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Chapter XXVII

PROFESSIONAL COMPETENCIES OF TEACHERS IN THE FIELD OF MODERN EDUCATIONAL AND INFORMATION-COMMUNICATION TECHNOLOGIES

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Abstract: Contemporary achievements of pedagogical science and the advancement of information communication technology (ICT), enable new organizational solutions to be applied in teaching, which makes the teaching process more interesting, dynamic and efficient. Modern society and education require an individual teacher who is able to follow changes in society and science. The main goal of this paper is to consider one of the primary question: What teacher competencies are needed and at at what level of application should they be for the modernization of teaching?

The empirical part of the paper represents which didactic multimedia teachers use the most in teaching, and what teachers attitudes are towards ability to use educational software in teaching. This study used a descriptive method, and scaling technique with a Likert type assessment scale instrument. The survey involved 209 elementary and secondary school teachers in the region of Nis. In concluding observations, it is noted that classic classrooms are slowly turning towards the use of multimedia, but the current application of educational software is still not satisfactory. Also, the authors draw attention to the need for a wider and more intensive range of professional teacher training courses, primarily in the didactic-methodology field, as well as the field of modern education technology, because this is certainly one of the best ways to meet the necessity of reform of our education and the ever-increasing challenges of modern education for the 21st century.

Keywords: *teacher competences, didactic innovation, ICT, educational technology, educational computer software (ECS).*

Introduction

Getting to know all students and technological teaching aids must be an integral part of each curriculum. Every profession today uses technology in its

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own way, and each requires knowledge of the computers and programs that they need, which become inevitable pedagogical tools. By enabling students to work on their own computers, they participate in a controlled environment. In traditional teaching it is not possible for a teacher in the classroom to observe every student involved in an activity, so using technology to exercise control ensures that students move towards the goal of their learning.

Computers can reduce the effort required from teachers as they provide instruction to students through various programs and pre-assignments, and ensure that students stay on track. Thus, experiential learning is increasingly decentralized, each student can learn through his/her computer, and does not have to continually receive instruction from the teacher. Students are no longer passive listeners in a classroom, but each student can participate in a program that is suited to him/her in accordance with his/her needs and interests. The computer's multimedia capabilities make it a very powerful medium for learning and an enriching experience, which is an aspect of the computer that both teachers and students most like, and which, rightly, places it centrally within the ICT system.

Theoretical Orientation

Teacher competences in the field of ICT and education technologies

We cannot dispute that the teacher was and remains irreplaceable and professionally the most responsible factor in the quality, organization, and implementation of all interrelated and conditioned phases of a complex teaching cycle. Understanding the notion and essence of teaching, where the teaching and learning activities simultaneously take place, one can explicitly confirm the thesis that its effectiveness depends mostly on the professional, didactic-methodical, educational, and technological competence of teachers (Miljanović 2017). Educational technology should not be understood only as the application of various technical means, but also as the application of new teaching methods in accordance with new educational techniques, as new organization of teaching and learning achievement, and as a combination of all possible resources in order to improve teaching and learning processes (Danilović 2004).

On the one hand, the use of modern educational and information-communication technology allows for the content to be individualized in regular, additional and supplementary classes, so that each student progresses at his/her own pace, in accordance with a program that is in line with his/her personal potentials. In this context, individual programs, ie programs of different difficulty and levels of complexity, depending on the potential of the student can be made. At the core of this technology, an individualized form of work that particularly favors students is promoted. On the other hand, for a number of teachers

stereotypes and prejudices are often conditioned by insufficient knowledge of the opportunities offered by modern ICT in the process of educational work. In order to understand this problem in more detail, this paper points out some of the possibilities of applying these technologies in the context of the introduction of didactic innovations in the function of individualization of the teaching process.

Today, ICT resources are increasingly used in the educational process not only as complementary resources, but as a means of learning. In these circumstances, the issue of teachers' ability to use media well (in a pedagogical sense), and to understand their place and role in the educational process is crucial. When used appropriately by competent teachers, technology can support, expand and improve learning by opening up new, hitherto unachievable, opportunities (Arsenijević, Andevski 2011; Kariuki et al. 2001; Kirschner et al. 2002).

The teacher should first of all assess students' abilities and set specific tasks for each individual, so that classes are individualized in accordance with the abilities of each student. On the other hand, programmed teaching is also a kind of innovative teaching that enables students to gain knowledge slowly, step by step. Programmed teaching is divided into parts and is applied through innovative means, through a computer that allows teachers to organize work so that students exceed content at a pace that is in accordance with their abilities (Vilotijevic, Vilotijević 2016). Programmed teaching is not often applied in pedagogical practice because it has advantages and disadvantages. Advantages are mastering content at a pace that corresponds to the student, but on the other hand, too much divided teaching material loses the essence of continuity. The tendency is to approach forms of teaching as electronic, computerized teaching (Mercer, Scrimshaw 1993).

With regard to ICT in teaching, the use of computers and the Internet has enabled a wide array of different forms of knowledge acquisition. One of the innovative forms of acquiring knowledge in class is everyone doing so through educational software. First of all, it is emphasized that not all content is suitable for computer software development, which requires teachers and professors to be able to create adequate teaching content (Goktas et al. 2008; Mihalca 2005; Radivojević 2016; Stankovic 2005). First and foremost, it is necessary for teachers to know the area from which content is selected and to possess information competencies.

The use of educational software is possible in teaching younger and older grades of school. If it is done with students of lower grades, it is necessary that contents have a more general character, whereas for older students there can be very specific lessons and topic areas. Creation of educational software implies a textual, illustrative, and audio-visual combination of content in order for content to be easily accommodated by students. In addition, the importance of

educational software is realized in that students can quickly check their knowledge and abilities (Milošević 2007; Stanković, Stanojević 2019).

Today, rightly speaking, it is possible to talk about the comprehensive application of computers, and therefore ICT, in education, practically in all parts of this system. The possibilities are enormous, almost unimaginable, but globally the following areas can be mentioned:

- individual learning and teaching;
- Exercise and repetition in the acquisition of knowledge and skills;
- information search and access (expert) databases;
- processing of texts and the creation of schemas, tables, charts...;
- play and simulation of the complex process model;
- group learning and teaching;
- electronic mail communication and video chat (e.g. Skype program);
- multimedia presentations;
- Distance learning (video conferences with remote groups, electronic mentors...);
- Pedagogical documentation – e.g. records (internal student tracking, , for teachers needs or publicly, at the level of electronic diaries), grade, school, etc.;
- Administrative affairs (support to the work of the secretariat, accounting...), etc.

ICT is changing the image of traditional school organization. Today, it is evident that pedagogical changes are inevitably accompanied by investments in ICT 2. The basic goals of computerization of schools are: providing basic information literacy for all (media culture); basic professional and technological training and computerization of schools – a new school.

Methods

The subject of the empirical research presented aimed to examine the self-assessment of teachers' competence for didactic multi-media and teachers' ability to use educational software in teaching. A study of the literature analyzed the characteristics of educational and information-communication technology within the contemporary educational process, with a special emphasis on the importance of developing professional competencies for achievements in this area. The researchg examined which multi-media teachers most often use in teaching, for what purpose these media are most often used, as well as concrete attitudes about the use of computers, PWP presentations, the Internet, and educational software.

The method used in this research was selected in accordance with the subject, purpose, research tasks, and nature of the research. In the theoretical part of the research, a method of theoretical analysis was used, which enabled theoretical understanding of different methodological approaches in the study of educational and information-communicational technology and professional competences of teachers, as well as the descriptive method used for the empirical - analytical part of the research. In order to collect data on teachers' attitudes towards this problem, a scaling technique was used, and the Likert type (ICT-ORS) scale with 30 statements was used as an instrument. For the purposes of this research, the most significant items on self-assessment of teacher competence for teaching multimedia in teaching were analyzed.

Table 1: Relativity of the scale of the Likert type (ICT-ORS)

Cronbach's alpha	N of Items
.797	30

By measuring the metric characteristics of the instrument using Cronbach's alpha coefficient (Cronbach's alpha is 0.80), we determined that the scale meets the criterion of reliability of the instrument. The Cronbach's alpha coefficient showed us that all respondents measure the same phenomenon, i.e. they are consistent.

The research was conducted in the school year 2018/19. The research involved 209 teachers (105 from Primary and 104 from High schools), from the territory of the south of Serbia.

Statistical data processing was performed using a standard statistical apparatus[1], primarily at the level of the calculation of percentages, arithmetic means, and standard deviation, as well as calculating the statistical significance of differences between arithmetic means.

Results and Interpretation

Within the first research task, we examined teachers' attitudes towards the use of computers in teaching. Computers represent modern media for which teachers need to be trained to apply to innovate teaching activities.

[1] $\overline{X}$ – Arithmetic mean (mean value);
SD (Standard deviation) – deviation of individual results from the arithmetic mean;
N – number of units in the sample (number of respondents);
df – number of degrees of freedom;
p – the degree of significance of the difference;
t – t ratio – the difference between the arithmetic mean;

Table 2: Computer application in teaching

	N	Minimum	Maximum	Mean ()	Std. Deviation
I use the computer to create presentations needed for classes	209	2.00	5.00	4.0670	.79983
The computer serves me to bring content to students by using pictures.	209	2.00	5.00	3.5072	.93603
My computer does not serve much, I do it all by myself.	209	1.00	3.00	1.8278	.71320
An adequate film encourages children to participate in a discussion.	209	2.00	5.00	4.1148	.99335
I use my computer for personal needs, not just for classes.	209	3.00	5.00	4.4163	.64594
Valid N (listwise)	209				

The results provide interesting as we can conclude that teachers are competent in the application of computers, both on a personal and a professional level. Teachers disagree with the statement that they can do it all by themselves, and therefore do recognize the benefits of using the computer. With high arithmetic environments M > 4.00, teachers confirm that they use computers to prepare specific teaching contents, using images, presentations and films, but also using them for personal needs.

Table 3: Differences in computer usage with regard to type of school

	Type of School	N	Mean	Std. Deviation	Std. Error Mean
Computer	Primary	105	17.6000	1.88924	.18437
	High	104	18.2692	1.52793	.14983

t= -2-81; df= 207; p= 0.01

The research has shown that teachers value more highly items for testing the use of computers for teaching in secondary schools (M = 17.60) compared to teachers in elementary schools (M = 18.26). The results indicate that secondary school teachers use computers to prepare specific teaching content, using images, presentations and films, and for personal needs more than teachers' in primary schools. The difference is statistically significant, at the level of $p < 0.05$; $p = 0.01$

Table 4: Teachers, students and multimedia content

	N	Minimum	Maximum	Mean ()	Std. Deviation
Students use the Internet to supplement what I teach in class.	209	2.00	5.00	3.7368	.96707
Students teach content using Power Point presentations.	209	2.00	5.00	3.9904	.88247
Students learn from presentations.	209	2.00	5.00	3.7847	.99352
Material from the Internet is additionally rewarded when evaluating knowledge	209	2.00	5.00	3.5789	1.03531
I learned from the students information from the Internet that I did not know before.	209	1.00	5.00	3.3971	1.15200
Making presentations is easy and fun for pupils, and they learn faster.	209	2.00	5.00	3.8852	.96388
Valid N (listwise)	209				

Although we noted that teachers use multimedia content in teaching, we wanted to see the other side, ie the use of multimedia content by students and whether there is mutual cooperation in the exchange of experiences between teachers and students. The results shown in Table 4 indicate that the arithmetic meanings of the response range from uncertainty to the scale of estimation M = 3.00 to the agreement with the shown items M = 4.00. We can conclude that the application of multimedia by students is not unknown, but we cannot safely confirm that multimedia is used in teaching as much as teachers use them for the purpose of the teaching process.

Table 5: Differences in teachers' attitudes about multimedia content compared to type of school

	Type of School	N	Mean	Std. Deviation	Std. Error Mean
Teacher-students and multimedia content	Primary	105	18.5905	2.31921	.22633
	High	104	18.6827	2.52084	.24719

t = -0.28; df = 207; 0.73

The results presented in Table 4 are confirmed by teachers of both Primary and High schools (Table 5). There are no statistically significant differences in respondents' responses, $p > 0.05$; $p = 0.73$, indicating the homogeneity of the response. Undetermined responses exist regardless of the set variable of the school.

Table 6: Educational software in the classroom

	N	Minimum	Maximum	Mean	Std. Deviation
I am able to use educational software	209	1.00	4.00	2.1053	.94991
I use educational software in classroom.	209	1.00	4.00	1.8182	.73082
I think that the educational software is tailored to every student.	209	1.00	4.00	2.5502	.94493
I have the conditions and the time to create educational software.	209	1.00	3.00	1.8756	.78067
It takes a lot of investment to create educational software.	209	3.00	5.00	3.9904	.79657
The computer can not replace the lively word of a teacher.	209	2.00	5.00	3.9139	.84481
Valid N (listwise)	209				

In Table 6, we received significant data when it comes to the competence of teachers for the application of educational software. Respondents answers show that they are not trained to work on educational software, and therefore it's no wonder that educational software is not used in teaching. Low arithmetic medium on a scale of 1 to 5 indicates that they have no conditions and time to devote themselves to learning and making educational software and feel that the application of education software requires investment. It is not surprising that teachers agree that computer and educational software cannot replace the lively discourse of teachers.

Table 7: Difference in application of educational software in relation to type of school

	Type of School	N	Mean	Std. Deviation	Std. Error Mean
Educational Software	Primary	105	12.2286	2.23717	.21833
	High	104	12.4519	1.80549	.17704

t= 0.79; df= 207; p=0.43

As we noted in Table 6 that teachers are not trained in the creation of educational software and therefore for its application, it remains to be discovered whether this "state" is the same in Primary and High schools (Table 7). With almost identical arithmetic environments, we estimate homogeneity in the

answers of Primary and High school teachers, i.e. there is no statistical difference in the respondents' responses in relation to the type of school, $p > 0.05$; $p = 0.43$.

The teaching profession has changed over time and become much more complex. Contemporary teaching demands professional development from teachers in many fields (Rosenfeld, Martinez-Pons 2005). It is no longer sufficient for teachers to know only their field, but they need a breadth of knowledge in pedagogical work. In this way, professional development of teachers enables them to improve in many areas of interest or need in their work. One of the new roles of teachers is certainly the role of an innovator in the school.

ICT can be used to intensify a variety of intelligences, provide uniform learning techniques for different types of individuals, and create an environment in which pupils learn, which correspond to different types of intelligence. At a higher level of education, technology, as a means of communication, leads to cooperative learning by allowing learners to work and learn from different locations. This facilitates group learning – students work together on shared goals with peers at school, and out of school, exchanging ideas through e-communication tools (e-mail, chatting, discussion boards, and virtual classrooms). They participate in joint projects and discuss global themes with students around the world. Thus, ICT develops both interpersonal levels and intrapersonal awareness. Teachers should ideally design their instructional methods to fit in adequately with all four learning styles: experience, reflection, conceptualization, and experimentation.

By using these technologies, learning becomes participatory, interactive, decentralized, generally reproducible, global, and involves multimedia. The main problem faced even by those who have a positive attitude is the design of a curriculum model that will correspond to technology. A potential solution to overcome this problem would be to understand that for younger ages, ICT is used not so much for learning content, but primarily for the development of learning skills. Five basic (holistic) skills that modern technology, or any process and subject of learning, must provide to all students are: self-development and empowerment, communication, analysis, creativity, and productivity.

All of these are components of what we have previously called "critical thinking". None of these skills exist independently and all of them are in a dialectical relationship. Behind every reason given against the use of technology, there is a need for new skills that need to be learned. Those who have a positive attitude regarding the development of new technologies, accept them as a challenge they can handle.

Concluding considerations

The basic characteristics of modern society are change and information. If we accept information as identification of something new, then it is in itself a form of notification of change. The computer as a central component of the ICT system is absolutely necessary in the process of information transfer (educational material) and is currently an irreplaceable instrument of modern educational technology. As an imperative of modern teaching, educational technology implies adequate ways of achieving educational goals, as well as different methods and means of successful teaching.

Modern organization of teaching is unimaginable without the introduction of innovations. Didactic-methodical reform and modernization involves the use of new didactic materials and teaching strategies. A multimedia approach in teaching processes not only changes the style and way of work, but also to a great extent the quality of knowledge. This creates the conditions for acquiring more diverse, more dynamic, and complex knowledge. Since the total volume of knowledge is increasing every day, this implies the need for continuous learning and improvement. The new concept of electronic (e-learning) learning gives a new imprint and greatly facilitates this process.

Teachers generally have basic, but not necessarily sufficient knowledge for the functional use of computers in teaching. Some studies (Stankovic, Blazic 2015; Stankovic, Stanojevic 2019) point out that even where the computer is used, it occupies more time in preparation than in teaching itself, the use of educational software is negligible, and teachers are trained independently from the literature or with the help of more experienced colleagues and friends. Furthermore, very few teachers follow innovations in the field of educational technology and a large number of employees in education do not use the Internet at all during their teaching work.

The condition without which progress cannot be made is the professional development of teachers throughout their lives, and in parallel with that, defining the standards for all levels of teaching.

The introduction and application of new educational technology is not only a matter of means, but also a question of attitude towards it. In 1986, P. Mandic (Jugodidakta 1986: 4) emphasized that "resistance to the introduction of new technology often occurs because teachers do not understand enough its significance and its pedagogical abilities; because its introduction assumes the investment of special efforts, adaptation to new forms of work and taking of obligations that require a more complete pedagogical culture; because the introduction of new pedagogical technology requires retraining and permanent professional development of teachers, and these are the obligations that teachers are reluctant to accept in conditions where their material status is not what it should be considering the job and work they perform".

Although the aims and recommendations of the Government of the Republic of Serbia in the Development Strategy of the Information Society in Serbia (p. 99) have decisively been taken into account, the question is, to what extent is the "state" ready to implement its plans in practice? Considering the fact that data from the Serbian budget in the previous decade foresaw allocations of less than 1% of GDP for education (out of which over 90% of funds go to employees' salaries), and on average about 0.25% for science, forecasts do not seem so optimistic. In any case, one must first understand the importance and role of education and science in every society. This can also be seen in the example of Germany, which for the same needs take on average about 7% of GDP for education and 3% for science. Or, for example, Japan, which belongs to the ranks of fairly poor countries in terms of natural resources, through continuous large investments in education and science has long since become a world economic power, precisely thanks to professional staff, ie knowledge.

So, it has to start from the top – from the state itself and its relevant institutions. In addition to far greater material allocations and investments, greater mobility of line ministries (education and science, and ministries of international cooperation) is necessary, through the competent regional education communities, to the schools and educational institutions themselves. Also, it is necessary to involve and connect with primary teacher faculties, since, after graduation, teachers are still left to themselves, not to mention the presence of former staff who did not even have the opportunity to study educational technology during their education and vocational training. It is necessary to intensify and accredit as many courses as possible, to organize symposia and seminars, especially research projects in this field, in order to further awaken the awareness of educational workers and adequately popularize the most up-to-date didactic-methodical achievements.

The final step is certainly fieldwork in schools where, after training for the creation and application of educational software, a large number of teachers can easily be mobilized (for example, within one class) for the collection of teaching materials, and then, within the framework of team work, a series of educational software – electronic textbooks (in the function of individualization) for the needs of a larger number of cases. In parallel with this, it is necessary to work on the gradual abandonment of rigid time constraints and go over (e.g. through "block scheduling") to extremely flexible daily and thematic frameworks of teaching work.

References

Arsenijević, J. & Andevski, M. (2011). Kompetencije vaspitača za upotrebu novih medija i tehnologija. [Educators' competencies for the use of new media and technologies]. *Zbornik Visoke škole strukovnih studija za obrazovanje vaspitača u Kikindi*, 1, 25–34.

Danilović, M. (2004). Priznanje i razvoj „Obrazovne tehnologije" kao naučne oblasti i nastavnog predmeta. [Recognition and development of "Educational Technologies" as a science field and teaching subject]. *Zbornik Instituta za pedagoška istraživanja*, 36, 106–121.

Goktas, Y., Yildirim, Z. & Yildirim, S. (2008). A Review of ICT related courses in preservice teacher education programs. *Asia Pacific Education Review*, 9(2), 81–92.

Jugodidakta (1986). *Savremena obrazovna tehnologija i savremeni udžbenik*. [*Contemporary educational technology and contemporary textbook*]. Sarajevo: SOUR „Svjetlost", OOUR Zavod za udžbenike i nastavna sredstva.

Kariuki, M., Franklin, T. & Duran, M. (2001). A technology partnership: lessons learned by mentors. *Journal of Technology and Teacher Education*, 9 (3), 407–417.

Kirschner, P. A., Wopereis, I. G. J. H. & Van den Dool, P. C. (2002). *ICT3: Information and communication technology for teacher training: Pedagogic benchmarks for teacher education*. Utrecht: the Netherlands: Inspectie van het Onderwijs

Mercer, N. & Scrimshaw, P. (1993) Researching the electronic classroom. In P. Scrimshaw (Ed.), *Language,Classrooms and Computers* (pp. 184–191). London: Routledge

Mihalca, L. (2005). Designing educational software for learning mathematics in primary education. In *Proceedings of Recent Research Developments in Learning Technologies* (pp. 705–716).

Milošević, M. (2007). Primena novih informacionih tehnologija u procesu obrazovanja. [Application of new information technologies in the education process]. *Pedagoška stvarnost*, 53, 3–4, 259–266.

Mijanović, N. (2017). Obrazovno tehnološka kompetentnost nastavnika kao faktor organizovanja savremene nastave i učenja. [Educational and technological competence of teachers as a factor in organizing modern teaching and learning]. *Inovacije u nastavi*, 30(2), 15–28. https://doi.org/10.5937/inovacije1702015M

Radivojević, D. (2016). Obrazovni računarski softver u nastavi prirode i društva. [Educational computer software in teaching of nature and society]. *Bijeljinski metodički časopis*, 3, 24–30.

Rosenfeld, B. & Martinez-Pons, M. (2005). Promoting classroom technology use. *The Quarterly Review of Distance Education*, 6(2), 145–153.

Stanković, Z. (2005). *Primena nastave na više nivoa složenosti multimedijalnim pristupom.* [*Application of teaching at multiple levels of complexity with multimedia approach*]. Niš: Filozofski fakultet u Nišu; Prosveta.

Stanković, Z. & Blazič, M. (2015). Didactical model of instruction based on the application of educational software. *Didactica Slovenica*, 30, 1, 21–45.

Stanković, Z. & Stanojević, D. (2019). *Didaktičke inovacije u teoriji i nastavnoj praksi*. [*Didactic innovation in theory and teaching practice*]. Niš: Filozofski fakultet u Nišu.

Strategija razvoja informacionog društva u Republici Srbiji do 2020. godine. [*Strategy of Information Society Development in the Republic of Serbia until 2020]* (2009). [online] Retrived from: http://www.digitalnaagenda.gov.rs/FileSystem/SiteDocuments/strategije/Strategija_razvoja_informacionog_drustva_2020.pdf (Accessed 12/9/2018)

Vilotijević M. & Vilotijević, N. (2016). *Modeli razvijajuće nastave*. [*Models of evolving teaching*]. Beograd: Učiteljski fakultet.