TEACHER SELF-ASSESSMENT OF THEIR SCIENCE AND TECHNICS COMPETENCES AND PROFESSIONAL DEVELOPMENT

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Abstract/Izvleček In this paper, the authors present the results of an empirical study that formed part of the broader research project, "Culture of Educational Institution as a Factor in Co-Construction of Knowledge," at the University of Rijeka. The research was conducted on a sample of 317 elementary class teachers from Croatia and Slovenia. The authors sought to establish how class teachers assess their professionalism in practice; whether they show statistically significant differences in assessing their professionalism and professional development in practice at different stages of their careers.

Učiteljeva presoja naravoslovnih in tehničnih kompetenc ter lastnega profesionalnega razvoja

V prispevku avtorji predstavljajo rezultate empirične raziskave, ki je bila del širšega raziskovalnega projekta "Culture of Educational Institution as a Factor in Co-Construction of Knowledge" na Univerzi na Reki. Raziskava je bila izvedena na vzorcu 317 učiteljev osnovnih šol iz Hrvaške in Slovenije. Avtorje je zanimalo, kako učitelji ocenjujejo svoj profesionalizem v praksi, ali se učitelji v različnih obdobjih kariere statistično pomembno razlikujejo pri ocenjevanju svoje profesionalnosti in profesionalnega razvoja v praksi.

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Introduction

The modern educational process should undergo continuous development and change, along with the teachers and pupils who are affected by such changes. In order for change to be continuous, Blažević (2013) believes that teachers must possess pedagogical, psychological, methodological, communicative, social, information-communication, intercultural, and organizational competences. This paper focuses on the pedagogical competences of teachers defined by Jurčić (2012, 16) as "personal, subject, communication, didactic-methodological, reflective, social, emotional, intercultural, and civic competences;" it is thus necessary to observe them as intertwined in the core areas of teachers' work. Pejić Papak, Vujičić, and Arrigoni (2015) emphasize that a pedagogically competent teacher is one who can harness the incentives and potential of their environment as well as their own (necessary personal and professional capacities) and achieve good student-centred developmental outcomes. Therefore, it is necessary first to define the key competences that a learner must have to be successful in modern society, including the need to develop more complex skills and adaptability, the ability of lifelong learning.

The European and national standards, guidelines, and forecasts provide a list of competences required for the 21st-century student and European citizen (Lončarić & Pejić Papak, 2009). The key competences for Lifelong Learning – A European Reference Framework (2006) are those which all individuals require for personal validation and development, an active civic life, social integration, and employment. These competences include Communication in the mother tongue; Communication in foreign languages; Mathematical competence and basic competences in science and technics; Digital competence; Learning to learn; Social and civic competences; Sense of initiative and entrepreneurship, and Cultural awareness and expression. The key competences for lifelong learning also permeate the topics presented in the Recommendations of the Commission for European Communities (Improving competences for the 21st Century: An agenda for European cooperation on schools, 2008): critical thinking, taking the initiative, problem-solving, risk assessment, decision making, and constructive management of feelings. All key competences are considered equally important because each contributes to a successful life in the knowledge society, and many of them overlap and are intertwined.

It is desirable that the aspects that are important in one area are also interactive and support competences in another area.

The development of a national competence-based curriculum (Vujičić & Pejić Papak, 2017) directs the contemporary demand for new types of knowledge, skills, abilities, values, attitudes and competences that promote innovation, creativity, problem-solving, critical thinking, entrepreneurial skill, and information and communication skills, which can be achieved through a contemporary approach to teaching, strategies that focus on the student who must be at the centre of the educational process and a teacher who supports, initiates, and moderates activities that enable the students to construct knowledge.

The continuity of development requires a permanent development of teachers' competences because only a competent teacher can develop the competences that the students will need to integrate themselves and engage successfully in their environment. The authors share the understanding of professional development provided by Valenčič Zuljan (2001, 30), who sees professional development as "a process of meaningful and lifelong learning in which teachers (students) conceive and develop their conceptions and change their teaching practice; it is a process that involves the teacher's personal, professional, and social dimension and implies their progression towards critical, independent, responsible decision-making and behavior". Professional development cannot be a spontaneous process but involves systematically planned opportunities and gaining experience (Čepić, Kalin, & Šteh, 2017), which depend on changes in society, expectations from and towards the profession itself, as well as a change in the professional himself.

Today, it is understood that professional development is no longer a choice of motivated individuals but a necessity for every teacher. With the increasing (awareness of the) importance of teacher professional development, the number of studes on professional development has increased, as well. Some research focuses on the stages of professional development (e.g., Fuller, 1969; Katz, 1972; Huberman, 1992, 1993; Day, Sammons, Stobart, Kington and Gu,2007; Blanuša Trošelj, 2018), while others focus on individual factors (e.g., research as a factor in professional development or analysis of multiple factors in professional development (Valenčič Zuljan, 2012; Gonzalez, Brown & Slate, 2008; Inman & Marlow, 2004; Day et al., 2007; Bubb & Earley, 2010; Blanuša Trošelj, 2018).

Different factors affect teachers and their professional development throughout their career or, if they are the same factors, not in equal measure. Many researchers (Fuller, 1969; Kagan, 1992; Katz, 1972; Berliner, 1992) focus on differentiating the stages in professional development. They have created models of professional development, dealing with various characteristics, needs and goals of teachers in specific phases of professional development. Katz (1972) points out that thoughts and behaviours developing intermittently, in sequence, adjusting to the individual's tasks and environment. Therefore, it is impossible (Katz, 1972) to start one's professional role as a professional veteran. Every teacher possesses certain competences at the beginning of his/her career; these are tested, changed, and upgraded to "higher" levels through years of practice.

One of the key factors in teacher professional development is the teacher's ability to reflect on his/her day-to-day educational practice (Schön, 1983; Valenčič Zuljan, 2008). It represents the "transformation of knowledge with the help of understanding the practice" (Šagud, 2012, 284). In doing so, the reflexive teacher thinks about himself, the student, the activities, opportunities, and appropriate actions that will assist development (Mlinarević, 2002) by constantly questioning and testing his/her thoughts, behaviours and procedures in his/her work. Various internal factors are important for quality reflection, such as the teacher's understanding, beliefs, and knowledge of the importance of reflection for the teacher's quality pedagogical work, the teacher's ability to analyse and assess the impact of his/her work on the cognitive, emotional, and psychomotor development of the student, the readiness of the individual to introduce change, as well as external factors, the school climate and culture –peer interactions and the way the institution is run (Vujičić & Pejić Papak, 2017).

Numerous challenges, increasingly heterogeneous classes, and greater public expectations from teachers contribute to the increased stress placed on the teaching profession. Various studies confirm that the teaching profession is one of the more stressful callings (Johnson, Cooper, Cartwright, Donald, Taylor, & Millet, 2005; Kyriacou, 2011; Antonius et al. 2006); it is therefore important for the teacher to build resilience to ensure the long-term quality of his/her performance.

Valenčič Zuljan and Kiswarday (2015) define a resilient teacher as a qualified professional who is able to create a teaching environment in which the optimal educational and personal development of the students is achieved.

At the same time, the teacher is able to create a processed image of himself and of the teaching profession over the course of interpersonal influences of personal and social views. This enables him to improve his professional development continuously and to change the environment constructively.

The notion of a resilient teacher is clarified from the aspect of the teacher's competence to provide quality instruction and other educational activities as well as the teacher's deep understanding of himself and his own professional development. Resilience and professional development are mutually interconnected. Teacher resilience is important for teacher professional development (a teacher who is constantly stressed finds it more challenging to perform his job and to care for his long-term professional development). At the same time, a teacher who works on the development of his/her competences and invests in his/her professional development is more resistant to stress as well as better at performing his/her role.

Research methodology and problem

The achievement of quality education depends significantly on the teacher. Research has shown (Darling Hammond, Holtzman, Gatlin, & Heilig, 2005) that teacher quality has a significant impact on student achievement and that this is one of the most important factors in the school environment, exerting a greater effect on student performance than school organization, school management, or financial conditions. Based on these research findings, it is crucial to equip teachers to perform their professional roles, as well as to make them aware of the need for their continuing professional learning and development in order to achieve quality student knowledge.

The extent to which teachers will be prepared to learn professionally depends on their conception of the professional role of the teacher, their motivation, and reflection skills as well as the stimuli coming from their work environment.

In this paper, we were interested in establishing how teachers assess their professionalism and professional development in practice, and whether teachers at different stages of their careers show statistically significant differences in assessing their professionalism and professional development in practice.

Research questions

1. How do teachers assess their own professionalism in practice, and do teachers show statistically significant differences in assessing their professionalism and professional development in practice at different stages of their careers?

2. How do teachers assess their science and technics competences, and are their assessments statistically significantly related to the factors in professional development?

Research methods

The research was conducted in accordance with the principles of the quantitative research paradigm. We used a descriptive and causal, non-experimental method of pedagogical research (Cencič, 2009; Sagadin, 1993).

Instrument of data collection

For the purpose of this research, a questionnaire was constructed that included Likert-type measurement instruments (This paper forms part of the project "Culture of Educational Institution as a Factor in Co-construction of Knowledge," University of Rijeka (number: 13.10.2.2.01) and five-point assessment scales that probed teachers' attitudes towards the contemporary approach to the educational process. For the purposes of this paper, the results of the Scale related to the teachers' assessment of their own professionalism in practice, Teacher Professional Development, containing 19 items, were analysed. The Scale was adopted from Blanuša Trošelj's (2018) doctoral thesis, Professional Development of Preschool Teachers in Croatia. Since the Scale in the doctoral thesis was applied to preschool teachers, we examined the Scale's characteristics on the sample of class teachers. After Oblimin rotation, the statements were abstracted into substantively three meaningful factors (KMO = 0.841; Bartlett's test of Chi-Square sphericity = 2824.250 with $p = .000$), while two items were exempt from either factor, as they were not attributed to either.

In addition, the following socio-demographic indicators were examined: gender (dichotomous variable) and age (open-ended question), the results of which were grouped into six categories of seniority in accordance with Day et al. (2007).

Instruments of statistical data processing

The data were processed in the IBM SPSS Version21 statistical package. Factor analysis using Oblimin rotation was used to abstract the factors on the Scale, while the Kruskal Wallis and Mann Whitney tests were used to determine the differences. Descriptive analysis and correlation tests were used to determine the interconnectedness of items related to science.

Participants

The study was conducted on a sample of 317 elementary class teachers from the Republic of Croatia and the Republic of Slovenia. The majority of the participants were female (N = 278, 96.2 %), and only 11 were male (3.8 %); 28 respondents did not provide information on their gender. These teachers' work experience ranged between one and 40 years of service, with an average of 15 years of service. For the purpose of further analysis and in accordance with Day et al. (2007), the teachers were grouped into six categories of work experience according to the stage of the teacher's professional life: 47 teachers had up to 3 years of service (17 %); 17 teachers had between 4 and 7 years of service (6.1 %); 65 teachers had between 8 and 15 years of service (23.5 %); 51 teachers had between 16 and 23 years of service (18.4 %); 59 teachers had between 24 and 30 years of service (21.3 %), and 38 teachers (13.7 %) had over 30 years of service. Forty teachers did not respond to this question and were therefore excluded from further analysis. Participation in the study was anonymous and voluntary.

We called the first factor (Table 1) Professional Insecurity; it comprises seven statements that substantially describe the teachers' fears and insecurity in their work. It includes the following items: *It is difficult for me to explain my actions at work to my associates, colleagues, and the principal*; *I struggle with certain situations in my work*; *I am no longer interested in additional training*; *I make mistakes more frequently in the presence of other adults in the group*; *I am afraid that I will not make the right decision in my work*; *I am afraid of new and/or unfamiliar work situations*, and *I have done my part; it is time for someone younger.* The reliability coefficient of this factor is Cronbach alpha 0.786. Other characteristics of this factor are M = 2.1086, SD = 0.04726, Symmetry = 0.866, Kurtosis = 0.019.

Metric characteristics of the Scale

Table 1: Structure of factors on the Scale of Teacher Professional Development.

Pattern Matrix

	Component		
	1	**2**	**3**
It is difficult for me to explain my actions at work to my associates, colleagues and the principal.	**-.702**		
I struggle with certain situations in my work.	**-.677**		
I am no longer interested in additional training.	**-.658**		-.471
I make mistakes more frequently in the presence of other adults in the group.	**-.643**		
I am afraid that I will not make the right decision in my work.	**-.573**		
I am afraid of new and/or unfamiliar work situations.	**-.572**		
I have done my part; it is time for someone younger.	**-.561**		-.561
I consider myself a good mentor to the youth.		**.813**	
I apply and test the theory in practice with ease.		**.676**	
I am fully in control of things in my work.		**.676**	
I am confident in myself and my competences.		**.645**	
In my work, I use new knowledge derived from science research.		**.508**	
I behave professionally at every moment of my work.		**.420**	
I still have a lot to learn.	-.305		**.632**
I think I am in my prime work years.		.338	**.612**
I still have a lot to offer.			**.605**
I think that I need the help of more experienced colleagues.	-.321		**.499**

The second factor, Professionalism (Professional Expertise), includes items which, unlike the previous factor, support professional stability and the sense of "managing" the situation in one's teaching profession:

I consider myself a good mentor to the youth; *I apply and test theory in practice with ease*; *I am fully in control of things in my work*; *I am confident in myself and my competences*; *In my work, I use new knowledge derived from scientific research*, and *I behave professionally at every moment of my work*. The reliability coefficient of this factor is Cronbach alpha 0.721. Other characteristics of this factor are M = 3.9362, SD = 0.03558, Symmetry = -0.027, Kurtosis = -0.218.

Finally, the third abstracted factor, Room for Professional Growth, includes the following items: *I still have a lot to learn*; *I think I am in my prime work years*; *I still have a lot to offer*; and *I think that I need the help of more experienced colleagues*. The reliability coefficient of this factor is Cronbach alpha 0.505. Other characteristics of this factor are M = 3.8418, SD = 0.04290, Symmetry = -0.512, Kurtosis = 0.831.

The Kolmogorov-Smirnov test of normal distribution was performed for all three factors, and all three deviated from the normal distribution. Therefore, non-parametric tests were applied in subsequent data processing.

Results and interpretation

Teachers' assessments of their professionalism and professional development in practice
We sought to find out how teachers assess their own professionalism in practice. We were also interested in whether teachers show statistically significant differences in their assessment of their professionalism and professional development in practice at different stages of their careers. The Kruskal Wallis test analysed whether there was a statistically significant difference in the variables Professional Insecurity (χ^2 = 14.490, *df* = 5, *p* < .05), Professionalism (χ^2 = 18.425, *df* = 5, *p* < .05), and Room for Growth (χ^2= 28.109, *df* = 5, *p* < .05). It emerged that there are statistically significant differences between different groups of teachers with respect to their stage of professional development, which was determined based on the difference in the length of the teachers' years of service on all three variables. The Mann Whitney test was performed to determine which categories of teachers showed statistically significant differences.

With regards to Professional Insecurity, a statistically significant difference was identified between teachers with up to 3 years of service and teachers with 4 to 7 years of service (*U* = 57.500, *Z* = -3.846, *p* < .05), in the sense that teachers with fewer years of service (*M* = 28.26) experience higher levels of insecurity than those with more years of service (*M* = 11.42). Also, teachers with up to 3 years of service show a statistically significant difference in this feeling from the group with 8 to 15 years of service (*U* = 584.500, *Z* = 2.584, *p* < .05).

Teachers with up to 3 years of service (*M* = 52.29) feel more insecure than teachers with 8 to 15 years of service (*M* = 38.03). Teachers with up to 3 years of service also show a statistically significant difference from teachers with 24 to 30 years of service (*U* = 484.000 *Z* = -2.103, *p* < .05), whereby teachers with up to 3 years of service (*M* = 43.33) feel more insecure than teachers with 24 to 30 years of service (*M* = 32.8).

A statistically significant difference also emerged between teachers with 4 to 7 years of service and teachers with 16 to 23 years of service (*U* = 118.000, *Z* = -2.372, *p* < .05) and 24 to 30 years of service (*U* = 164.500, *Z* = -2.072, *p* < .05).

Moreover, teachers with 4 to 7 years of service experience a lower level of uncertainty (M = 16.08) than teachers with 16 to 23 years of service (M = 26.42). Teachers with 4 to 7 years of service experience less insecurity (M = 19.65) even in comparison to teachers with 24 to 30 years of service (M = 29.99). No statistically significant differences were recorded among other groups of teachers in the feeling of Professional Insecurity with regards to different years of service.

In terms of Professionalism, differences were identified between separate groups of teachers at different stages of professional life. A statistically significant difference emerged between teachers with up to 3 years of service and teachers with 8 to 15 years of service (U = 1000.500, Z = -3.020, p < .05), because teachers with fewer years of service (M = 45.29) feel a lower level of professionalism than those with more years of service (M = 63.87). Also, teachers with up to 3 years of service experience a statistically significant difference in this feeling from the group with 16 to 23 years of service (U = 683.000, Z = -3.572, p < .05). Even in this situation, teachers with up to 3 years of service (M = 38.53) experience a lower level of professionalism than teachers with 16 to 23 years of service (M = 58.84).

Finally, teachers in the first phase of professional life demonstrate a statistically significant difference from teachers with 24 to 30 years of service (U = 758.000, Z = -3.922, p < .05), in the sense that teachers with fewer years of service assess their professionalism with lower values (M = 40.13) than their colleagues with more years of service (M = 63.43). There were no statistically significant differences between other groups of teachers with respect to different stages of professional life.

More differences were recorded between different groups of teachers in the factor Room for Professional Growth than in the previous two factors.

Thus, statistically significant differences emerged between groups of teachers with up to 3 years of service and teachers with 24 to 30 years of service (U = 683.500, Z = -4.206, p <. 05) because teachers with fewer years of service (M = 65.64) feel there is more room for growth than teachers with 24 to 30 years of service (M = 40.99). Also, teachers with up to 3 years of service show a statistically more significant difference in this feeling than the group of teachers with over 30 years of service (U = 421.000, Z = -3.693, p < .05).

Furthermore, teachers with 4 to 7 years of service show a greater statistically significant difference than teachers with 24 to 30 years of service (U = 334.500, Z = -1.692, p < .05); teachers with fewer years of service (M = 46.32) feel that they have more room for growth than teachers with more years of service (M = 34.87).

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Teachers with 8 to 15 years of service show a greater statistically significant difference from teachers with 24 to 30 years of service ($U = 1167.000$, $Z = -3.350$, $p < .05$); teachers with fewer years of service ($M = 70.48$) feel there is more room for growth than teachers with more years of service ($M = 49.47$).

Furthermore, there are statistically significant differences between all groups of teachers in the sense that teachers show statistically greater differences with the previous phase of professional life as their years of service increase in the sense that they feel an ever-decreasing need for growth. Accordingly, teachers with 8 to 15 years of service also show a greater statistically significant difference from teachers with more than 30 years of service ($U = 689.000$, $Z = -3.104$, $p < .05$), whereby teachers with fewer years of service ($M = 56.06$) feel that they have more room for growth than teachers with more years of service ($M = 37.69$).

Teachers with 16 to 23 years of service show a greater statistically significant difference from teachers in the next phase of professional life ($U = 1115.500$, $Z = -2.099$, $p < .05$) and feel there is more room for growth ($M = 61.13$) than their colleagues with 24 to 30 years of service. However, teachers with 24 to 30 years of service feel there is more room for growth ($M = 48.40$) than teachers with more than 30 years of service ($M = 36.36$) and, according to the analysis, show a statistically significant difference in this regard ($U = 542.500$, $Z = -2.213$, $p < .05$).

No statistically significant differences were recorded in the feeling of Room for Growth in the earlier stages of the professional life of teachers.

Teachers' assessment of their science and technics competences
In times of rapid technological development, the scientific literacy of each individual is very important. Participation in a technical society requires an in-depth and critical understanding of technics and its impact on individuals, the environment and society. Therefore, the teachers' knowledge of these topics, didactic competence and positive attitudes to science and technics are of vital importance if they wish to encourage the scientific literacy of their students. We were curious to explore how teachers assess their science and technics competences and whether their assessments were statistically significantly related to the factors in professional development. Items were rated on a five-point scale; 1 – I strongly disagree; 2 – I disagree; 3 – I neither agree nor disagree; 4 – I agree; 5 – I strongly agree.

It is observable from Table 2 that ratings 4 and 5 are more represented than 1 and 2 in all the items of science and technics competences. However, it should be pointed out that the share for the rating 3 – I neither agree nor disagree - is high for all items and ranges from 26.4 % for "Teaching science and technics brings me professional satisfaction" to 46.2 % for "I find teaching scientific content challenging in terms of spatial and material conditions."

Rating 4 has the highest share (in terms of frequency) in four items:

- "Teachers should receive additional training in science and technics" (47.9 %), (rating 3 – 29.7 %, rating 5 – 17.4 %);

- "I am very capable of dealing with students' questions about science and technics" (46.8 %), (rating 3 – 38.2 %; rating 5 – 8.5 %);

- "I have sufficient content knowledge to be able to provide quality support to students in their research and project development" (51.4 %), (rating 3 – 36 %, rating 5 – 8.5 %); and

- "Teaching science and technics brings me professional satisfaction" (48.1 %), rating 3 – 26.4 %, rating 5 – 21.8 %).

Rating 3 has the largest proportion in two items:

- "I find teaching scientific content challenging in terms of the spatial and material conditions" (46.2 %) and

- "I do not feel competent enough while teaching science in class" (39.2 %). These are also items with a slightly greater representation of rating 2 (11.8 % and 31.8 %).

Teachers who assess themselves as Professionally Insecure (factor 1) give statistically significantly higher assessments of the item "I do not feel competent enough while teaching science in class," while no statistically significant differences were obtained for other items.

Teachers who assess themselves as Professional Experts (factor 2) assess the following items statistically significantly higher:

- "Teachers should receive additional training in science and technics" ($p = .000$);

- "I am very capable of dealing with students' questions about science and technics" ($p = .000$);

- "I have sufficient content knowledge to be able to provide quality support to students in their research and project development" ($p = .000$); and

- "Teaching science and technics brings me professional satisfaction" ($p = .004$).

On the other hand, the teachers assess the item "I do not feel competent enough while teaching science in class" significantly lower.

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Table 2: Relationship between teachers' assessment of science and technics competences and factors in teacher professional development.

Items	M SD	1 f (%)	2 f (%)	3 f (%)	4 f (%)	5 f (%)	Fact. 1 ρ p	Fact. 2 ρ p	Fact. 3 ρ p
Teachers should receive additional training in science and technics.	3.77 0.79	0.3	4.7	29.7	**47.9**	17.4	-.04 .570	**.20**** **.000**	**.16**** **.005**
I am very capable of dealing with students' questions about science and technics.	3.58 0.73	0	6.3	38.2	**46.8**	8.5	-.03 .712	**.32**** **.000**	.00 .894
I have sufficient content knowledge to be able to provide quality support to students in their research and project development.	3.64 0.69	0	4.1	36	**51.4**	8.5	-.09 .195	**.39**** **.000**	-.00 .923
I find teaching science content challenging in terms of spatial and material conditions.	2.57 0.94	1.9	11.8	**46.2**	33.0	7.1	.08 .221	-.02 .774	.16 .021
I do not feel competent enough while teaching science in class.	2.57 0.94	13.8	31.8	**39.2**	13.8	1.4	**.23**** **.001**	**-.15**** **.027**	.05 .391
Teaching science and technics brings me professional satisfaction.	3.87 0.81	0.9	2.8	26.4	**48.1**	21.8	-.14 .055	**.19**** **.004**	**.18**** **.009**

*Legend: Fact. 1– Professional Insecurity; Fact. 2– Professionalism, Fact. 3 – Room for Growth; r-correlation coefficient; * p < .05. ** p < .01.*

The item "I find teaching scientific content challenging in terms of the spatial and material conditions" is not statistically significantly related to factor 2.

Teachers who emphasize the value of Room for Professional Growth (factor 3) assess the following items as statistically significant:

- "Teachers should receive additional training in science and technics" ($p = .005$);
- "I find teaching scientific content challenging in terms of spatial and material conditions." ($p = .021$); and
- "Teaching science and technics brings me professional satisfaction" ($p = .009$).

Three factors were abstracted on the Scale by means of factor analysis with the aim for the teachers to assess their own professionalism and professional development in practice: Professional Insecurity, Professionalism, and Professional Growth. In conclusion, it was found that there is a statistically significant difference between different groups of teachers in their length of service with respect to the stage of professional development. Teachers with fewer years of service experience have a higher level of Professional Insecurity, and Professionalism than those with more years of service. In addition, statistically significant differences occur in the group of teachers with up to 3 years of service because they feel there is more room for Professional Growth.

Conclusion

The initial period of education is important in the development of the science and technics competence of an individual and the shaping of his/her relationship to science and technics.

The extent to which teaching in the first years of schooling (class instruction in Croatian schools, i.e., the first and second triads of nine-year Slovenian primary schools) will influence the development of science and technics literacy of children depends on the competence of class teachers and their readiness for lifelong learning.

Teachers' awareness of the importance of developing children's science and technics literacy, as well as their ability to organize quality teaching and stimulate student interests, is of paramount importance. In science and technics education, at the beginning of primary education, it is necessary to take into account the developmental level of students and the specifics of learning during this period, as well as the fact that the learning process must be based on the child's natural curiosity, on learning about the child's experience and knowledge, the encouragement of cognitive conflict, and scaffolding in the process of its resolution. In the process of solving a cognitive conflict and in the whole process of learning, teacher support is crucial.

To achieve quality learning, the teacher should enable the students to access knowledge through different paths, by using varied materials and doing different activities, which is especially important for younger students. Project work, problem-based learning, inquiry and experiential learning are all kinds of instruction in which technology is usually used in an authentic, i.e. real-life context, which makes instruction more relevant and interesting. Through these approaches, students gain a more thorough knowledge of science and technics. Consequently, they also have a positive effect on the students' attitude towards instruction. This requires the teacher to take care of his own professional development and gain confidence in teaching.

Therefore, the goal of professional development is the improvement of teaching practice and, consequently, the welfare of the pupils. It is a long-term process that involves continuing opportunities and experiences systematically designed for each teacher, depending on his/her background, interests, characteristics, and stage of professional development. In an ever-changing society, teachers cannot restrict themselves to the position and knowledge they currently have. Although teachers at particular stages of professional development show some differences, they all must possess the skill of constant adjustment, replenishment, and acquisition of new abilities and knowledge.

This is supported by the results of this research, revealing the peculiarities of each stage of teacher professional development in the field of technics competences.

We found that the teachers included in this research attribute high ratings to the meaning of science and technics competence development. As much as 63.3 % of teachers believe that additional teacher education is important or very important. They also assess their own qualification for teaching highly. The item "I am very capable of dealing with students' questions about science and technics" was given ratings 4 and 5 by 55.3 % of teachers, while the item "I have sufficient content knowledge to be able to provide quality support to students in their research and project development" was given ratings 4 and 5 by 59.9 % of teachers. As much as 79.2 % of teachers rated the item "I find teaching scientific content challenging in terms of spatial and material conditions" with ratings 4 and 5. We were pleased to find that 69.9 % of teachers believe that teaching science and technics brings them professional satisfaction.

Various studies show that enthusiasm in teaching a certain school subject and professional motivation affect teacher effectiveness and consequently student achievement (Kunter, Tsai, Klusmann, Brunner, Krauss, & Baumert, 2008; Kunter, Klusmann, Baumert, Richter, Voss, & Hachfeld, 2013).

In connection with the factors in professional development and the teachers' assessment of their science and technics competences, it can be concluded that those teachers who see themselves as Professionally Insecure show a statistically significantly higher assessment of their lack of competence in teaching science and technics content in the classroom. In addition, teachers who attribute importance to the factor Room for Professional Growth have a statistically significant understanding of the importance of education in the field of science and technicsand take pleasure in teaching science and technics.

Taking into account the high ratings of teachers' own qualification (ratings 4 and 5) and a fairly high share of rating 3 (undecided), it would be interesting to widen the scope of the research and add observation of instruction as well as a survey for students. It would also be valuable to perform interviews with teachers about gaining the competences in question and which factors influenced their professional development.

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