Development of teacher trainees' digital competence

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Abstract

Teacher pre-service training should be an important arena for learning how to use new technologies in teaching. Fulfilment of the task to learn how to use new technologies in teaching is based upon several pillars. Two of them are represented by the answers to the questions use of which technologies pre-service training of teachers should be aimed at, and what expectations teacher trainees link with passing the subjects focused on development of their professional digital competence (or in a broader sense didactic technological competences). In the paper there are presented responses to these two questions resulting from teacher trainees` opinions to this issues. The opinions were collected within a research survey with the research sample consisted of 280 respondents (teacher trainees) from three different universities.

Keywords:
Curricula design
Didactic-technological competences
Digital literacy
Software applications
Teacher training

1   Introduction

Current conceptual platform for introducing digital means into the education system in the Slovak Republic is elaborated in the document of the Ministry of Education, Science, Research and Sport of the Slovak Republic (MESRaS SR) entitled *Conception of Informatisation and Digitization of Education* Sector *with a View to the year 2020* (so-called DIGIPEDIA 2020), approved by the Government of the Slovak Republic in November 2014. This document specifies the main objectives of informatisation and digitization of the Slovak education system in five strategic areas: infrastructure development, e-services optimization, subject matter digitization, digital skills and cooperation with employers (https://www.minedu.sk/). Intention of DIGIPEDIA is by means of different projects (e.g. the project *Planet of Knowledge*) to ensure innovative forms and methods of teaching primary and secondary school pupils and students, to increase pupils and students` interest in science and technology subjects and studying technical branches, as well as to support financially establishment of interactive classrooms at schools (Central Information Portal of the MESRaS SR). What is missing among the five strategic areas stated in DIGIPEDIA is the area of teacher training to ensure that teachers will be able to act in the new "digital environment", i.e. to ensure that the teachers will be able in their teaching practice to implement the innovative forms and methods and to use the created digital teaching materials and equipment of the interactive classrooms. A logical reason why this area is not included among the strategic areas of the project is the fact that pre-service training of teachers, teacher trainees study programs, includes besides other also didactic technological preparation of teacher trainees aimed at development of their professional digital competences. As digital technologies and their applications are subject to rapid development and innovation changes, the lifetime of the curricula of this part of teaching study programs is continually shortened and consequently there arises a need for frequent innovations of the relevant part of the curricula.

The undermentioned inquire survey was aimed at finding how the pre-service teacher training in the area of digital competences development should be innovated from the teacher trainees` point of view (Záhorec et al., 2020).

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2 Aims and methodology of the carried out research

To find out how, from the teacher trainees` point of view, the pre-service teacher training in the area of digital competences development should be done, there was used a screening of teacher trainees` opinions on some aspects relating this issue.

In frame of the carried out survey the respondents got a list of nine education topics which they were asked to assessed from different points of view. Selection of the topics was derived from the development trends and actual situation at primary and secondary schools regarding material and technical equipment of the schools. The list of the nine assessed education topics is presented in Table 1 (items B1 – B9).

Identif. code of the topic	Content areas of the assessed education topics
B1	software applications, as e.g. *ActivInspire, SMART Notebook, Flow!Works,* used to create different electronic educational activities, interactive teaching and learning tasks and educational/knowledge games
B2	online application *Prezi* used to create non-linear dynamic presentations with educational – but not only – content applicable in teaching and learning activities
B3	*computer / tablet applications, as e.g. FreeMind, Mindomo, XMind,* used to create mind maps useable in teaching and learning activities intended also for pupils and students with special needs
B4	modern interactive voting systems, *as e.g. ActivExpression2, SMART Response 2, QRF700/900, Turning Point,* through which it is possible to ask questions to diagnose, test and assess pupils and students` knowledge during teaching
B5	internet application *Socrative 2.0* used to diagnose, test and assess pupils and students` knowledge on-line either during or out of teaching
B6	modern tools for collaborative creation and management of electronic on-line documents, as e.g. *Google documents,* based on the use of current possibilities of Web 2.0 internet category
B7	software applications, as e.g. *Microsoft PowerPoint,* useable for creation of didactic presentations with educational content with the use of different feed-back and multimedial elements supporting teacher` explanation of the subject matter and pupils/students` knowledge systemization
B8	Software applications, as e.g. *Microsoft Excel,* used to process tabulated data useable in teachers` work
B9	software applications, as e.g. *Microsoft Word,* used to process and format teachers` own text documents connected with their professional work and activities

Table 1: Overview of the assessed topics.

One point of view, from which the respondents were asked to assess each of the selected items B1 – B9, was a measure of the significance to incorporate the particular education topic into the teacher trainee study programs to form and develop teachers` professional digital competences. So the respondents assessed the topics in relation to teachers` needs and requirements underlying their successfulness in their future professional career performance (responses B1.1 – B9.1). This they did using a six-point scale, where the particular points meant:
1 – *definitely not to incorporate*,
2 – *not to incorporate*,
3 – *probably not needed to incorporate*,
4 – *probably needed to incorporate*,
5 – *to incorporate*,
6 – *definitely to incorporate*.
The scale did not offer a choice of a neutral, emotionally indifferent assessment attitude, as we wanted to obtain clearly stated opinions of the respondents on the given issue.

The second point of view, from which the respondents were asked to assess each of the selected items B1 – B9, were the expectations which the respondents associate with passing a subject of the given topic in frame of the teacher pre-service didactic technological preparation (responses B1.5 – B9.5). This they did choosing one of the offered alternative answers, the one which corresponded mostly with their attitude. Formulation of the questionnaire item was:

Passing of the subject devoted to the given issue I would associate with fulfilment of my expectations in the area of:
a) applying the acquired skills mainly in teaching my majors;
b) applying the acquired skills in teaching in general;
c) general increasing of my pedagogical competences (teaching mastery);
d) inspirational incentives to my performance of the teacher profession;
e) applying the acquired skills in frame of teaching extracurricular activities of pupils/students;
f) applying the acquired skills in frame of my own personal spare-time activities.

Collection of the research data was done in the second half (summer term) of the academic year 2018/2019. Research sample consisted of 280 teacher trainees, from which 205 were teacher trainees studying in Slovakia and 75 were teacher trainees studying in the Czech Republic. Description of the research sample is presented in Table 2.

Factor (Item)	Group	Frequency (N = 280)	%
GENDER (A1)	Male	49	17.5
	Female	231	82.8
UNIVERSITY (A2)	Comenius University in Bratislava	205	73.2
	Charles University in Prague	48	17.2
	University of Hradec Králové	27	9.6
COUNTRY (A2)	Slovakia (SR)	205	73.2
	Czech Republic (CR)	75	26.8
GRADE OF STUDY (A4)	Bachelor Degree	254	90.7
	Master Degree	26	9.3

Table 2: Description of the research sample.

3 Research results and their discussion

Research results are summarized in Table 3 and Table 4. Table 3 presents results of the statistical processing of the respondents` responses to the question of the significance, or importance, of the incorporation of the given selected educational topics (assessed kinds of software applications) B1 – B9 into the curricula of pre-service teacher training. There are presented means of the average score (assessment) achieved at each of the items, standard deviations, standard errors of the mean estimation and 95% confidence interval for the mean.

Assessed item	Mean	Stand. deviat.	Stand. error	Confidence Interval for the Mean	
				-90 %	+95 %
B1.1 – *ActivInspire, SMART Notebook, Flow!Works*	4.68	0.99	0.06	4.56	4.79
B2.1 – *Prezi*	4.38	1.09	0.07	4.25	4.51
B3.1 – *FreeMind, Mindomo, XMind*	4.42	1.11	0.07	4.29	4.55
B4.1 – *ActivExpression2, SMART Response 2,QRF700/900*	4.15	1.21	0.07	4.00	4.29
B5.1 – *Socrative 2.0*	4.29	1.17	0.07	4.15	4.43
B6.1 – *Google Docs*	4.58	1.17	0.07	4.44	4.72
B7.1 – *Microsoft PowerPoint*	5.25	1.08	0.06	5.12	5.38
B8.1 – *Microsoft Excel*	5.06	1.09	0.07	4.93	5.19
B9.1 – *Microsoft Word*	5.44	0.96	0.06	5.32	5.55

Table 3: Measure of the significance of incorporation the topics (SW appl.) B1 – B9 into the teacher trainees` study programs.

As the data presented in Table 3 show, values of the average score achieved at all of the items B1 – B9 are within the interval of values from 4.15 to 5.44 of the maximal scale value 6. Significantly the highest value of the mean was recorded at the item B9, i.e. in case of the software applications used to process and format teachers` own text documents connected with their professional work and activities (*Microsoft Word*). Score 5.44 (B9.1) shows that the teacher trainees are aware of the need to improve their skills to work consciously with a broader scope of tools of the text editor in the context of their professional activities (e.g. in the context of a perfect structuring and uniform formatting own materials used in their future teacher career).

Very positive results – in our opinion – have been achieved also at further four items, in particular at the items B1, B6, B7 and B8. In teacher trainees` opinion, beside the text editor *Microsoft Word* also the work with these other kinds of software applications should be incorporated in their study programs to develop their professional competence profile and their digital literacy. Average score achieved at each of these items has been on the level of the scale value 5, what means *to incorporate* topics of the work with such software application as *ActivInspire, SMART Notebook, Flow!Works* (B1), *Google Documents* (B6), *Microsoft PowerPoint* (B7) and *Microsoft Excel* (B8) into the curricula of the relevant subjects of the teacher trainee study programs.

In general, one can say that the average score of the recorded responses at none of the nine items was below the scale value 4, what means that all items were assessed minimally at the level *probably needed to incorporate* into the curricula of the teacher trainee study programs.

The presented results are in some details surprising, as the students are generally taught to work with such software applications as *Microsoft Word, Microsoft PowerPoint* a *Microsoft Excel* (as users) already at the lower levels of education. It can therefore be assumed that they are already coming to university with properly developed skills to use these applications. However, as the results of the screening show, the scope and level of ability to work with them, which the students acquire at secondary school level, do not give them a feeling of convenience in applying them in their (future) profession practice. At this point it may be argued that behind these recorded results may be hidden either a deliberate intention or unconscious tendency of the respondents to "deliberately manipulate" screening results so that the curricula created on the basis of the screening results would allow students to pass their study as easily as possible. However, analysis of students' views on the extent to which teaching of these issues (educational topics) should be included in teacher study programs and character of the subjects within which they should be taught (compulsory, compulsory optional, optional) bear witness against this objection (results of the mentioned analysis are not presented here, for more detail see Záhorec, Hašková, Nagyová, 2020).

The lowest value of standard deviation (0.96), what means the lowest variability of the respondents` responses (5.32 – 5.55), was recorded at the item B9.1 But as the data in Table 3 show, achieved values of standard deviation do not differ markedly in general. Contrary to that, answers in relation to the item B4 (B4.1 – standard deviation 1.21) were the most variable. Paradoxically, at this item (B4) also the highest value was recorded (4.15). This means that students mostly differ in their opinions on the need to incorporate or not to incorporate the issue of digital testing and voting systems (*ActivExpression2, SMART Response 2, QRF700/900,*

TurningPoint) into the curricula of the pre-gradual teacher training. Within the general assessment done by them, these didactic means were perceived as less needed to be incorporated into the teacher professional training.

In our opinion, the results recorded at the item B4 arose as a consequence of a low respondents` familiarization with the issue of the use of voting and testing systems, and mainly with possibilities of their effective use in teaching practice (e.g. using ad-hoc questions (ExpressPoll), prepared questions and Self-Paced questions in teaching in the form of different interactive educational activities and knowledge-based games supporting pupils/students` activation and keeping pupils / student`s attention in the lesson, based on the pupils/student`s common characteristics as are competitivity or playfulness). These systems represent up-to-day modern didactic means assigned to diagnose and assess pupils/students` knowledge during teaching and learning process, through which it is possible to ask different questions different pupils/students at the same time (all pupils/students at once). On the one hand, pupils/students can immediately evaluate their fruitfulness, respectively correctness of their activities and their results, as they get an immediate feedback summarizing their results (correct and incorrect answers). On the other hand, as well the teacher gets an immediate feedback, information on pupils/students` knowledge, and can discuss with pupils / students` the voting results before their announcing (i.e. before announcing the correct answers).

A higher value of variability (value of the standard deviation 1.17) was recorded also in case of the respondents` responses to the item B6. Average values of the achieved score on the basis of the confidence interval for the mean are within the range of values from 4.44 to 4.72. In frame of the used scale this represents assessments from recommendation *to incorporate* the given topic into the curricula of the teacher training study programs to the requirement *definitely to incorporate.*

Results of the statistical analysis of the assessment of the measure of the significance to incorporate the issue of the topics B1 – B9 into the teacher trainees` study programs presented on Table 3 are visualised in a graphical form in Figure 1 presenting dot and interval estimation of the assessments of the particular items.
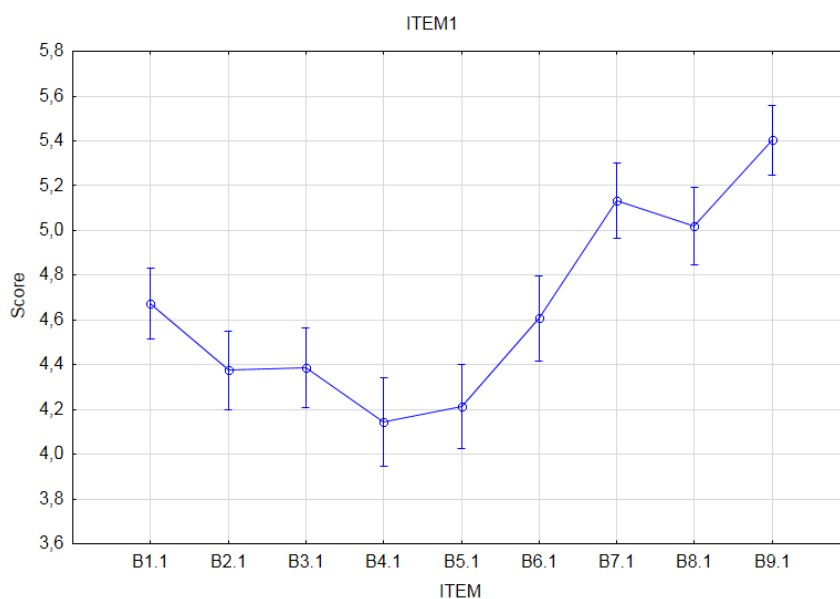

Fig 1: Visualisation of the differences among the average values of the score of the items B1.1 – B9.1.

From the graphical interpretation of the results (Figure 1) one can see moderate opinion shift at the assessment of two items, the item B9 – educational topic focused on processing and formatting teachers` own text documents connected with their professional work and activities (*Microsoft Word*) and the item B7 – creation of didactic presentations with educational content with the use of different feed-back and multimedia elements supporting teacher` explanation of the subject matter and pupils/students` knowledge systemization (*Microsoft PowerPoint*), from the assessments of the other items.

Results of the statistical processing of the respondents` responses to the question on the expected benefits which the respondents associate with passing the subjects dealing with issues of the given selected educational topics are presented in Table 4. There is presented an overview of the absolute and relative frequencies of the particular responses *a – f* to each of the items B1 – B9 (B1.5 – B9.5).

Item / Response	a	b	c	d	e	f
B1.5						
∑	74	90	69	36	7	4
	26.43 %	32.14 %	24.64 %	12.86 %	2.50 %	1.43 %
B2.5						
∑	63	89	67	34	15	12
	22.50 %	31.79 %	23.93 %	12.14 %	5.36 %	4.29 %
B3.5						
∑	80	80	53	36	12	19
	28.57 %	2.,57 %	18.93 %	12.86 %	4.29 %	6.79 %
B4.5						
∑	64	74	56	37	24	25
	22.86 %	26.43 %	20.00 %	13.21 %	8.57 %	8.93 %
B5.5						
∑	82	72	61	28	17	20
	29.29 %	25.71 %	21.79 %	10.00 %	6.07 %	7.14 %
B6.5						
∑	75	75	64	28	12	26
	26.79 %	26.79 %	22.86 %	10.00 %	4.29 %	9.29 %
B7.5						
∑	138	71	44	17	6	4
	49.29 %	25.36 %	15.71 %	6.07 %	2.14 %	1.43 %
B8.5						
∑	94	83	71	14	8	10
	33.57 %	29.64 %	25.36 %	5.00 %	2.86 %	3.57 %
B9.5						
∑	151	60	44	12	5	8
	53.93 %	21.43 %	15.71 %	4.29 %	1.79 %	2.86 %

Table 4: Absolute and relative frequencies of the respondents` responses *a – f* at the items B1.5 – B9.5.

Legend to Table 4: *a – applying the acquired skills mainly in teaching my majors; b – applying the acquired skills in teaching in general; c – general increasing of my pedagogical competences (teaching mastery); d – inspirational incentives to my performance of the teacher profession; e – applying the acquired skills in frame of teaching extracurricular activities of pupils/students; f – applying the acquired skills in frame of my own personal spare-time activities.*

Following the results presented in Table 4 one can say that by the respondents the least expected benefit associated with passing the subjects dealing with issues of the given selected educational topics is *applying the acquired skills in frame of teaching extracurricular activities of pupils/students* (alternative answer *e* – in case of three from the evaluated nine items this answer is ranked within the six alternative possibilities on the fifth place and in case of the other cases on the last, sixth place). Relative frequencies of this answer at the particular items are within the value interval from 1.79 % (B9.5) to 8.57 % (B4.5). Approximately in the same value interval are ranked also the relative frequencies of the alternative answer f, according to which the respondents associate passing the subjects dealing with issues of the given particular topics mainly with utilizing the acquired skills in their *applying in frame of own personal spare-time activities.* Relative frequencies of this answer, which alternates with the answer *e* on the last and next to last places, are within the scope of the values 1.43 % (B1.5) – 9.29 % (B6.5). The answer *d* – associating passing the subjects dealing with the topics B1 – B9 with getting *inspirational incentives to the future performance of the teacher profession,* has been constantly ranked on the fourth place at each of the items B1 – B9. Frequencies of this responded statement are not markedly higher than frequencies of the alternative answers *e* and *f.* They are within the scope from 4.29 % (B9.5) to 13.21 % (B4.5). The alternative answer *c* has also at each of the items B1 – B9 its constant place. In case of this item it is the third place. This its uniformity is broken only once, at the item B2.5, where on the basis of the recorded frequencies, the answer *a* is ranked on the third place and the answer *c* is ranked on the second place. Frequencies of the answer *c* can be already considered as statistically significant, as they are in the scope from 15.71 % (equally at two items, B9.5 and B7.5) up to 25.36 % (B8.5). Altogether, a quarter even a third of the respondents would associate passing the relevant subjects with an expectation of *applying the acquired skills in teaching in general.*

Relative frequencies of this response (answer *b*) achieved at the particular items values from 21.43 % (B9.5) up to 32.14 % (B1.5). As the results show, definitely the most marked expectations linked to passing the relevant subjects the respondents associate with *applying the acquired skills mainly in teaching their majors*. Although within its ranking based on the achieved relative frequencies this answer (answer *a*) alternates on the first position with the answer *b*, unlike the answer *b*, scope of the recorded frequencies of the answer *a* is significantly wider, from 22.50 % (B2.5) to 53.93 % (B9.5). Having a deeper look at the recorded frequencies, can be seen that at the items B1.5 – B6.5, the relative frequencies of the responses *a* and *b* are approximately on the same level. A noticeable change, a significant increase in responses *a* compared to answers *b*, occurs at the items B7.5 – B9.5, especially at B7.5 and B9.5 (B7 – software applications as *Microsoft PowerPoint*; B9 – software applications as *Microsoft Word*). This „change" can be related to that what has been indirectly already above-mentioned. That is the fact that within the pre-service teacher training in the area aimed at the development of teacher trainees` didactic technological competences, attention is dominantly paid to the development of common user skills to work with *Microsoft* software applications, without any noticeable transfer of the acquired skills into the area of teaching. And for all that, as the presented results of this part of the screening survey show, students expect that passing such training will contribute them to develop above all their ability to apply the acquired skills in teaching in general, but especially in teaching their subjects (majors). So as it is clear, main expectations of the students are focused on development of the skills to apply the acquired skills to work with these software applications and hardware systems in teaching their majors. In order to meet these expectations of students, it will be necessary to change not only curricula of the subjects, which task is to develop teacher trainees` didactic technological competences, but to change also incorporation of these subjects into the study programs. This is related mainly to the cross curricular interconnection of these subjects with branch didactics. Branch didactics is usually included in the master level of the study while the subjects dealing with the development of teacher trainees` didactic technological competences (with respect to accentuation development of the user digital literacy of the students) are incorporated into the lower grades of the study (usually into the bachelor level of the study). Currently applied way in which these subjects used to be included (more or less exactly in a reversed interconnection) supports quite spontaneously within the didactic-technological training of the students rather "student" than "teacher" view on the possibilities of the use of these means (i.e. what prevails is the assessment of the work with these technologies from the student's point of view instead of considering this work from the teacher`s point of view). In our opinion, what could help to eliminate this problem is the shift of the concerned subjects into the higher grades of the study.

4   Conclusion

As the results of different researches show (Uluyol and Sahin, 2016; Shopova, 2014; Ottestad, Kelentrić and Guðmundsdóttir, 2014), success of technology use in teaching depends mostly on the teacher`s personality and his/her skills. That is why it is very important to keep sustainably quality of teachers` professional didactic technological competences. This task includes also the need to innovate continuously the pre-service training of teacher trainees. Results of the carried out research indicates some requirements which should be currently reflected in innovation of curricula of this part of the training. In particular, besides the traditionally taught use of the software applications *Microsoft Word*, *Microsoft Excel* and *Microsoft PowerPoint*, to the topics and issues which should be included or reinforced in the curricula of teacher trainees study programs belong mainly the use of the software products *ActivInspire*, *FreeMind*, *Flow!Works*, *Google Docs* and if possible also *FreeMind*, *Mindomo*, *XMind* and *Prezi* with accent on the methodological aspects of the use of these didactic means in teaching and learning process.

The presented survey was carried out in the academic year 2018/2019, before the corona pandemic occurred. It was carried out at time when we had no experience of teaching in corona pandemic conditions. In that time the core of the teacher training related to the use of digital technologies was appropriate implementation of different software applications into teaching. Nowadays, in conditions of the pandemic, we see what may be even more important is to train teachers to work with different on-line systems. The pandemic has caused that education is moving into the virtual reality. For pupils, students and their teachers too, a new situation has arisen. We all are online. To support distance form of education at all its levels, digital multiplatform tools are used. For many teachers this form of education is no novelty (Balogh and Kucharik, 2019; Boltižiar, Biskupič and Barka, 2016). This form has been used in specific situations (for example in case of pupils/students` illness already for a longer time. But on the other hand a majority of teachers has not come into the contact with this form of education in their teaching practice yet. From the position of the teacher they are not familiar with methodology

of online teaching. So beside the above mentioned research results also the new (corona) conditions should be taken into the consideration with respect to upgrading the teacher training in the area of their didactic technological competences. And taking into consideration the situation under the corona pandemic means that into the curricula of the teaching study programs also the issue of teaching through online systems (such as e.g. *Microsoft Teams, Zoom, Cisco Webex, GoToMeeting, BlueJeans*) should be included.

Acknowledgement

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