower secondary education teacher* (b) of the factor SUB-CATEGORY OF THE TEACHING STAFF for the aspect C5. This is proved also in Figure 1, in which the interval estimations of the scale value mean in case of the respondent group – *primary education teachers* (a) and the respondent group – *lower secondary education teachers* (b) do not overlap, or they overlap only partially. By contrast, it does overlap in case of the group of the respondents – *upper secondary education teachers* (c) with the two other groups (*primary education teachers* (a) and *lower secondary education teachers* (b)), between which statistically significant differences in the respondents' assessments were not proved.

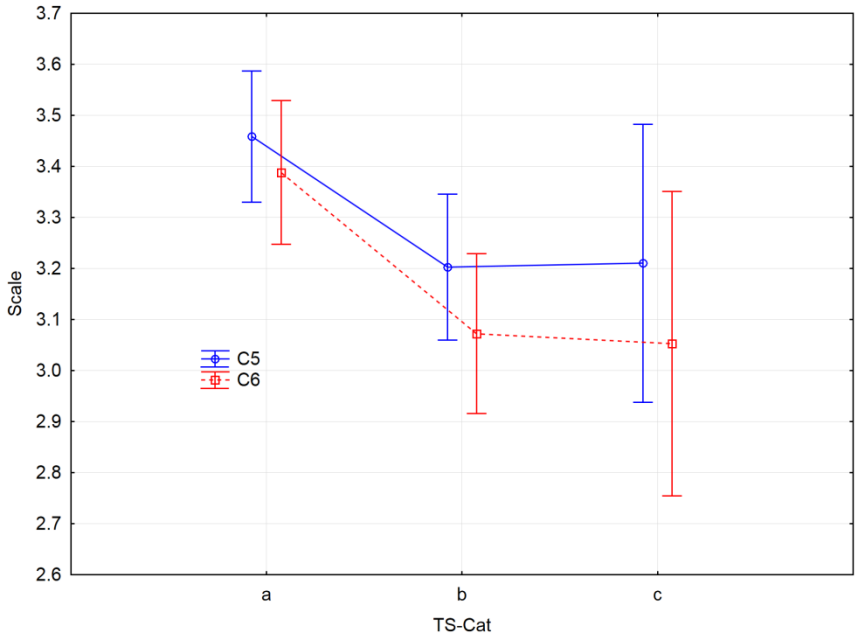

Fig. 1. Dot and interval estimation of the assessments stated at the aspects C5 and C6 in dependence on the factor SUB-CATEGORY OF THE TEACHING STAFF

Identification of the homogeneous groups in case of the specified teaching aspects C11 – *positive influence on pupils` disciplined behaviour* and C12 – *increase of the positive classroom climate* according to the SUB-CATEGORY OF THE TEACHING STAFF factor category value is visualised by the graph of the mean and interval estimation in Figure 2.

From the point of view of the respondent differentiation according to their affiliation to some of the SUB-CATEGORY OF THE TEACHING STAFF factor value, the highest mean score value at the assessment of the both education components (aspects C11 and C12) was recorded at the group of the respondents – *primary education teachers* (a). At this teaching staff group the value of the total mean reached significantly the highest value, what is 2.96 (C11) or 3.00 (C12) respectively. From the range of the interval estimation of the scale value mean at both of these components it can be seen that the most homogeneous assessments of the three tested variables were recorded just in case of this group of the respondents. On the contrary, comparatively more heterogeneous assessments were recorded in case of the group of the respondents – *lower secondary education teachers* (b) as well as in case of the group of the *upper secondary education teachers* (c).

Test results proved statistical significance of the assessment differences in case of the aspect C11 between the group of *primary education teachers* (a), what is the case of the second homogeneous group, and the other two observed groups – *lower secondary education teachers* (b) and *upper secondary education teachers* (c), i.e. the first homogenous group. This can be seen also in the graphical visualisation of the whole situation in Figure 2, where the interval estimation of the scale value mean in case of the group of the respondents – *primary education teachers* (a) does not overlap, or it overlaps only partially, with the two other tested groups, i.e. with the group of the respondents – *lower secondary education teachers* (b) and the group of the respondents – *upper*

secondary education teachers (c). On the contrary, the graphs overlap in case of the respondent groups *upper secondary education teachers* (c) and *lower secondary education teachers* (b), between which the statistically significant differences were not proved. In frame of the mentioned homogeneous groups respondents assessed this aspects of education almost in the same way.

As to the statistical significance of the differences between the assessments, the same situation as was recorded at the aspect C5, was identified also at the aspect C12, i.e. significant differences between the assessments given by the respondents of the *primary education teachers* group (a) and the *lower secondary education teachers* group (b) were recognized also in case of the aspect C12 (Figure 1). This fact is visible also on the graphical visualisation presented in Figure 2, where the interval estimation of the scale value mean for the group of the respondents *primary education teachers* (a) does not overlap just only with the value of the tested factor SUB-CATEGORY OF THE TEACHING STAFF *lower secondary education teacher* (b). On the contrary, in case of the group of the respondents *upper secondary education teachers* (c) it overlaps with both other tested values of the factor – *lower secondary education teachers* (b) and *primary education teachers* (a), between which no statistically significant differences of the respondents' assessments were proved.

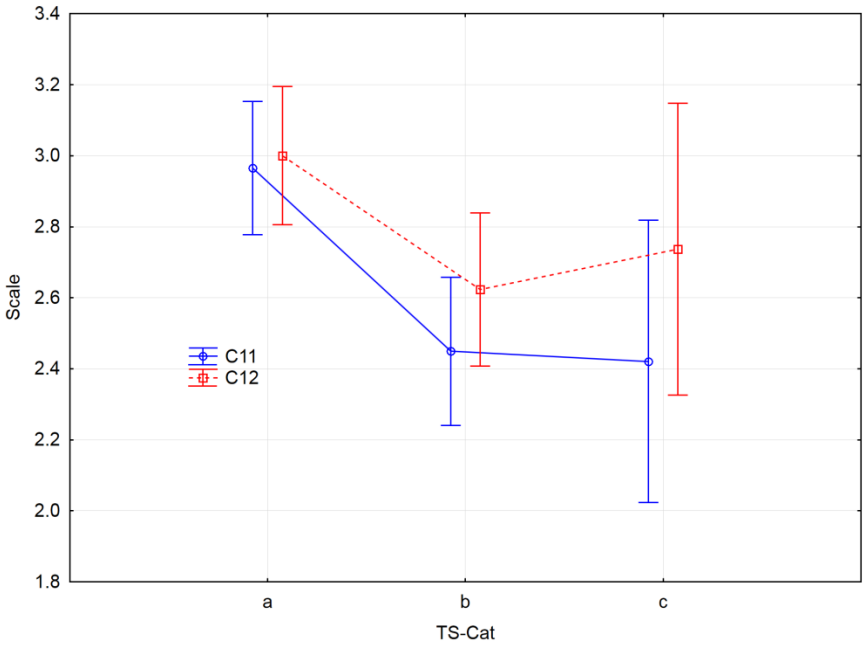

Fig. 2. Dot and interval estimation of the assessments stated at the aspects C11 and C12 in dependence on the factor SUB-CATEGORY OF THE TEACHING STAFF

Dependence of the research data on the factor LENGTH OF TEACHING PRACTICE

Further we tested dependence of the respondents' assessments of the given aspects of education C1 – C13 on the other segmentation factor of the respondents, and that was LENGTH OF TEACHING PRACTICE (factor LTP). This means that the attention was given to divergences of the mean score values of the respondents' assessments of the significance of the pedagogical intervention of various interactive educational activities and digital teaching facilities to increase efficiency of the specified aspects C1 – C13 in dependence on the respondents' length of teaching practice. According this segmentation factor three groups of respondents (values of the LTP factor) were differentiated, and these according Table 1 were: (a) *pedagogical employees with the length of teaching practice up to 5 years* (including), (b) *pedagogical employees with the length of teaching practice from 5 up to 20 years* (including) and (c) *pedagogical employees with the length of teaching practice more than 20 years*.

Tests of the general null hypothesis

Ho: Respondents' assessments of the significance of the use of various interactive educational activities and digital means in teaching processes for the selected specific aspect of

education C_i (i = 1 – 13) C does not depend on the level of the factor LENGTH OF TEACHING PRACTICE

concretized in successive steps for the given teaching aspects C1 – C13 did not reject any of the 13 particular null hypothesis.

Following the information presented in different professional literature sources (Kalaš, 2011; Clarke, Svanaes, 2014; Pešaković et al., 2014; Ifenthaler, Schweinbenz, 2013; Vanderlinde, van Braak, 2011; Adomavičius et al., 2004; Markauskaite, 2003) it was supposed that also this segmentation factor, factor *LENGTH OF TEACHING PRACTICE*, could influence in some way or even cause differentness of the assessments of the given aspects C_i stated by the relevant groups of teachers. But following the results of one-way ANOVA as well as its nonparametric alternative Kruskal-Wallis ANOVA null hypotheses were not rejected in case of all 13 variables (aspects C1 – C13), i.e. these variables do not depend on the factor LENGTH OF TEACHING PRACTICE. Results of the research data processing did not proved statistical dependence on the value of the factor variable LENGTH OF TEACHING PRACTICE for any of the aspects C_i. So it cannot be stated that the length of teachers` teaching practice would have any influence on differentness of the ways in which the teachers assess contribution of the pedagogical intervention of the interactive educational activities and digital means in teaching processes to the improvement of the observed selected teaching aspects (and consequently through them to teaching efficiency increase).

For the sake of brevity, as an example of the research data descriptive statistic processing and their evaluation, there are presented only results of several selected aspects C_i in detail in Table 5. Specifically there are presented results of the assessments of the aspects C1 (*increase of pupils` motivation*), C2 (*increase of pupils` interest in the taught subject*), C5 (*pupils` easier understanding of the presented new subject matter*), C8 (*increase of the taught subject popularity, its favour*), C9 (*increase of pupils` mutual co-operation*), C11 (*positive influence on pupils` disciplined behaviour*) a C12 (*increase of the positive classroom climate*). Thereinafter we focus more only on a global interpretation of the results obtained within this part of the research.

Table 5. Results of the descriptive statistics of the aspects C1, C2, C5, C8, C9, C11 and C12

Aspect C1	Factor value	N	Mean	Standard deviation	Standard error	Confidence Interval for the Mean	
						-95.00 %	+95.00 %
Total		173	3.589595	0.527507	0.040106	3.510433	3.668758
LTP	a	46	3.695652	0.510754	0.075307	3.543977	3.847327
LTP	b	87	3.563218	0.521651	0.055927	3.452039	3.674397
LTP	c	40	3.525	0.554122	0.087614	3.347783	3.702217

Aspect C2	Factor value	N	Mean	Standard deviation	Standard error	Confidence Interval for the Mean	
						-95.00 %	+95.00 %
Total		173	3.456647	0.633029	0.048128	3.361649	3.551646
LTP	a	46	3.521739	0.657914	0.097004	3.326363	3.717115
LTP	b	87	3.448276	0.605376	0.064903	3.319253	3.577299
LTP	c	40	3.4	0.671775	0.106217	3.185156	3.614844

Aspect C5	Factor value	N	Mean	Standard deviation	Standard error	Confidence Interval for the Mean	
						-95.00 %	+95.00 %
Total		173	3.32948	0.61104	0.046457	3.237781	3.421178
LTP	a	46	3.369565	0.488021	0.071955	3.224641	3.514489
LTP	b	87	3.321839	0.673316	0.072187	3.178336	3.465342
LTP	c	40	3.3	0.607644	0.096077	3.105666	3.494334

Aspect C8	Factor value	N	Mean	Standard deviation	Standard error	Confidence Interval for the Mean	
						-95.00 %	+95.00 %

Total		173	3.358382	0.61842	0.047018	3.265576	3.451187
LTP	a	46	3.304348	0.591404	0.087198	3.128723	3.479973
LTP	b	87	3.402299	0.655208	0.070246	3.262655	3.541943
LTP	c	40	3.325	0.572332	0.090494	3.141959	3.508041

Aspect C9	Factor value	N	Mean	Standard deviation	Standard error	Confidence Interval for the Mean	
						-95.00 %	+95.00 %
Total		173	2.815029	0.777896	0.059142	2.698291	2.931767
LTP	a	46	2.76087	0.873938	0.128855	2.501342	3.020397
LTP	b	87	2.908046	0.772073	0.082775	2.743495	3.072597
LTP	c	40	2.675	0.655842	0.103698	2.465252	2.884748

Aspect C11	Factor value	N	Mean	Standard deviation	Standard error	Confidence Interval for the Mean	
						-95.00 %	+95.00 %
Total		173	2.699422	0.909798	0.069171	2.562889	2.835955
LTP	a	46	2.869565	0.832898	0.122804	2.622225	3.116906
LTP	b	87	2.724138	0.984646	0.105565	2.514281	2.933994
LTP	c	40	2.45	0.782829	0.123776	2.199639	2.700361

Aspect C12	Factor value	N	Mean	Standard deviation	Standard error	Confidence Interval for the Mean	
						-95.00 %	+95.00 %
Total		173	2.820809	0.919571	0.069914	2.68281	2.958809
LTP	a	46	2.782609	0.96409	0.142147	2.496309	3.068908
LTP	b	87	2.816092	0.958787	0.102793	2.611747	3.020437
LTP	c	40	2.875	0.790569	0.125	2.622164	3.127836

Average values of the scores of the respondents' assessments of all aspects C1 – C13 fall within the scale range 3 (*rather significant*) – 4 (definitely *significant*) from the maximal scale value 4. Even at nine of the 13 aspects (C1, C2, C3, C4, C5, C6, C7, C10 and C11) the highest assessment (mean) was achieved in case of the group of the respondents – *pedagogical employees with the length of teaching practice up to 5 years* (a), in case of 3 aspects (C8, C9 and C13) the highest assessment (mean) was achieved in case of the group of the respondents – *pedagogical employees with the length of teaching practice from 5 up to 20 years* (b), and in case of one aspect (C12) the highest average score value resulted from the assessments stated by the group of respondents – *pedagogical employees with the length of teaching practice more than 20 years* (c).

The lowest variability (standard deviation 0.49) was recorded at the assessments of the aspect C5 (range 3.22 – 3.51) done by the group of the respondents – *pedagogical employees with the length of teaching practice up to 5 years*. On the other hand the most heterogeneous assessments (standard deviation 0.98) were recorded in vase of the group of the respondents – *pedagogical employees with the length of teaching practice from 5 up to 20 years* and their assessment of the aspect C11 (range 2.51 – 2.93).

In general, results of this part of the research declared teachers´ positive attitude towards the use of the modern technologies in education processes, and surprisingly they consider the impact of the use of these technologies in teaching on efficiency of the education to be very significant, and that independently on the length of their teaching practice. The teachers perceive the use of these didactical means in education as a contingency to increase *pupils´ motivation* (C1 = 3.59) and *activity during the lesson* (C3 = 3.50) in an attractive and interest-holding way, and so totally as well to increase *pupils` interest in the taught subject* (C2 = 3.46). At the same time a very positive finding is that also the teachers with the length of their teaching practice above 20 years are aware of the fact that the use of modern (interactive/digital) technologies in education is currently a necessity due to the social pressure for individual´s information and communication technology literacy.

Current state of the use of interactive and digital means in teaching at schools

Besides the already above presented items (focused on the education components C1 – C13), in the questionnaire designed for the purpose of our research survey there was included one additional questionnaire item to monitor and assess ways the (primary and secondary school) teachers use interactive educational activities and digital means in their teaching practice. In this item (C14) the respondents were asked to mark from the offered item menu maximum three from seven software applications, which they use most often to create their own interactive educational activities for their pupils (see in chapter 2, part methodology of the screening). In relation to the „most often used" applications they were asked to specify „rank" of these three most often used means (by marking their position I, II, III, where I was for the most often used one). Overview of the main results of this part of the research is summarised and presented in Table 6.

For those teachers, who do use no of the offered software products or do not use any interactive means of teaching in their teaching practice, the questionnaire item C14 included three other alternatives to respond to this question (item C14), and these were:

g) I do not create my own interactive educational activities for pupils but I use some taken over from open sources or from my colleagues.

h) I do not create my own interactive educational activities for pupils but I take over some from open sources or from my colleagues and modify them.

i) I do not create any interactive educational activities and I neither use any.

From the research sample of 173 respondents, 39 teachers stated one of these responses (g – 23 = 13.29 %; h – 7 = 4.05%, i – 9 = 5.20 %) and the rest of them (134 = 77.47 %) specified at least one of the offered product as an application which they really do use in their teaching practice.

Table 6 presents absolute and relative frequencies of the particular responses (according their statements on the rank I, II and III) of the whole research sample to the questionnaire item C14, without any differentiation of the respondents according to the factor SUB-CATEGORY OF THE TEACHING STAFF nor LENGTH OF TEACHING PRACTICE. Relative frequencies presented to each of the ranks I – III refer always to the sum of the absolute frequencies recorded to the corresponding rank.

Table 6. Frequencies of the respondents' responses to the question C14

	Frequencies – rank I		Frequencies – rank II		Frequencies – rank III	
Response	Absolute frequency	Relative frequency	Absolute frequency	Relative frequency	Absolute frequency	Relative frequency
a	73	54.48 %	25	20.00 %	27	21.43 %
b	9	6.72 %	29	13.00 %	17	13.49 %
c	22	16.42 %	10	8.00 %	17	13.49 %
d	4	2.98 %	10	8.00 %	11	8.73 %
e	14	10.45 %	20	16.00 %	28	22.22 %
f	12	8.95 %	31	24.00 %	26	20.64 %

Note to Table 6:
a – ActivInspire; b – Flow!Works; c – SMARTNotebook; d – Prezi; e – Mindomo; f – FreeMind; g – I do not create my own interactive educational activities for pupils but I use some taken over from open sources or from my colleagues; h – I do not create my own interactive educational activities for pupils but I take over some from open sources or from my colleagues and modify them; i – I do not create any interactive educational activities and I neither use any.

As the presented results show, the software application, which the teachers use most often to create various interactive teaching materials and learning activities for their pupils at primary and secondary schools, is unquestionably *ActivInspire* (see in Table 6 frequency of its use recorded on each of the ranks I – III), used to whiteboard ActivBoard. To the second most often used application (see the same in Table 6) can be assigned two software products, and these are *FreeMind* and *Flow!Works*. In a less significant frequency the teachers use also *Mindomo*.

Results of this part of the research without differentiation of the ranks of the three most ofen used software applications statedby the respondents are graphically visualised in Figure 3. The total sum 100 % is related to the total sum of the statements at the given software applications (unles Table 6 without differentiation of the rank of their statements), and so – as the respondents could mark 1, 2 or 3 of the responses – the total sum does not represent the number of the respondents but the number of by them stated particular answeres. The results presented in the graph altogether confirm the results.

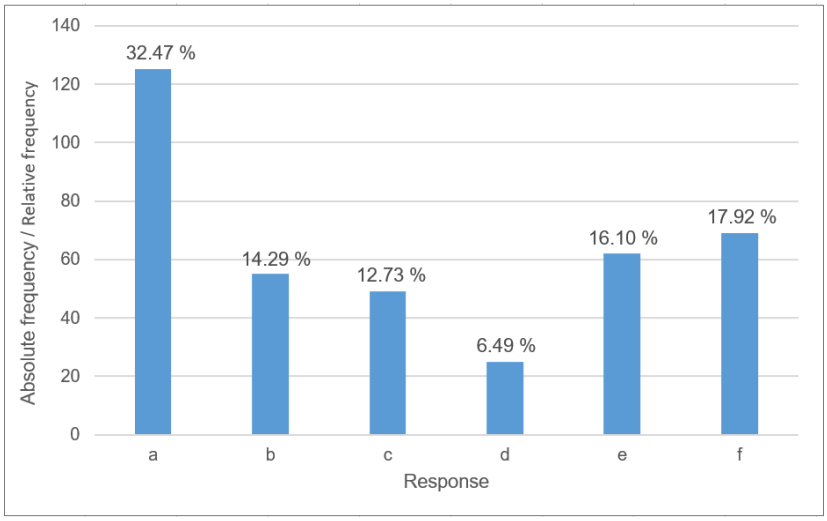

Fig. 3. Total frequencies of the particular responses to the question C14 on the most often used software applications

6. Conclusion

It is very beneficial for the pedagogical employees, if the institutions providing continual education of in-service teachers follow their current educational needs and respond to them offering the teachers adequate study programs or courses of further education. Of course, also the pre-graduate teacher training should respond to these needs, i.e. faculties of education should modified those parts of their teacher training study programs within which the didactic technological competences of the teacher trainees (as an integral part of the professional competence profile of a teacher) are formed and developed.

The results of the particular parts of the carried out research point out to current needs of primary and secondary school teachers regarding their professional digital literacy skills, i.e. in focus on which topics and issues they would need to upgrade these skills (and at the same time teaching of which topics and issues should be included or reinforced in the curricula of the tertiary teacher training study programs). As the results have showed, to these topics and issues belong mainly the use of software products *ActivInspire*, *FreeMind*, *Flow!Works* and *Mindomo* in teaching and learning processes. Moreover, it shows to be profitable to include more courses/study subjects devoted to the didactical and methodological preparation of teacher trainees in the use of the digital interactive means in teaching into their study programs.

To the situation in Slovakia, very similar situation is also in the Czech Republic. As Neumajer states (Neumajer, 2012), majority of the accredited courses of further continual education of teachers in the Czech Republic is aimed rather at acquiring elemental or advance skills to work with the digital technologies (in frame of the technological aspects of these means). But the teachers lack an adequate offer of courses aimed at methodological aspects of the use of these didactic means in education. Moreover there is also an absolute lack of education programs and courses which would present to the teachers object lesson practical examples how the modern interactive digital technologies can be used in teaching particular school subjects.

7. Acknowledgment

This work has been supported by the Cultural and Educational Grant Agency of the Ministry of Education, Science, Research and Sport of the Slovak Republic under the project No. KEGA 041UK-4/2017.

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