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Marina Diković, Monika Terlević

DIGITAL COMPETENCE IN INITIAL (PRESCHOOL) TEACHER EDUCATION

Education is currently undergoing a digital transformation at all levels. Future preschool teachers should be subjected to teaching methods that enhance their digital literacy, which indicates the importance for university teachers to increasingly incorporate ICT into the curricula. Therefore, the aim of this research was to analyse the presence of digital competence in the Croatian initial preschool teacher education studies' course syllabi. A qualitative content analysis of a total of 964 course syllabi was carried out, following the model of Sillat et al. (2017). The implementation of digital literacy was examined in terms of required competencies, course objectives, course content, learning outcomes, teaching forms, course requirements, assessment and recommended bibliography. The results show that digital competence plays a role in the total of 204 course syllabi – digital competence is implemented in 130 course syllabi at the undergraduate level and 74 course syllabi at the graduate level. Digital competence is most pronounced in the learning outcomes (N = 210). The contribution of this research can be perceived in upgrading the scientific theory on the implementation of ICT in the initial preschool teachers' education. This can be the basis for providing the guidelines for improving the quality of the teaching process and strengthening digital competence of initial preschool teachers' university programmes to generate new knowledge, skills and attitudes about the usage of digital tools as a complement to collaborative learning methods.

Key words: curricula; digital competence; early childhood education and care; future preschool teachers; higher education

1. INTRODUCTION

Today, contemporary society is more influenced by digitalization than ever before. Education is experiencing a digital transformation too, which is leading to the implementation of digital tools into the learning and teaching processes, especially in higher education. The role of university teachers, particularly those working in the initial (preschool) teacher education (I(P)TE), becomes crucial in preparing students for digital demands of their academic and professional lives.

Some research (Casillas Martín et al. 2020; Dong 2018; Liu, Toki & Pange 2014; Masoumi 2021) show that future preschool teachers often lack sufficient abilities to effectively use information and communication technology (ICT) in their academic life or in their professional future. This competence absence is attributed to insufficient ICT training and professional development opportunities (Dong 2018). An essential aspect of their education should not only involve creating software applications, but also learning how to practically implement them into their professional interaction with children (Anisimova 2020). Moreover, following studies (Dong 2018; Mulhim 2014; Salehi & Salehi 2012) have shown that time management issues in educational work contribute to future preschool teachers' lack of digital competence. Furthermore, teachers' competence and confidence, as noted by Aubrey and Dahl (2014), may impact their efforts to integrate digital literacy tools into their professional practice (Dong 2018; Nikolopolou & Gialamas 2015; Pelgrum 2001; Zhang et al. 2023). So, it is imperative to establish an affordable, well-designed, high-quality system of initial early childhood education and care (ECEC) with regards to its own numerous potential advantages, both for the individual and for society as a whole (Križman Pavlović et al. 2020).

Course syllabi should be planned to develop scientific thinking and to improve positive mindset regarding digital literacy (Gialamas & Nikolopoulou 2010; Lindfors, Pettersson & Olofsson 2021; Stockless et al. 2022). Literature reviews of digital competencies in the ECEC system (Rho, Park & Kwon 2014; Su & Yang 2023; Tomić 2023) point out the overall gap in studies on digital competence. They are providing valuable suggestions to university teachers and policymakers for informed decision-making on the integration of ICT in I(P)TE, which emphasises the crucial need for a holistic approach on improving digital competence by integrating digital tools in ECEC. In the Republic of Croatia, I(P)TE consists of undergraduate and graduate university studies, following a sequential model. The minimum requirement for the employment of preschool teachers is a Bachelor's degree. Enrolment in the graduate

study programs in ECEC requires the completion of an undergraduate degree in ECEC (Eurydice 2024).

Digital and technology-based competencies, as one of the key competencies of the *Council Recommendation on Key Competences for Lifelong Learning* (2006/962/EC), can be described as "the confident, critical and responsible use of, and engagement with, digital technologies for learning, at work, and for participation in society". Engagement with digital technologies and content requires a reflective and critical open-minded and forward-looking attitude to the evolution of every individual. Sillat et al. (2017: 1811) specified that I(P)TE represents "an important part in developing digital competence and education technology practice supporting the integration of ICT into kindergarten learning process". In order to be creative and innovative in acquiring digital competencies in children, it is of crucial importance for university teachers to work on developing their didactic, pedagogical and methodological skills in area of digital competencies. Sillat et al. (2017) emphasize that the most important changes in curricula's design of future preschool teachers should be integrating digital competence into curricula's learning outcomes, course integration and collaboration among the academic staff. Thus, "the research participants stated that modern technology can be used as a teaching tool, information searching agent, and while creating learning materials, as well as working with children, using a variety of software and technological solutions" (Sillat et al. 2017: 1806). Therefore, we associate the purpose of our research with a study by Sillat et al. (2017), where authors confirm the importance of early preschool curricula where "the learning outcomes should state the possibilities for contributing in the safe use of ICT skills in early childhood education" (Sillat et al. 2017: 1811). This highlights the need for a well-rounded and technology-integrated curriculum in I(P)TE that prepares them to navigate the digital competencies effectively.

This paper resolves with the DigComp model. Authors Vuorikari, Kluzer and Punie (2022) outline digital competencies across five key areas: *information and data literacy, communication and collaboration, digital content creation, safety,* and *problem solving.* The first key area from the model resolutions around *Information and data literacy.* This area express "information needs, to locate and retrieve digital data, information and content" (p. 7). It is important to organize digital data and content, and to analyse it before its enquiry. The second part of DigComp model refers to *Communication and collaboration* in different levels of society through digital technologies in order to participate in community and present its identity as an active citizen. *Digital content creation* is the third element of DigComp model that could help

children and young people in learning, i.e. people through lifelong learning, so that they could give instructions to technology to create an effective digital environment, and have successful feedback from technology. This should be done in a *Safe(ty)* way for every person involved, especially to protect people, their health and social well-being, but also to protect digital data and devices. In order to fulfil all of this before mentioned competences, we have to bear in mind the need to identify new problems, and answers for them in the digital area, but also to be innovative and contribute to digital development (*Problem solving*). These competences can be identified on different proficiency levels: from *foundational* (1) to *highly specialised* (8), and they are connected with knowledge acquisition, skills development, and forming their attitudes.

2. RESEARCH CONDUCTED IN THE FIELD OF PRESCHOOL TEACHERS' DIGITAL COMPETENCE

The research by Tomić (2023) has shown that the effective integration of ICT in preschool education requires training and support of university teachers, a variety of appropriate ICT tools, and development of children's digital literacy skills. Amhag, Hellström and Stigmar (2019) pointed out that university teachers provide a key role for successful integration of ICT in higher education. However, a study conducted by Anisimova (2020) has revealed a high level of digital literacy among future preschool teachers. This confirms the need for implementing digital tools in the future preschool teachers' education process.

The findings of Cekić-Jovanović et al. (2020) indicated that, while future preschool teachers had positive attitudes towards and recognized the possibilities of applying digital technology in their educational work in preschool institutions, a positive self-assessment of their digital competence is crucial for them to be able to more frequently apply digital technology in practice to improve its quality. Future preschool teachers' training programmes are a key element that could improve self-perception of digital competence (Romero-Tena et al. 2020), and it is necessary to create training plans to allow them to position themselves at a professional level. It is important to investigate preschool teachers' understanding of their own digital competencies.

Križman Pavlović et al. (2020) emphasize that despite a lower level of quality compared to other countries ten years ago (Sweden, Netherlands, Great Britain, and Slovenia), the satisfaction of Croatian future preschool teachers with the quality of professional development in the workplace is now at a high level. Students at Croatian

ECEC studies acquire professional competencies at undergraduate and graduate levels that prepare them for a very demanding role of educating children of early and preschool age.

Accordingly, research by Cekić-Jovanović et al. (2020) shows that students in academic studies have a more positive attitude toward digital competence compared to those in vocational studies. These findings suggest an improvement in the overall situation regarding digital competence in ECEC in the Republic of Croatia. Madsen et al. (2023) emphasize that the dynamics of digital practices across nations (Norway, Slovenia, Portugal, Poland, Turkey, Ukraine, England, and Jordan) reveal that attitudes, digital skills, and knowledge are statistically strong predictors of pre-service teachers' future use of educational digital technology. This concludes the importance of fostering positive attitudes and competence among future preschool teachers to ensure effective implementation of ICT in their educational practices.

3. METHOD

3.1. Research Aim

The aim of this research was to analyse the presence of digital competence within the Croatian I(P)TE course syllabi.

3.2. Research Questions

RQ1 To what extent is digital competence included in the course syllabi?
RQ2 How is digital competence integrated in undergraduate and graduate I(P)TE course syllabi?
RQ3 Is there a correlation between undergraduate and graduate I(P)TE courses objectives in the context of digital competence categories connected with *DigComp* model?

3.3. Instrument

Within the purpose of achieving previous research questions, a *matrix* was created specifically for this research. The validity of the instrument was determined by content analysis of previous research and pedagogical theory (Milas 2009). It contains nine columns: course title, required competencies, objectives, course content, learning

outcomes, types of teaching, course requirements, assessment, and recommended bibliography.

3.4. Sample

This study involved the participation of seven Croatian universities and faculties: Pula (N = 220 course syllabi), Rijeka (N = 141), Zadar (N = 101), Split (N = 179), Zagreb (N = 83), Slavonski Brod (N = 94), and Osijek (N = 146), all of which offered ECEC studies. A total of 964 course syllabi were analysed – 658 undergraduate course syllabi and 306 graduate course syllabi. The sample included universities that educate both full-time and part-time students.

3.5. Procedure

The qualitative approach used in this research is based on a conceptual and relational content analysis (Patton 2015; Pavić i Šundalić 2021). The analysis focused on examining the implementation of digital literacy within the ECEC studies' course syllabi and their correlation between undergraduate and graduate course syllabi. In conducting the analysis, the *DigComp* conceptual reference model by Vuorikari, Kluzer and Punie (2022) served as a guiding framework. *DigComp* model, which builds upon the previous edition from 2013 utilized by Sillat et al. (2017), provided a structured approach for evaluating the presence of digital competence within the course syllabi.

4. RESULTS AND DISCUSSION

4.1. Inclusion of the digital competence within the I(P)TE course syllabi (RQ1)

The results of this research show that digital competence is implemented in at least one category of the DigComp conceptual reference model in all undergraduate and graduate course syllabi. Out of a total of 964 courses analysed, digital competence was identified in 130 undergraduate course syllabi (83 mandatory and 47 elective) and 74 graduate course syllabi (53 mandatory and 21 elective). The matrix dimension where digital competence was most prominently featured was in the articulation of learning outcomes, with 210 instances identified.

Table 1. The results of the implementation of the digital competence within the course syllabi of Croatian ECEC studies (f)

University	Level of education: undergraduate (U)/graduate (G)	Course (total)	Required competence	Objectives	Course content	Learning outcomes	Types of teaching	Course requirements	Assessment	Recommended bibliography
Pula	U	8	0	6	8	26	2	4	2	24
	G	3	0	2	2	11	1	2	1	32
Slavonski Brod	U	10	0	1	2	5	10	0	0	4
	G	9	0	2	2	5	8	0	0	5
Split	U	76	66	2	8	20	22	4	2	8
	G	49	42	3	3	16	19	0	0	20
Zagreb	U	14	0	2	4	6	14	2	0	10
	G	9	5	0	2	4	5	1	0	1
Rijeka	U	12	0	1	2	32	0	0	0	14
	G	1	0	1	1	3	1	0	0	3
Zadar	U	6	0	6	6	54	0	4	0	8
	G	1	0	1	1	0	1	0	1	1
Osijek	U	4	0	4	4	22	4	4	4	10
	G	2	0	2	2	6	1	1	2	7

The results show that university teachers are utilizing multimedia and mixed e-learning methods in their teaching types across 88 courses (Table 1). The highest number of digital competencies was found in the required competencies and in the learning outcomes of all universities, and the most of all elements from the matrix were found at the University of Split. As described by Sillat et al. (2017), this emphasizes the ability of teachers to use multimedia elements such as animation, video and images to contribute to learning and effectively integrate digital tools into the teaching process. Such pedagogical approaches align with the contemporary emphasis on leveraging technology to enhance teaching and learning processes in ECEC contexts. Digital competence, as one of the Key Competences for Lifelong Learning, en-

compasses a wide range of skills that include knowledge, skills, and attitudes necessary for confident, critical, and responsible engagement with digital technologies (Vuorikari, Kluzer & Punie 2022).All stakeholders in higher education at all other universities are important for developing digital competence. However, we must keep in mind that changes in the educational system are created in integrated systems and through continuous and consistent work. Based on the answer to the first research question, we can highlight that university teachers could plan and program educational outcomes that will have a goal of promoting the digital competence development.

4.2. Comparison of the digital competence implementation in undergraduate and graduate I(P)TE course syllabi (RQ 2)

The comparison of digital competence implementation in undergraduate and graduate course syllabi of ECEC is providing valuable insights into the progression of future preschool teachers' digital readiness. The results show that digital competence at the undergraduate level of I(P)TE primarily revolves around areas of competencies in information and data literacy (N = 5), communication and collaboration (N = 6) and digital content creation (N = 8). However, the competencies are predominantly addresses at foundational (1-2) and intermediate (3-4) proficiency levels. In contrast to before mentioned, graduate-level programmes of I(P)TE place greater emphasis, and forms their implemented digital competencies on digital content creation area (N = 3), and problem solving (N = 3). Those competencies are addresses at more advanced proficiency levels – mostly advanced (6) and highly specialised (7-8).

The emphasis on the advanced proficiency levels among graduate students addresses the need for university teachers to work on their advanced skills and knowledge for navigating the complexities of digital environments effectively. In other words, these results tell us that, as expected, graduate students are learning at more advanced levels as opposed to undergraduate students, bearing in mind the complex context of their environment in kindergarten. At the most advanced and specialised level, they are expected to create solutions to complex problems regarding implementation of their digital competencies in ECEC practice. This confirms Sillat et al.'s (2017) indication that graduate-level competence encompasses a broader range of skills, including computing skills and advanced internet usage, reflecting the multifaceted nature of digital readiness required in today's educational system.

Furthermore, the results show that undergraduate course syllabi of I(P)TE lack digital competencies in the problem solving area. This can lead to a key problem involving preschool teachers' incompetence to actively integrate digital tools into their curricula, and "be able to effectively use ICT to support teaching and learning, and communicate and collaborate with children, and their families" (Dong 2018: 3) by problem solving competencies (Edwards 2016; Lindfors, Pettersson & Olofsson 2021) in a safe environment.

Thirdly, the lack of digital competence in learning outcomes on safety-related competencies for the undergraduate students shows an important negative concern that needs to become an imperative, and change fast. While undergraduate programmes primarily focus on foundational competencies, graduate programs delve into more advanced levels of safety-related competencies. Bearing in mind that the minimum requirement for employment in public preschool institutions in the Republic of Croatia is a Bachelor's degree (Eurydice 2024), it shows to say that a future preschool teacher isn't competent to protect devices, personal data and privacy, health and well-being, and the environment (Vuorikari, Kluzer & Punie 2022). This is crucial for the practice of ECEC, involving youngsters, their personal data, well-being and their families in digital environments, but it is vital for university teachers as well, especially for the part of planning their course syllabi, and for the betterment of their class in this digital era.

Therefore, according to Amhag, Hellström and Stigmar (2019, p. 1) "teacher educators need to identify the pedagogical surplus value in their own teaching and learning context with digital tools to increase motivation for concrete, effective, and subject-oriented successful examples as presented by experienced teachers". Nikolopolou and Gialamas (2015) further indicate that digital competencies should be implemented in the course syllabi as a model of teaching and learning, having in mind that this could lead to ICT integration in preschool teachers' ECEC practice.

This will help future preschool teachers to create higher academic results on a highly specialized level regarding the complex system of ECEC. This qualitative analysis points out the importance of implementing digital competence development in I(P)TE. They should be in accordance with students' individual needs and interests in higher education. University teachers hold a place at providing opportunities for their students in developing digital competence.

4.3. The correlations between undergraduate and graduate I(P)TE courses objectives in the context of digital competence (RQ 3)

Considering *DigComp* model (Vuorikari, Kluzer & Punie 2022) the analysis matrix contains keywords found in the course objectives, verbs from learning outcomes and courses requirements. The objectives in the course syllabi of all Croatian universities are written in such a way that the key concepts the student should learn are evident. The largest number of keywords from the course syllabi of undergraduate studies can be related to the third category of the *DigComp* model of *digital content creation*, while there are no keywords that can be connected to the *safety* category (Table 2).

Some examples of goals related to other categories of the Dig Comp model are:

- *to acquire knowledge about the computer and its role in ICT*;
- *to adopt basic terms from the basics of informatics*; and
- *to use computer tools for word processing*.

The verbs in the table show the level of knowledge according to Bloom's taxonomy (Anderson & Krathwohl 2001). Examples of learning outcomes from the undergraduate level are:

- *to define basic terms from the basics of informatics*;
- *to use ICT terminology*; and
- *to interpret the basic concepts of modern information technology*.

Examples of learning outcomes from the graduate level are:

- *to analyse the qualitative advantages and disadvantages of using computers in preschool education in order to create new didactic content for children's work/play with computers*;
- *to design contents for preschool children on the e-learning system*;
- *to recognize electronic violence;*
- *act preventively to protect children in the virtual environment*; and
- *to evaluate program multimedia content for children*.

While comparing learning outcomes in digital competence from the undergraduate and graduate course syllabi of Croatian universities and faculties, it can be concluded that at the undergraduate level, the learning outcomes are from the third proficiency level (to apply), while the learning outcomes from the graduate level are also associated with the sixth level (to create) (Anderson & Krathwohl 2001). This is in

accordance with the *DigComp* model proficiency levels (Vuorikari, Kluzer & Punie 2022).

Course requirements at undergraduate and graduate level are the same, consisting of multimedia, exercises, and practical tasks via e-learning, which are extremely beneficial for achieving the learning outcomes foreseen in the course syllabi. Also, these results can be related to constructive alignment (Ali 2018; Biggs 1996). In order to examine the third research problem, it was necessary to calculate the correlation between the content of the syllabus in the field of digital competence at undergraduate and graduate studies in the Republic of Croatia, and the *DigComp* model.

Table 2. Digital competence in course syllabi' course objectives at Croatian universities in the context of DigComp model; frequencies of course contents and learning outcomes

The level of studies	Number of course area (% of total courses)	Course objectives (*f*)	*DigComp* model categories		Course content (*f*)	Learning outcomes (*f*)
undergraduate	130 (13.48)	23	information and data literacy	5	36	165
			communication and collaboration	6		
			digital content creation	8		
			safety	0		
			problem solving	4		
graduate	74 (7.67)	11	information and data literacy	2	13	45
			communication and collaboration	2		
			digital content creation	3		
			safety	1		
			problem solving	3		

$\chi 2 = 11.6058$, df = 2, $p < .02$

Comparing the results of this research with the model of Sillat et al. (2017), we can conclude that the learning outcomes did not provide a sufficiently clear picture of the connection of ICT with everyday life and the connection with the social community. Additionally, in the Croatian context, it was shown that there is a lack of goals and learning outcomes in the field of *safety* in a virtual environment at the undergraduate level. Sillat et al. (2017: 1809) further confirm that "preschool teacher train-

ing supports the skills for modelling digital age work and learning by conducting training sessions". The result is not significant ($p < .02$), so there is no correlation between undergraduate and graduate courses objectives of ECEC (Table 2). In reality, university teachers should plan and program learning outcomes from higher proficiency levels at the undergraduate level, at least for the professional competences, but in the graduate level they should focus on scientific approach to digital implementation.

The extent to which digital competence is included in the I(P)TE indicates the possibilities of its implementation, but also creates an image of a society that should be at service of its citizens and prove that it is steered in the direction of digitalization. Starting from early childhood, children should be guided in creating a digital environment that will not only have obstacles and weaknesses, but serve children and society for the betterment of the new paradigm.

This research indicates that the studies that prepare preschool teachers in Croatia are very different, but that they are also ready for a change. Looking at the position of digital competence within the spectrum of various programmes in I(P)TE, it should be emphasized that a lot of work needs to be done in order to introduce structure in the preparation of students for work, all for the sake of preparing children for growth and development in the digital age.

Taken into consideration that the information and communication literacy is the most common condition course enrolment requirement at all Croatian universities, the findings elicited diversity, interdisciplinarity in course syllabi, but also expertise in preparing preschool teachers for their everyday professional life. Digital competence is most often covered in courses in the field of informatics, although there are also those university teachers who include digital literacy in their syllabi in order to achieve learning outcomes.

5. CONCLUSION

In modern society and community, ICT is a very important segment for the quality of life, and therefore it is also crucial in the preparation of future preschool teachers for their educational work with children and their parents. I(P)TE has a strong impact on integrating digital tools into students' future professional practice. This is why the initial training programmes for future preschool teachers should be planned and implemented to foster a scientific view and positive attitudes towards ICT.

The results of this research have shown that university teachers are utilizing contemporary teaching methods in higher education regarding acquisition of digital com-

petence. Digital competence is mostly connected to the first category of the *DigComp* model of *digital content creation*, and there are no keywords that can be connected to the *safety* category. However, the results have shown that digital technology is observed in all categories (model *DigComp*) at the undergraduate and graduate course syllabi, at least to some extent. The conclusion from the comparison analysis indicates that graduate-level programmes of I(P)TE place greater emphasis on *safety*, and *problem solving* areas at more advanced proficiency levels, as opposed to the undergraduate-level. The correlation between the undergraduate and graduate studies level have shown that there is no significant correlation. Based on the results of this research, university teachers should introduce learning outcomes on a higher proficiency levels, bearing in mind development their professional and scientific digital competences, which depends on the study level.

The contribution of this research is reflected in the scientific approach to the conceptual and relational content analysis of the course syllabi in order to observe the elements of monitoring and thus be able to draw conclusions for new research. Further research would be based on this analysis of the course syllabi, and should be conducted with aim of the development of university teacher for the improvement of future preschool teacher digital competences, but should also continue and develop with the university teachers' opinion as those who directly implement the analysed content in higher education teaching. This is an important topic that can contribute to the creation of new knowledge about the integration of ICT in the I(P)TE, but also in the system of ECEC in the Republic of Croatia.

The results of this research show that there is a sufficient number of contents in the course syllabi of ECEC. But, what we could reject by continuing to research this topic are the difficulties and advantages that university teachers encounter in order to better train future preschool teachers for their work with children in that area. Implications of this research can be found in the need for strengthening university teachers' competence which could lead to implementing ICT learning outcomes in future preschool teachers' course syllabi and professional life.

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DIGITALNA KOMPETENCIJA U INICIJALNOM OBRAZOVANJU BUDUĆIH ODGOJITELJA

Sažetak:

Obrazovanje je pod izuzetnim utjecajem procesa globalizacije i digitalizacije. Budući odgojitelji trebaju iskustveno sudjelovati u metodama suradničkog učenja u svrhu osnaživanja digitalne pismenosti, i to implementacijom IKT-a u kurikulum. Cilj je ovog istraživanja stoga bio napraviti analizu izvedbenih planova studija pri fakultetima u Republici Hrvatskoj koji sudjeluju u inicijalnom obrazovanju budućih odgojitelja. Kvalitativna analiza sačinjena je na ukupno 964 izvedbenih planova nastave, prateći model autora Sillat i suradnika (2017). Analiza je sačinena pomoću matrice uz pomoć koje je analizirana uporaba digitalnih alata iz perspektive ciljeva kolegija, sadržaja kolegija, ishoda učenja, metoda izvođenja nastave, obveza studenata te praćenja, ocjenjivanja i vrednovanja rada studenata uz dostupnu literaturu. Rezultati su pokazali kako je digitalna kompetencija na neki način uključena u ukupno 204 silaba – od toga 130 na prijediplomskoj razini (83 obveznih i 47 izbornih) te 74 na diplomskoj razini (53 obveznih i 21 izbornih). Digitalna kompetencija najprisutnija je u ishodima učenja (N = 210). Doprinos ovog istraživanja uviđa se u nadogradnji teorije o implementaciji IKT-a u obrazovanje budućih odgojitelja. Prethodno može činiti temelj unapređenja kvalitete nastavnog procesa i osnaživanja digitalnih kompetencija budućih odgojitelja radi generiranja novih spoznaja o uporabi digitalnih alata kao nadopuni metodama suradničkog učenja. Ovo istraživanje možebitni je temelj unapređenja procesa planiranja rada visokoškolskih nastavnika u svrhu adekvatnog obrazovanja budućih odgojitelja.

Ključne riječi: budući odgojitelji; digitalna kompetencija; kurikulum; rani i predškolski odgoj i obrazovanje; visokoškolsko obrazovanje

Authors' address
Adrese autorica

Marina Diković
Juraj Dobrila University of Pula
Faculty of Educational Sciences
marina.dikovic@unipu.hr

Monika Terlević
Juraj Dobrila University of Pula
Faculty of Educational Sciences
monika.terlevic.1@unipu.hr