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Opportunities and Challenges in the Work of Natural Science Teachers During Online Teaching: Teachers' Beliefs and Attitudes

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Abstract. The COVID-19 pandemic has had a catastrophic impact on all sectors of the economy worldwide, including education. This led to the closing of schools, soon followed by online teaching that replaced traditional classroom teaching for the duration of the pandemic. This case study is relevant to examining natural science teachers' attitudes and beliefs about online teaching and the challenges they faced during the pandemic. Data were collected using standardized, open-ended interviews with six outstanding natural science teachers from elementary schools. In this article, we explore the work-related challenges and opportunities experienced by outstanding teachers because of the COVID-19 pandemic and the introduction of online teaching. The results of the study show that teachers are open to changes and express relatively positive attitudes and beliefs about online teaching during the COVID-19 crisis, such as using a variety of digital tools during online teaching and after returning to classroom teaching. They are developing and improving their digital competences as well as their self-reflection skills, which give them the space they need to reflect consciously and deeply on their teaching. However, they encounter various obstacles to teaching online, such as technical difficulties, difficulties in assessment, excessive parental involvement in children's work, etc. The efforts to develop personally and professionally improve the quality of pedagogical work, including distance learning, and contribute to the development of teachers' professional identity. The limitation of this study is relatively small group of teachers who participated in the research, i.e., only six of them.
Keywords: online teaching, COVID-19, natural science teachers

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Gamtos mokslų mokytojų darbo galimybės ir iššūkiai mokant nuotoliu: mokytojų įsitikinimai ir nuostatos

Santrauka. COVID-19 pandemija turėjo katastrofišką poveikį visiems pasaulio ekonomikos sektoriams, įskaitant švietimą. Dėl to buvo uždarytos mokyklos, o netrukus prasidėjo mokymas nuotoliu, kuris pandemijos metu pakeitė tradicinį mokymą klasėje. Ši atvejo studija padėjo ištirti gamtos mokslų mokytojų požiūrį ir įsitikinimus apie mokymą nuotoliu bei iššūkius, su kuriais jie susidūrė pandemijos metu. Duomenys buvo renkami naudojant standartizuotus, atviro tipo klausimų interviu su šešiais ypač talentingais gamtos mokslų mokytojais iš pradinių mokyklų. Straipsnyje nagrinėjami mokytojų išskiriami su darbu susiję iššūkiai ir galimybės, atsiradusios dėl COVID-19 pandemijos ir prasidėjusio nuotolinio mokymo. Tyrimo rezultatai rodo, kad mokytojai yra atviri pokyčiams ir išsako gana teigiamą požiūrį į nuotolinį mokymą COVID-19 krizės metu, pavyzdžiui, jie naudojasi įvairiais skaitmeniniais įrankiais mokydami nuotoliu ir vėliau vesdami pamokas gyvai. Jie tobulina ir lavina savo skaitmenines kompetencijas bei savirefleksijos įgūdžius, o šie suteikia jiems erdvės sąmoningai ir giliai apmąstyti mokymo procesą. Tačiau mokydami internetu mokytojai susiduria su įvairiomis kliūtimis – techniniais sunkumais, vertinimo sunkumais, pernelyg dideliu tėvų įsitraukimu į vaikų darbą ir kt. Pastangos tobulėti asmeniškai ir profesionaliai gerina pedagoginio darbo, įskaitant nuotolinį mokymąsi, kokybę ir prisideda prie mokytojų profesinio identiteto formavimo. Šio tyrimo ribotumas – santykinai nedidelė tyrime dalyvavusių mokytojų grupė (tik šeši mokytojai).
Pagrindiniai žodžiai: nuotolinis mokymas, COVID-19 pandemija, gamtos mokslų mokytojai

1. Introduction

The world, and by extension the education system, is constantly facing rapidly growing changes that impose new questions and challenges on teachers. Teachers are not required to know all the answers but need to become agents of change because they are responsible not only for their development but also for the development of their school and the entire education system (Labone & Long, 2016). Among other things, they must continue learning how to ask important questions, develop new perspectives, clarify hypotheses, and collaborate with colleagues to develop ways to improve student learning outcomes. The additional challenge was introduced when the education and teachers faced the COVID-19 pandemic and all the related effects.

Day (2016) defines an effective teacher as someone who possesses academic optimism, hope, trust, and a strong sense of morality, as well as the knowledge and skills needed to foster students' active engagement, support the realization of their potential, and nurture the love of learning. Teacher's quality is a complex concept that needs to be considered in the context of political, social, professional, and personal contexts, and is often associated with an outcome-oriented perspective (Flores, 2019). In this sense, teachers as professionals are expected to have strong fundamental knowledge and advocacy for the interests and needs of their students, strong individual and collective identities, and autonomy at work (Day, 2017).

Online learning, also referred to as virtual learning, cyberlearning, and e-learning is a form of learning in which students are not physically present in the classroom and the learning process is realized via the internet (Schwirzke, Vashaw, Watson, 2018). Online learning requires a commitment to the principles of online learning so that teachers can create and maintain an instructional, social, and cognitive presence. Their success is demonstrated by encouraging and facilitating active communication, interaction, cooperation, and students' engagement throughout online classes. Therefore, they should

possess characteristics such as high motivation, organization, analytics, accessibility, flexibility, openness, and understanding (Keengwe, Schnellert, Kungu, 2014; Albrahim, 2020). Preparing to online teaching is a challenge for any science teacher because it focuses not only on the implementation of online learning but also on the implementation of practical activities in learning science, which is one of the most important characteristics of this subject (Wisanti, Ambawati, Putri, Rahayu, Khaleyla, 2021).

When considering online classes, there are two key points to consider: technological competence and access. Technological competence implies the teacher is technologically literate, i.e., able to use digital devices and applications to deliver virtual classes (De la Rama et al., 2020). Online education initiatives include the use of synchronized online communication and online learning activities within a virtual learning platform and also ensure the continuity of teaching and learning from anywhere without interruption. However, technology alone does not guarantee an effective learning experience. This can only be achieved through systematic training initiatives that clearly define the principles of teaching and learning that institutions expect from their teachers and students (Vlachopoulos, 2020).

2. Theoretical framework

Hughes (2014) states that our society faces difficult and complex problems, such as unsustainable demographic and environmental factors, poverty, global economy, corruption, and, simultaneously, unstoppable breakthroughs in technological and scientific progress. The task of the educational system in the face of such global challenges is to encourage students to solve problems, search for arguments, draw credible conclusions, deal quickly with unpredictable situations, make decisions, and exercise creativity, respect, and flexibility. Since the main issue nowadays is learning how to learn, learning to live together and adapt, the author emphasizes that critical thinking imposes itself as an important pedagogical response. Therefore, it is imperative that as many students as possible develop critical thinking skills during their education, because that will prepare them for daily challenges and opportunities. Schools, as educational institutions, can support student development through coherent and well-integrated support, by creating a classroom community in which students affirm and learn social responsibility, and by aligning family and school values with cultural values. Such multifaceted approaches to developmental relationships foster the trust, security, and sense of belonging necessary for student engagement in all school activities (Darling-Hammond, Flook, Cook-Harvey, Barron, Osher, 2020).

When considering teachers' competencies from a lifelong perspective, Vizek Vidović & Domović (2013) emphasize the understanding of key competencies that contribute to changing the role of teachers. It is manifested in the shift from dealing with the content of the subject to managing the learning process in the classroom and successfully responding to the learning needs of each student. The authors classify them into competencies related to the classroom environment (teaching in a multicultural environment, successful integration of students with special educational needs, professional orientation and

guidance of students for their future careers), competencies related to the organizational level of the school (teamwork, collaboration with colleagues, and school management), adequate social competencies, commitment to continuous professional development, the ability to reflect on one's practice, and competencies necessary for active participation in the formation of educational policies and the application of new practices.

The *European Commission* (2013) defines teaching competencies as a complex combination of knowledge, understanding, values, and attitudes that lead to effective action in different situations. At the same time, it emphasizes the importance of continuous professional development for teachers to improve pedagogical performance and effectiveness and strengthen teachers' teaching competencies. Supportive and empathic relationships between students and teachers are associated with better student engagement in school, greater emotional control, social competence, and willingness to face challenges (Osher, Cantor, Berg, Steyer, Rose, 2018). Sprott (2019) notes that teachers experience the development of 21st-century teaching skills and global competencies by engaging students as collaborators in professional development, visiting other teachers in the same school or outside of school, developing foundational and lasting professional relationships, and working in professions outside of the education system. Albrahim (2020) emphasizes the importance of identifying online teaching skills and competencies that can help teachers work in an online environment. These skills and competencies are classified into six categories: pedagogical skills, content skills, design skills, technological skills, management and institutional skills, and social and communication skills.

Research by DeCoito & Estaiteyeh) (2022) shows that teachers use a variety of platforms for online classes and that the choice of the platform is based primarily on ease of use and interactivity. Instructional strategies include pre-recorded videos and individualized learning, where teachers assign students specific tasks to complete independently. Although most teachers felt they had a high level of competence in online teaching, they struggled to combine their technological, pedagogical, and subject-specific knowledge. Challenges such as lack of quality teaching and assessment resources, lack of training, difficulties in student access to online teaching, and ICT literacy affected teachers' attitudes toward online teaching, which in turn negatively impacted their pedagogical practices. Subsequently, De la Rama et al. (2020) found that teachers' positive attitudes toward virtual classes helped to create a positive online environment that was useful for students, which also promoted their motivation for online learning. It was also found that teachers' positive attitude towards virtual science classes is related to their competence in using technology. Teachers are important stakeholders in education and their attitude toward the implementation of e-learning (i.e. virtual/online classes) has a significant impact on students' attitudes toward it.

A study conducted by Wu (2021) shows that elementary school teachers most often use self-made videos and presentations during class and use a variety of interactions in online classes. They frequently assign tasks to students, regardless of the learning phase, and encourage video/audio discussion using synchronous and asynchronous methods, as well as assessment of effectiveness. The discussion proved to be a more important

factor in online classes than in face-to-face classes. Teachers' technical capabilities for online teaching, students' familiarity with digital platforms, the software and hardware, and the support provided by the school information center can greatly influence the quality of e-learning. The author suggests that teachers should consider in advance how to respond to the challenges of implementing hands-on and experimental activities in online classes, as they are very important. Therefore, it is suggested that teachers organize asynchronous activities after class in addition to synchronous activities during class so that students can carry out learning activities at home.

Wisanti et al. (2021) cited the lack of experience in delivering online classes and the availability of an internet connection and appropriate equipment for students as the main difficulties. In addition, it was a major challenge for teachers to motivate students to learn online. They had difficulty in helping students learning online to understand scientific concepts. It was found that teachers overcame the challenges by using active learning, using multimedia, talking to parents, and communicating with each student one-on-one. Similar findings were made by Türkmen & Öntürk (2021), who also highlighted internet connectivity, infrastructural hardware problems, and the inability to discipline students, as well as noise emanating from the home environment, as the biggest obstacle in online teaching. Teachers' rapid transition to online teaching without sufficient knowledge and a clear vision has led to a sense of inadequacy, especially among teachers who lack experience in using technology because they cannot conduct experiments for their students in online classes. In fact, science lessons should be experiential and conducted through experiments, which was not possible because students only watched and did not actively participate in conducting the experiments.

3. Method

The aim of this study is to examine the opportunities and challenges in classroom practices of natural science teachers, as well as their personal beliefs and attitudes during online teaching. For this study, we were guided by the following research question: What challenges and opportunities do natural science teachers face in online teaching during the pandemic?

3.1. Participants

The research was conducted as a case study involving 6 female teachers working in seventh grades of different elementary schools in the eastern part of Republic of Croatia. They were chosen deliberately, by the method of voluntary consent during the professional development program. As part of this professional development program, participants collaborated in an online learning community established through the Zoom application. This collaboration aimed to improve practice by analyzing videos of their teaching. The professional development program lasted one year with an interruption during the lockdown due to the coronavirus pandemic. All six teachers are mentors or advisors. More precisely, the sample is deliberately homogeneous, which is manifested

in the subject participants teach as well as in their mentor/advisor status. So, female teachers are not part of the typical population sample. The validity of the case study is not derived from its representativeness because it is not a representative sample from a larger set. Instead of typicality, the concept of participant selection is based on the dynamics of the relationship between the sample (subjects, i.e., participants) and the context, i.e., the analytical framework within which the case is observed (Thomas, 2011).

3.2. Research instrument

The survey was conducted between January and July 2020. The research used a standardized open-ended interview with the questions constructed and designed for this research particularly. According to Patton (2015) this type of qualitative interview "consists of a set of questions carefully worded and arranged with the intention of taking each respondent through the same sequence and asking each respondent the same questions with essentially the same words" (p. 645). In our research each participant was allowed to respond in their words without being given preconceived answers. The interview was conducted with each teacher in three interview cycles. The first interview was conducted in January/February 2020, the second in April 2020, and the third at the end of the school year (June/July 2020). A total of 18 interviews were conducted. The audio recordings and transcripts of the interviews remain on the researcher's hard drive. Researchers used video camera to record lessons, which teachers later reviewed and analyzed.

3.3. Ethical considerations

Before the research began, the aim and purpose of the study were explained, and written consent was obtained. Teachers' names remained anonymous to ensure the privacy and confidentiality of the data. Instead of names, labels were used to distinguish each research participant. At the same time, the exact names of the institutions where the research was conducted were avoided. Study was given ethical clearance by school principals and participant teachers.

3.4. Data analysis

After the initial coding, the data is coded through an open coding procedure that refers to assigning a label to a part of the text to describe and categorize that part of the text. In this way, we obtained situational codes, activity codes, event codes, strategy codes, relationship codes, etc. (Cohen, Manion, Morrison, 2018). The obtained codes were grouped into categories according to thematic criteria (Creswell, 2012). Subsequently, all data within themes that were overlooked in the earlier stages of coding were coded. Re-coding a dataset is not unexpected, as coding is a continuous and systematic process. Such thematic analysis summarizes the most important features of a large amount of data and provides a comprehensive description of the dataset (Braun & Clarke, 2006). Coding was done "manually" by the researcher, without the use of a qualitative data analysis

program. Data analysis included categorizing the data into three descriptive categories: coping with online teaching, readiness to work in crises, and student learning outcomes.

4. Results

4.1. Coping with online teaching

The COVID -19 pandemic that afflicted and burdened the educational system put teachers in an extraordinary situation to which they had to respond by changing their teaching methods. They were faced with completely new challenges, to which they adapted to the best of their abilities. Most of the teachers express satisfaction with the different competencies they have and that they need for their work. They have learned to use different digital tools in their teaching. Considering the fact that they have encountered some digital tools for the first time in new circumstances, the teachers assess their own competencies and their use in teaching relatively satisfactory.

Table 1. *Category "4.1 Coping with online teaching"*

CODES	CATEGORY
Self-reflection	Coping with online teaching
Interaction with students in online teaching	
Challenges in online teaching	
Student participation in distance learning	
Digital competencies	

Self-reflection

While watching videos of their classes, teachers notice some irregularities in their work. They mostly point out that they are critical of their work, and all notice the possibilities for certain changes. Some changes are related to attitudes toward students, others to specific elements of teaching, i.e., the teaching process. However, teachers often state that they need to pay more attention to peer assessment and self-assessment in the classroom to provide quality feedback. From this, we can conclude that teachers are open to changes they would like to make themselves, as well as suggestions from other colleagues that they find useful.

> "*I often find myself counting the fillers I use or watching my gestures and movements, but I soon let that go and focus on the pedagogical aspect of filming. I think watching these videos has made me more aware of my communication with students – I should include some of them more often in the process/tasks at hand and allow more time for answering the question to others*." (Teacher 3, Interview 2)

> *"I need to be a bit more relaxed. I see certain hiccups that I can straighten out in the following classes. When I think about how my class were, I miss some parts that I only become aware of after watching the video of my class. Also, the comments from other colleagues help a lot in guiding my work in a certain direction for the preparation of the next classes." (Teacher 4, Interview 2)*

Interaction with students in online teaching

Teachers' interaction with students during online teaching is limited to verbal communication. It is perceived by teachers to be of lower quality and weaker effect than under normal working conditions. They emphasize that they work hard to be accessible, provide feedback, and support students. They also state that they have tried to motivate students by encouraging communication, but this has not been successful with some students. On the other hand, some students did not hesitate to communicate in writing outside the scheduled class time. It is evident that the shift of direct communication to the virtual world resulted in the disruption of the social aspect of teaching and social contacts. This is especially evident in the absence of real contact and emotional expressions that existed in the real classroom.

> *"The interaction is much more modest, only words, no visual element, no non-verbal communication."* (Teacher 2, Interview 3)

> *"Online interactions with students were of lower quality compared to regular classes. For any activity, assignment, or feedback, students could respond and ask for clarification at any time, but only a small number of students did so. I tried several times to communicate with some of them but to no avail.*" (Teacher 4, Interview 3)

Challenges in online teaching

With the outbreak of the COVID-19 pandemic, students faced various and complex challenges and needed to adapt as best they could. Teachers cite encouraging and ensuring student participation in online teaching and the over-involvement of parents in their children's work as the most important challenges under the given circumstances. They also cite technical difficulties and organizational difficulties in planning and delivering lessons. According to the teachers, they mostly solved these challenges through communication (written and verbal) with the students or through the mediation of the class teachers. Although this form of teaching caught teachers, students, and parents off guard, they had to master both teaching and learning overnight. The challenges of online classes made teachers' work much more difficult, but on the other hand, they also became an integral part of the newly created situation in which they had to learn to navigate.

> "*Some of the challenges are including all students in the teaching process and not assigning too many tasks. It was very difficult to see my students on the screen, look them in the eyes, and yet remain helpless. (...) Every time I thought I could have done something differently and better. I also wondered whether they really understood the material I was trying to teach them. My way of coping included a lot of written correspondence, conversation, exchange of information*." (Teacher 5, Interview 3)

Student participation in distance learning

Teachers assess the involvement of students in distance learning as satisfactory. Naturally, the resulting circumstances suited some of the students more, and the others less. Apart from motivation, other difficulties had to be considered, such as various technical

difficulties as well as the conditions in which students live. The teachers show understanding for this but note that students' involvement is not always lacking for legitimate reasons. Most teachers feel that majority of students take their duties seriously and participate regularly. Some consider students' participation diffused, periodic, and only half-present. On the other hand, they state that these students are often passive in traditional classes as well. It should be remembered that some students are quiet and withdrawn. For them, therefore, it is better to learn in the virtual classes, where they are comfortable at home in an environment that is familiar to them.

> "*Most of the students fulfilled their tasks responsibly and conscientiously. (...) We had to consider the living conditions of the children who did not engage. Some had good reasons, so we agreed on deadlines and were happy to meet the minimum requirements, while others simply did not want to work and did not give a legitimate excuse*." (Teacher 6, Interview 3)

> *"Most of the students were active, a smaller part was not, but there were issues with these students in other subjects as well."* (Teacher 4, Interview 3)

Digital competencies

The use of appropriate digital tools is not a novelty in online teaching, as teachers have also used these tools in classroom teaching. Therefore, teachers usually assess their competence in using digital tools well under the given circumstances. They explored different tools to make the lessons as interesting as possible and tried to facilitate the learning process for the students. They mostly used the tools they thought best for the students and themselves. When necessary, they sought help and advice from colleagues and students. While some teachers have only used them as much as they needed to prepare and deliver lessons, it is important to realize that there is always room to introduce new tools.

> "*I have mastered and am proficient in several tools. Students also respond well to them. I would like to learn more to make work in the virtual classroom easier for them and me. However, students tend to get confused by the excessive variety of tools*." (Teacher 1, Interview 3)

> *"I think I'm very good at using digital tools. I got to know a lot of different tools and chose the ones that suit me, and for the rest I know when and how I can use them additionally. Using the tools was the least of the problems in online classes."* (Teacher 4, Interview 3)

4.2. Readiness to work in crises (during lockdown)

The coronavirus pandemic has created new types of challenges for teachers, particularly with the shift of teaching from classrooms to family homes and the lockdown in which the country found itself. The new circumstances of some teachers caused them to rethink their life values. On the other hand, the need to adapt to the virtual environment led, in some cases, to an increased workload that directly affected their personal lives. Teachers have been forced to reorganize their work and personal lives according to the new conditions. As a result, the experience of distance education has led to a rethinking of how to plan and deliver classroom teaching in the future. Teachers emphasize continuous investment in lifelong education and one's own professional development.

Table 2. *Category "4.2 Readiness to work in crises (during lockdown)"*

CODES	CATEGORY
Life in lockdown	Readiness to work in crises (during lockdown)
Attitudes and beliefs	
The effect of online teaching on future work	
Private obligations	

Life in lockdown

The lockdown, transition to online teaching, circumstances, and crisis caused by coronavirus affected teachers' private lives as well. Quarantine at home does not suit anyone, but the interviewed teachers found some positive aspects in it. They were able to spend more time with their families and devote themselves more to their hobbies, such as sports. This is where work overload occurs, especially in the new virtual environment. Distance teaching brings other types of commitments and new challenges for teachers that take more time than classroom teaching. For teachers who are also mothers, it was a challenge to combine work duties with helping their children with distance learning. It is interesting that no one seemed to be overly afraid and concerned with the health side of the pandemic. They were trying to balance their professional and personal lives as best they could with the new situation.

"*I spend more time with my family, but at the same time I spend more time on the computer (to prepare classes and complete other assignments). To some extent, I like quarantine, but I don't like restrictions regarding movement. Nevertheless, prevention is important, so I don't think it's that bad because I spend more time in nature* (*local promenades, forests, etc.*)." (Teacher 3, Interview 2)

"I don't like to be indoors, i.e., always at home, so it's a bit difficult for me because I miss my walks and sports, and above all, working in the classroom. We are all at home and planning our day as best we know how. I get up early, do my work in the virtual classroom, answer students' questions, help with homework, plan lessons for tomorrow. I take a break and check my children's work in their virtual classrooms and after that I return to my school duties. I manage to take an hour off and go for a short walk with my family" (Teacher 1, Interview 2)

Attitudes and beliefs

Their efforts invested in the development of personal and professional progress improve the quality of educational work and contribute to the development of their professional identity. The teachers' statements show that investing in their professional development is particularly important to them. Some of them consider it a duty, even during online teaching. We believe that teachers' motivation and desire for regular professional development strongly contribute to this. In fact, such a long-term investment in their professional development helped them during online teaching. It provided them with new insights and easier access to learning resources where they found working materials and

tools for teaching. As circumstances change, it is necessary to follow trends. Therefore, regularity and continuity are key factors in professional development.

> "*I am always eager to invest in my professional development. I believe this is the duty of every person.* (Teacher 5, Interview 3)
>
> *"I continuously invest in my personal professional development and if 1 day lasted 48 hours, it would still be too little for me."* (Teacher 1, Interview 3)

The effect of online teaching on future work

According to the teachers, online teaching encouraged them to use a variety of digital tools in their future work. Under the circumstances, they had the opportunity and the need to familiarize themselves with these tools, so they found and used the ones that suited them best. The teachers also realized that they should use these tools in their classroom teaching. More importantly, teachers are considering changing assessment methods in the classroom because they discovered new ways to get feedback faster.

> "*To use digital tools more. Now we all have more experience and practice*." (Teacher 6, Interview 3)
>
> "*I liked some of the tools for written exams (they reduce the amount of paper and make correction easier). I would like to use certain tools during revision*." (Teacher 3, Interview 3)

Private obligations

Considering the time, they need to prepare and conduct online classes, teachers state that they usually manage to keep up with their private daily commitments. They emphasize that it was difficult to balance their personal and professional lives at first (until they got used to the new way of working and organized their responsibilities), but that it became easier later. We found that their personal and professional lives were intertwined every day, including weekends. During the lockdown, teachers often completed more work tasks In addition, some teachers are even more engaged in the professional part of their lives during the lockdown than with the personal part.

> "*It was difficult at first, but later I set a certain work rhythm so that I could schedule time for online teaching and use the rest of my time for personal commitments*." (Teacher 4, Interview 3)
>
> "*We adapt in a way, but I'm definitely much more dedicated to work than family.*" (Teacher 2, Interview 3)

4.3. Assessment and evaluation

A new way of monitoring the teaching process, and thus learning, brings new opportunities for interaction between teachers and students. Under these circumstances, students respond in different ways. For some, engagement, motivation, and interest in the work wane, while for others this form of work appeals. Under such conditions, teachers find it difficult to assess student learning outcomes that they have established themselves. They

often have difficulty judging the authenticity of certain activities they have assigned to students. For this reason, it was difficult to observe the changes that could/should have taken place in the students or in the teaching practice.

Table 3. *Category "4.3 Assessment and evaluation"*

CODES	CATEGORY
Evaluation	Assessment and evaluation
Interpreting students' learning outcomes	
Assessment of learning outcomes at the end of the school year	

Evaluation

The teachers agree that it was all but easy to assess and evaluate students in online teaching. However, most of them think that they did a good job in this regard, especially because they established clear criteria in advance. It was difficult to assess the students mainly because of the excessive involvement of some parents who completed assignments instead of their children. Regardless of what online courses are all about, assessment has proven to be an important element of the teaching process because it provides students with clear direction about their performance and progress and what is required of them. One can also see the skepticism of teachers about treating all students correctly, and they are afraid that no one will be left out. The more courageous and motivated have managed to conduct both peer evaluation and self-evaluation under new teaching conditions.

"*I believe that I am competent to assess and evaluate students because I have set clear criteria for evaluation and assessment at the very beginning of online teaching. I just don't know who I am grading*." (Teacher 1, Interview 3)

"*It is difficult to assess in a virtual environment. I gave them quizzes in real time, practical work, then we met on Zoom where they presented their conclusions, assessed each other and themselves. Finally, the grades were very similar to those they get in the classroom, some of the students made exceptional progress, and a small number of them did not quite manage."* (Teacher 1, Interview 3)

Interpreting students' learning outcomes

Analyzing and interpreting students' results is quite complex in a virtual environment. This can be affected by various factors: technical difficulties, additional involvement of teachers, involvement and activity of students, etc. Most teachers attempted to accomplish this by providing feedback on student work and progress and by discussing the results of students' performance with them. At the same time, some teachers note the importance of their agility and affirmative statements when providing answers to students. It is certain that the teacher's feedback is more often time-shifted in online

classes, is important because it provides control over the process of message exchange and interaction between the teacher and students.

"*I tried to assign different types of tasks/projects/problems to keep the necessary elements in teaching. We analyzed the tasks incorporating students' feedback with my feedback (columns, assessment grids, exit cards, etc.).*" (Teacher 3, Interview 3)

"*By communicating via Zoom, we were able to express and analyze the mentioned elements with the students as much as possible. Students prefer communication via Zoom to written correspondence.*" (Teacher 5, Interview 3)

Assessment of learning outcomes at the end of the school year

Teachers roughly assess, i.e., analyze the elements they have cited as outstanding learning outcomes of their students (motivational and interest aspects, as well as elements of higher levels of cognitive processes). They lack direct contact with students to ensure that all their work is the result of independent effort. For some students, the motivation decreased over time or was not even noticed, for some it was of the usual intensity as in the classroom, and for some it even increased. Teachers state that student motivation is diffused during online teaching. Shy students who are usually reluctant to engage in classroom teaching have clearly shown greater potential with this form of learning. It is evident that teachers invested additional efforts to encourage and maintain the motivation of their students.

"*I graded their Science and Biology projects; their assignments included connecting facts to real life. Some students were motivated throughout the online teaching, while others did not turn in a single assignment*." (Teacher 6, Interview 3)

"*Students' motivation and interest was good in the beginning. Of course, students who worked independently before the online classes continued to do so. But as time passed, their motivation (not everyone) slowly waned. I tried my best all the time, with motivating messages, calls, jokes, sometimes with harsher words, but all in their best interest.*" (Teacher 1, Interview 3)

5. Discussion

When the COVID-19 pandemic broke out, it put a strain on the education system and forced teachers to quickly adapt to the new situation. They had to respond by changing the way they learn, teach, and communicate. They learned to use numerous digital tools in their teaching. They also faced entirely new challenges, to which they adapted as best they could. Although teachers were able to devote time to their family lives and hobbies, they were preoccupied with the burden of professional obligations that required additional engagement in the virtual environment. This is indicated by the research findings (Sablić, Klasnić, Škugor, 2020), which show that teachers spend a lot of time planning and preparing distance learning, assessing students' work, studying, and implementing new digital tools. On the one hand, teachers spend more time with their families, and on the other hand, they spend more time on the computer as the volume of their work

increases in parallel. This is confirmed by the research findings (Aperribai, Cortabarria, Aguirre, Verche, Borges, 2020) that show that changes in work practices determine changes in teachers' family lives. Flores & Gago (2020) find that most teachers report an increase in their work hours and overtime compared to traditional classroom teaching. The lockdown led to complications in teachers' lives. This is reflected in more hours that teachers need to prepare and conduct online teaching, difficulties due to the lack of physical contact, and obstacles in balancing professional responsibilities with family.

During the lockdown, teachers focus more than ever on interacting and collaborating, contributing more to their social and emotional needs (Darling-Hammond & Hyler, 2020). Carrillo & Flores (2020) state that creating a stimulating learning atmosphere is the result of collaboration, interactivity, mutual respect and interdependence, and shared values, which provide emotional support, mitigate feelings of isolation, and increase teachers' confidence and enthusiasm.

Considering that teachers use a variety of digital tools in preparing for virtual classes that contribute to class dynamics and student activities, we conclude that this helps them determine student learning outcomes in the virtual environment, despite the difficulties of implementation. Teachers chose digital tools to stimulate students' interest and participation as well as the dynamics of the teaching process. This leads to further changes in their thinking about the future of classroom teaching in the context of using a variety of digital tools. Knowledge of information and communication technology (ICT) and the application of digital technologies in the classroom (Caena, 2014) is becoming a fundamental skill for teachers as the educational environment inevitably expands to the virtual world (Wang, 2019).

Even though teachers are considered competent for pedagogical work, they emphasize the need to develop the necessary skills to work with students, with family and social problems, but also to improve in the methodological and didactic field. This shows their awareness of the need to continuously develop important pedagogical competencies (Vizek Vidović & Domović, 2013). The teacher's communication skills helped them to overcome the difficulties in identifying and interpreting the results in the virtual environment. Empathy is particularly emphasized as an important social competence. The teachers understand the conditions under which students work during distance learning and the difficulties they encounter (Wang, Kim, Lee, Kim, 2014). This has certainly encouraged them to use various motivational practices in teaching to make it more accessible and interesting for students. This leads to teachers' satisfactory assessments of students' activities and the regularity of distance learning. This is also supported by Osher et al. (2018) who claim that supportive and empathetic student–teacher relationships are associated with better student engagement in school.

Despite the difficulties in implementing assessment in virtual classrooms, teachers generally rated their competencies as good under such conditions, which helped them interpret students' results. Reflecting on the potential impact of online teaching on their future work, they recognize the need to adapt the in-class assessment and do so accordingly. They have also improved their digital literacy competence, i.e., their knowledge

of how to use different ICT tools in teaching, which they consider to be good. They have previously emphasized that they need additional training in this area. The research findings (Bubb & Jones, 2020) show that 80% of the teachers surveyed believe that they have become better at using digital tools and technologies or already have well-developed ICT skills while teaching online from home. As a result, they continue to consider using a variety of digital tools after returning to classroom teaching. This is consistent with the findings of a study by van der Spoel, Noroozi, Schuurink, van Ginkel (2020), who found that post-pandemic teachers intend to integrate technology significantly more into their teaching because they believe it will increase teaching effectiveness, lead to greater differentiation and individualization of instruction, and improve student motivation.

(Self-)reflection of teachers is important to assess their practice and possibly adjust their activities, i.e., changes that can lead to better teaching (Gröschner, Schindler, Holzberger, Alles, Seidel, 2018). This especially refers to "video-based reflection on their own teaching, rather than viewing others' practice" (Peralta, Bennie, Gore, Lonsdale, 2020, p. 368). Although teachers analyze their teaching in professional learning communities rather than independently (Sablić, Mirosavljević, Škugor, 2020), the opportunity for self-reflection has helped to change teachers' perceptions of their work practices. By observing their current situation to maintain or improve their practice in the future (Winch, Oancea, Orchard, 2015), teachers find room for personal growth. Although they originally thought they should work on developing their didactic-methodological skills, they focused on acquiring and developing digital skills while teaching online. They integrated various digital tools into their work to make the lessons more dynamic and accessible to the students. Considering that we interviewed six highly motivated teachers who hold the status of teacher mentor or advisor, it is logical that their beliefs about investing in their professional development and their attitudes about the importance of ongoing professional development were very positive. As such, teachers are generally open to further change and continuous improvement. This is supported by the claim that continuous professional development is seen as a key strategy for improving learning and teaching (Frost, 2012). On the other hand, the overall investment in professional development, as well as all related activities, affects teachers' (im)balance between their personal and professional lives. Apparently, they were not unduly distracted by family responsibilities, which are usually seen as an obstacle, especially for female teachers (Krille, 2020).

Teachers' skills are enriched by the ability to self-reflect. Accordingly, research (Hollingsworth & Clarke, 2017) emphasizes the video as a means to promote teacher self-reflection because one's videos and classroom recordings of other teachers provide opportunities to consider and analyze classroom practice in different ways, offering many opportunities for teacher learning and professional development. Teachers are familiar with observing their work, which leads to the development of self-criticism. As Verhoef, Coenders, Pieters, Van Smaalen, Tall (2015) have noted, they become aware of their shortcomings in working with students and realize how they can improve. Through self-reflection, i.e., a critical review of their work, teachers recognize opportunities to change their teaching practices. Similar findings are made by Lebak (2015), who concludes that

interaction with other teachers, self-reflection, and examples of teaching videos allow teachers to think more deeply about the way they teach and lead to new approaches to teaching and changes in student learning outcomes.

6. Conclusion

The demands resulting from the radical changes in living conditions caused by the COVID-19 pandemic have a turbulent effect on both students and teachers, leading directly or indirectly to changes in their work. Teachers express relatively positive attitudes and beliefs about coping with online teaching and distance learning. However, they encounter various obstacles in online teaching such as technical difficulties, assessment difficulties, excessive involvement of parents in their children's work, etc. Developing teachers' digital skills in distance learning is essential for effective work. Changing the teaching process indirectly changes the way teachers think about using various digital tools after returning to classroom teaching. It seems that the use of digital tools in the classroom strongly influences teachers' work because they improve and increase their digital competencies, i.e., their knowledge of how to use different ICT tools in the classroom. Although teachers' pedagogical competencies, especially social, emotional, and communication competencies, are well developed, they need to be constantly strengthened and improved. During the crisis caused by the COVID-19 pandemic, which affected the education system on a large scale, the need for the digital transformation of schools and the adaptation of the system to the changes in information and communication due to the new learning and teaching environment became clear. Therefore, financial resources are needed to support the further development of digital infrastructures and teachers' digital skills and competencies.

Using exemplary teaching practices, teachers learn, get practical ideas they can apply in their further work, and consider their way of teaching. Using instructional videos to facilitate self-reflection provides teachers with the space they need to reflect on their teaching and encourages the development of self-criticism consciously and deeply. Their efforts invested in developing their personal and professional progress improve the quality of their pedagogical work, even in online teaching, and contribute to the development of their professional identity. The results obtained should encourage teachers to actively participate in professional development. However, it is important to note that this research is limited to six case studies. Therefore, the findings cannot be generalized.

Our work addresses some of the suggested research focuses concerning the professional development of teachers during / after the COVID-19 pandemic and establishes promoting teachers' active participation in developing approaches and tools to address learning losses and opportunities emerging from the pandemic as one of the key issues that also need some future research.

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