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EVALUATING PRESCHOOL TEACHERS' PERCEPTIONS OF MASTERING CODING FOR IMPLEMENTATION IN EARLY CHILDHOOD EDUCATION

Abstract. This research explores preschool teachers' perceptions of a programming course designed specifically for early childhood educators, focusing on the ScratchJr platform and the "Animated Genres" curriculum. The study was conducted across four academic years from 2020 to 2023, and included a 37-question survey aimed at master's students with previous qualifications in preschool teaching. The survey was divided into four parts: demographic, respondents performance in the course, their views on ScratchJr, and their assessments of the "Animated Genres" curriculum. Non-parametric descriptive and inferential statistical techniques were applied to data analysis.

Participants provided high ratings for the course organization, especially for the learning materials, syllabus, and the lecturer's enthusiasm. However, the potential for applying the skills learned in classroom environments received lower ratings. The main obstacle identified was the lack of essential equipment in preschools (μ=4.78), which impeded the use of tools such as ScratchJr. These challenges did not notably impact ScratchJr's rating. Furthermore, many respondents considered the "Animated Genres" curriculum an effective method to engage, motivate, and teach children.

In summary, during the four-year evaluation period, the course achieved commendable ratings (quality performance score μ=4.62), along with the ScratchJr tool (μ=4.52) and the curriculum (μ=4.56). These findings provide important insights for educators, curriculum developers, and policymakers looking to improve coding education for young learners, highlighting the need to fully address infrastructural constraints to capitalize on the advantages of early coding instruction.

The study revealed the technological, educational, and social affordances, as well as the limitations of teaching coding in Serbian preschools.

Keywords: Early childhood programming education; Preschool teachers' perceptions; Computational thinking in preschool; ScratchJr: Animated genres curriculum.

1. INTRODUCTION

The problem statement. The growing emphasis on digital literacy has brought coding and computational thinking to the forefront of early childhood education worldwide. Coding is increasingly recognized not only as a technical skill but also as a means of fostering creativity, problem-solving, and logical reasoning in young learners. However, the successful integration of coding in preschool institutions depends on teachers' competence, confidence, and perceptions of its relevance for early education. Preschool teachers often lack prior training in programming, and their readiness to master coding concepts and apply them through child-centered pedagogical approaches remains a major challenge.

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In Serbia, coding has only recently entered discussions about early childhood curricula, and the availability of teacher training programs is limited. Despite the potential of tools like ScratchJr and curricula such as “Animated Genres” to support developmentally appropriate coding activities, barriers such as insufficient and limited equipment in preschools constrain their implementation. Moreover, while previous studies have examined teachers’ attitudes toward coding, most have provided only cross-sectional insights, without considering how teachers’ perceptions, skills, and classroom application evolve over time through structured educational interventions.

This lack of longitudinal evidence creates a significant research gap in understanding how preschool teachers perceive and master coding competencies, and how their views on programming tools and curricula develop with sustained education and practice. Addressing this gap is essential for informing curriculum design, shaping teacher education programs, and guiding policy efforts to ensure that preschools can overcome infrastructural limitations and harness the educational potential of early coding instruction.

Analysis of recent studies and publications. The integration of coding into early childhood education has gained significant attention in recent years, driven by the increasing recognition of computational thinking (CT) as a foundational skill. In his classic book “Mindstorms: Children, Computers, and Powerful Ideas,” [1] Papert outlined how computers could transform education. In his opinion, children should use computers to experiment, explore, and express themselves.

Years later, computational thinking was introduced, stating that “Computational thinking involves solving problems, designing systems, and understanding human behavior, by drawing on the concepts fundamental to computer science. Computational thinking includes a range of mental tools that reflect the breadth of the field of computer science” [2, p.33].

Computational thinking will be a crucial skill for everyone, improving reading, writing, and math. It also symbolizes a way of thinking that applies to all contexts.

Early exposure to computational thinking will help develop analytical skills, logical reasoning, and problem-solving abilities [3] —all of which are essential for success in the twenty-first century.

Coding’s potential impact on cognitive and socio-emotional development and evidence-based analysis is presented in [4]. The study used a meta-thematic analysis that synthesized qualitative data from various studies.

Early exposure to programming concepts is believed to enhance young learners' problem-solving abilities, logical reasoning, and creativity [5]. Results presented in the study [6] confirm that it is possible to start teaching coding very early (at 3 years old).

Systematic review initiatives and tools used to develop computational thinking in young children, with an emphasis on the importance of early exposure are presented in [7, 8, 9, 10]. Also, a systematic review of works related to programming in early childhood education is presented by [11].

Learning CT via coding can even significantly boost children's spontaneous development of executive functions [12].

Beyond learning programming, coding in early education supports broader cognitive development, such as pattern recognition, abstract thinking, and sequencing. Incorporating programming activities into early education can positively impact young children's cognitive abilities, particularly in organizing ideas and adopting systematic approaches to challenges. A research study by [13] introduced an AI-powered platform to teach computational thinking to children aged 4-9. This system allows children to articulate tasks in natural language, which the platform translates into structured programs executed by a tangible robot.

Additionally, children can use coding as an opportunity to create games, stories, and animations that improve their educational experience.

Despite these advantages, teachers' ability to lead these kinds of activities will determine whether coding is successfully incorporated into preschool environments.

However, teachers' preparedness and attitudes play a major role in how successfully coding activities are implemented in preschool environments. The degree to which programming concepts are introduced in early learning environments is greatly influenced by preschool teachers' attitudes toward coding education.

Juraković et al. [14] found that both younger and older teachers over 35 show a positive attitude towards the application of ICT in preschool institutions, but there is no statistically significant difference in their positive attitude.

Previous studies indicate that teachers' confidence and perceived self-efficacy significantly influence their willingness to adopt new pedagogical approaches. Jeong and Kim in [15] concluded that teachers' acceptance of computer technology in early childhood education is strongly influenced by important factors such as computer self-efficacy, subjective norm, and personal innovativeness in education technology, all of which impact the decision of kindergarten teachers to use computers. A Chinese case study [16] on the pedagogical knowledge (PK) and computational thinking (CT) of early childhood educators in this field found that teachers understood CT concepts better than they understood CT practices and CT perspectives. When come to PK, teachers could use broad pedagogical knowledge, but had difficulty utilizing content-specific pedagogical knowledge. Otterborn et al. in [17] systematically investigated how Swedish preschool teachers integrated programming activities into their teaching practice. The integration of activities occurred through digital programming, unplugged programming, or a combination of both. Teachers strongly linked the principles of computational thinking and "twenty-first-century skills" to the intended learning objectives surrounding programming.

A positive attitude toward coding is often linked to adequate training, access to appropriate resources, and hands-on experience with programming tools. Some experiences from the UK when teachers were preparing for the mandatory inclusion of computing into the curriculum are presented in [18].

Fessakis et al. in [5, p.89] stated that "appropriately designed learning activities and supporting material […] easily integrated in every day school practice by well-informed and prepared teachers" are more significant for curriculum programming success in PreK–K2 classrooms than accessible technology.

According to statistically significant data, students whose teachers showed flexibility in lesson design, responsiveness to their requirements, technological content mastery, and concern for developing their independent thinking skills demonstrated higher programming achievement [19].

The research goal. This study aims to examine preschool teachers' attitudes toward computational thinking and coding instruction, focusing on their experiences with a master's course on programming for preschoolers, the ScratchJr platform, and the "Animated Genres" curriculum. The research examines the effectiveness of the proposed coding platform and accompanying curriculum, considering the technical and personnel conditions in preschool institutions in Serbia.

The findings from this study, which explored Serbian preschool teachers' attitudes toward computational thinking and coding instruction using the ScratchJr platform and the "Animated Genres" curriculum, may have important implications for early childhood education worldwide. ScratchJr has been widely adopted across the globe, with over 60 million users as of September 2024, and has been translated into 48 languages [20], reflecting its adaptability across diverse cultural and educational contexts.

By examining the Serbian experience, educators and policymakers in other countries can gain valuable insights into integrating coding platforms and curricula into preschool education,

considering local technical infrastructure and teacher preparedness. This cross-cultural applicability highlights the potential for such educational tools to enhance computational thinking skills among young learners worldwide.

2. THE THEORETICAL BACKGROUNDS

2.1. The “Programming for Preschoolers” Master's Course

Specialized training programs have been developed to support preschool educators in integrating coding into their teaching. The non-mandatory master's course “Programming for Preschoolers” (course code MSSIP203) is one such initiative designed to equip preschool teachers, who are also master students at the Academy of Applied Technical and Educational Studies Niš, Pirot Department, with the theoretical knowledge and practical skills required to introduce young children to computational thinking. The course is part of the curriculum “Master Preschool Teacher” (Accreditation no. 612-00-00014/6/2018-03, issued by the National Entity for Accreditation and Quality Assurance in Higher Education (NEAQA) in Serbia). The course is designed as a full-semester course, and it is conducted over 15 weeks. The course topics are based on the three-dimensional CT framework. According to Brennan and Resnick in [21], this framework encompasses computational perspectives, practices and concepts, i.e. the essential principles that designers apply when programming, including iteration, parallelism, and others; the methods they use as they work with these concepts, such as troubleshooting code or modifying existing projects; and the viewpoints that designers develop regarding their surroundings and their own identities. Some modifications of the above-mentioned framework are defined later by [22].

Hsu et al. [23] found that computational thinking has primarily been applied in program design and computer science, with only a few studies exploring its application in other disciplines. On the other hand, approaches intended for young children should involve aesthetic experience, design-based learning, and storytelling, and such approaches have apparently been less frequently adopted. Also, unplugged activities should be an integral part of any coding curriculum intended for preschool children [24, 25, 26] and their teachers should acquire the necessary knowledge and practical experiences to implement them.

The course covers foundational programming concepts, age-appropriate coding activities, including unplugged ones, and pedagogical strategies for engaging preschoolers in digital storytelling and game design. Topics of lectures and exercises are listed in Table 1.

Understanding how preschool teachers perceive and evaluate this course provides valuable insights into its effectiveness and areas for improvement.

The study examines why respondents chose to enroll in the course, their assessment of course content and structure, and their satisfaction with lectures and practical exercises conducted both in-person and online. Additionally, it explores their evaluation of the provided literature and learning resources, the extent to which the course met their expectations, and their confidence in applying the acquired skills in their classrooms.

Table 1

Topics and details of the course’s lectures and exercises

Week	Lecture topic	Lecture details	Exercises
1	The concept of computational thinking and its impact on children's development	•Why programming in early childhood? • The concept of computational thinking. • Basic characteristics of the programmer's way of thinking. •The impact of early programming learning on children's development.	Discussion and explanations related to the concept of computational thinking.

2	Opportunities for working in the field of programming for preschoolers	• Basic areas of activity • Unplugged programming • Block-based programming • Robotic manipulative tools	Planning and describing kinesthetic outdoor unplugged activity. Planning and describing table (pen & paper) or floor indoor unplugged activity.
3	Basic programming concepts	• Basic concepts that can be explained • Algorithm • Sequence (series of commands) • Iteration (loop) • Decomposition (breaking down) • Branching (condition)	Planning and preparing stories and activities describing basic programming concepts in children's everyday lives.
4	Unplugged programming activities	• Examples of activities	Preparing teaching material for unplugged activities
5	Basics of working in the ScratchJr studio	• What is ScratchJr? • Starting the program • User interface • Drawing • Description of blocks	Installation of ScratchJr app for chosen device and OS. User interface details. Stage, Program area, Block area, Drawing editor.
6-8	ScratchJr - Practical examples and tips	• Starting, renaming, and deleting a project • Using blocks and animating characters • Working with multiple characters • Working with trigger blocks • Sharing projects • Example library • Copying characters • Copying scripts • Projects with multiple pages • Moving backward	New project, open, save, and rename project Characters and backgrounds Working with blocks (motion, look, control, sound, trigger, ending) Copying characters and scripts Projects with multiple pages Sharing projects
9-10	ScratchJr - Implementation of basic programming concepts	• Algorithm and sequence of commands • Control structures • Debugging	Programming basic concepts – examples Homework project tasks (7) for testing the level of knowledge
11-12	Curriculum "Animated Genres" – plan and program	• Detailed analysis of translated (on Serbian) curriculum "Animated Genres"	Planning activity for module “Collage” Planning activity for module “Story” Planning activity for module “Game”
12-14	Seminar work	• Students choose by their wish the topic which belongs to the modules “Story” or “Game” and prepare a written activity plan with details, including the coding project	Consulting and correcting the errors
15	Seminar work	• Assessment	

2.2. ScratchJr as a Tool for Early Coding Education

ScratchJr is a widely used visual programming studio designed specifically for young children. According to its inventor, “ScratchJr was designed to support children in engaging with seven powerful ideas of computer science that are developmentally appropriate for young children: algorithms, modularity, control structures, representation, hardware/software, design process, and debugging” [27, p.4] and it is the most popular freely available introductory programming language for young children (ages 5-7). Kalogiannakis and Papadakis in [28] investigated pre-service kindergarten teachers’ acceptance of ScratchJr as a tool for learning and teaching computational thinking and science education and concluded that ScratchJr is an appropriate educational environment for pre-service kindergarten teachers to learn programming basics as well as a platform for the development of educational resources to

support the learning of science teaching" (p.31). They also proposed the use of the ScratchJr programming environment in the training of pre-service kindergarten teachers [29].

ScratchJr provides an accessible introduction to computational thinking by allowing preschoolers to create animations, interactive stories, and games using block-based coding. Bers [27] presents an overview of ScratchJr and the powerful computer science ideas it is designed to teach. In addition, data analytics show usage trends in Europe and how it compares to the rest of the world. The official ScratchJr book [30] was recommended as a textbook to the students. ScratchJr offers the features "low floors, high ceilings, and wide walls" a metaphor introduced in [31] during Scratch's promotion, and further described by Flannery et al. in [32].

This study investigates preschool teachers' familiarity with ScratchJr after taking the master's course, their experiences installing and using the software on various devices and operating systems, and their perceptions of its usability. Key areas of evaluation include the simplicity of the user interface, clarity of coding blocks, and the quality of the character and background drawing editor.

Beyond technical aspects, this research examines teachers' perspectives on ScratchJr's educational value in preschool learning. Specifically, it assesses their views on the tool's potential to support children's language, speech, and literacy development, introduce early mathematical concepts, enhance logical thinking, and foster artistic creativity. Understanding these perceptions provides insight into how teachers integrate ScratchJr into their instructional practices and the challenges they encounter in doing so.

2.3. The "Animated Genres" Curriculum

Teachers usually use ScratchJr with the "Animated Genres" curriculum [33] which is designed by the Developmental Technologies Research Group and freely available on the ScratchJr website [34]. A structured curriculum can significantly aid educators in implementing coding activities in a systematic and developmentally appropriate–manner. The "Animated Genres" curriculum is designed to provide a step-by-step guide for integrating ScratchJr into preschool education.

The curriculum is divided into three modules based on three interactive genres: interactive collage, animated story, and interactive game. Each module is comprised of two units: a series of lessons that introduce ScratchJr features and programming blocks and an opportunity for children to create their own projects by applying concepts learned in module lessons.

This study evaluates preschool teachers' perceptions of the curriculum's applicability and effectiveness, focusing on its three modules: "Collage" (first four lessons), "Story" (lessons five and six), and "Game" (lessons seven and eight). To facilitate the acceptance of its ideas, the curriculum "Animated Genres" has been translated into Serbian [35], and offered to students as ~~a~~ supplementary learning material.

Teachers' evaluations of the curriculum cover aspects such as the clarity of instructional materials, the methodological approach used in each module, and the translation quality of the provided curriculum. Additionally, the topics selected by respondents for their seminar papers offer further insight into their areas of interest and engagement with coding education.

2.4. Hypothesis Development

Based on the background information, the study presents the following hypotheses:

H1: Positive course organization quality correlates with higher teacher satisfaction, self-efficacy, and readiness to integrate coding activities.

H2: Favorable perceptions of ScratchJr's usability and educational benefits increase teachers' willingness to incorporate coding into preschool education.

H3: Limited access to technological infrastructure in preschool facilities negatively affects educators' ability to integrate programming tools like ScratchJr into their teaching practices.

H4: The "Animated Genres" curriculum is an effective guide for implementing coding activities with preschoolers, enhancing children's engagement and educational outcomes.

These hypotheses can guide future research aimed at improving coding education in early childhood settings by addressing factors such as educator experience, course design, infrastructural support, community involvement, and curriculum effectiveness.

3. RESEARCH METHODS

3.1. Research Design

The research was conducted over four years (2020-2023) using a questionnaire administered to the master students of the Academy of Applied Technical and Educational Studies Nis, Pirot Department, Serbia, at the end of each academic year. The questionnaire focused on their attitudes and evaluations of the course “Programming for the Preschoolers.”

Data were collected through an anonymous paper-based questionnaire presented in the Appendix A. The questionnaire consists of 37 questions divided into four sections: six questions about the respondents' basic information; eleven questions about course performance; thirteen questions about the software tool learned during the course (ScratchJr); and seven questions about the “Animated Genres” curriculum.

All the variables generated from the questionnaire are categorical, except the three continuous variables related to age, years since completing undergraduate studies, and years of professional work experience. We decided to introduce two new ordinal variables Age and Experience to substitute continuous ones. For the variable Age, three categories are introduced (Figure 1), and for Experience, four categories are used (Table 3). The final questionnaire contains 5 dichotomous, 7 nominal, and 25 ordinal variables. The ordinal variables are Likert-type scale items typically defined by five values (Unsatisfactory -1, Acceptable -2, Good-3, Very good-4, Excellent-5), except one item related to the reason for enrolling in the course, which is defined by six values.

Two questions were complex. The first, regarding the devices and operating systems used by respondents for ScratchJr throughout the course, offered six multiple-choice options. The second question asking respondents to identify the greatest obstacle to using ScratchJr in their institutions, provided five possible reasons, each rated from 1 (lowest) to 5 (highest).

As usual, not all the respondents answered every question. In the analysis, we noted the sample size for each question.

3.2. Participants and Ethical Consideration

Our study respondents were simultaneously students of the master’s program and preschool teachers. Therefore, we will use the terms respondents, teachers, course attendees, and participants interchangeably.

The total number of participants includes those from all 4 years of the research, i.e., $N=N_{20}+N_{21}+N_{22}+N_{23} = 121$.

Participants could either skip declaring their gender or choose to disclose it, but all chose to disclose it. Additionally, they could refrain from answering questions about their age, and two opted to do so.

Before completing the questionnaire, all respondents were informed about the study’s aim and their rights to withdraw from the study at any time. All respondents gave consent to the

anonymized use of the gathered data. Approval from the Academy's Research Ethics Committee [#01-1/335] was received for conducting this study.

3.3. Data Analysis

Due to the ordinal nature of the variables and the number of respondents per category, non-parametric statistics were used to analyze the data. Data were analyzed in IBM SPSS Statistics v.28 using descriptive and inferential statistics. Inferential data analysis was divided into three parts.

The first part of the questionnaire and the analysis focuses on the attendees' satisfaction with the course performance. The second part addresses attitudes about the ScratchJr application as it was the main tool used in the course. The third part examines the participants´ assessments of the "Animated Genres" curriculum.

In the first part, the non-parametric Spearman's Rank-Order Correlation test was used to analyze the strength and direction of the correlation between the variables. In the second and third parts, Kendall's Tau was used instead of Spearman's rank-order correlation test because of its robustness in a small sample. Proportional Odds Logistic Regression for Ordered Category Outcomes method was used to predict the ordinal outcome using predictor variables.

4. THE RESULTS AND DISCUSSION

4.1. Demographic Analysis

In total, 121 respondents completed the questionnaire. The oldest respondent was 58, and the youngest was 22, 36.18 on average. All participants declared their gender, with 117 identifying as female and 4 as male. The predominance of females in preschool teaching in Serbia may help explain the participants' gender distribution.

Twenty-five respondents (20.66%) were pre-service teachers without prior professional education experience. In-service teachers had between 0.5 and 32 years of professional experience, with an average of 10.27 years. Table 2 presents central tendencies and dispersions of respondents' demographic data.

Table 2

Central tendencies and dispersions of demographic data of the respondents

Year	N	Age (years)			Years from completion of undergraduate studies			Years of professional experience in education			Age of the group of children that the respondent works with	Prior experience in programming	
		Mean	SD	Var	Mean	SD	Var	Mean	SD	Var	Mean	n	%
2020	42	37.74	8.48	71.86	12.05	6.47	41.80	9.33	7.63	58.27	4.83	13	30.95
2021	25	30.64	7.50	56.31	6.16	4.85	23.49	3.60	4.62	21.36	5.00	9	36.00
2022	45	38.72	6.68	44.67	13.83	7.14	51.00	10.15	7.21	52.06	4.80	6	13.33
2023	9	32.22	8.65	74.84	7.22	5.49	30.17	5.28	4.67	21.84	5.21	2	22.22
Total	121	36.18	8.36	69.81	11.06	7.05	49.66	8.12	7.24	52.42	4.87	30	24.79

Master study is not a mandatory degree for preschool teachers in Serbia, and some students decide to pursue it many years after finishing their undergraduate studies. Meanwhile, most of them have worked as kindergarten and preschool teachers gaining valuable experience

and competencies in various fields of preschool education. The time since completing their undergraduate studies ranges from 1 to 32, with an average of 11.06 years. About one-quarter of respondents (30) stated they had prior computer programming experience.

Initially, we wanted to know the participants' ages and their professional teaching experience. Figure 1 shows the distribution of the participant's ages in years, and it can be concluded that attendees of all groups - younger, middle-aged, and older - are almost equally interested in the course.

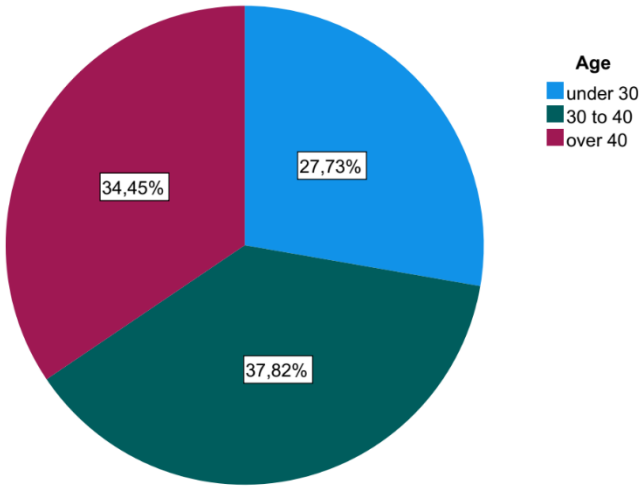

Figure 1. Age of the course attenders over four years (2020-2023)

Table 3 represents the distribution of professional working experience in the observed period. Two students did not answer questions about age and working experience. Therefore, Table 3 reflects a total of 119 participants' answers. The majority of students are relatively inexperienced; 67.22% have under 10 years of experience, and 94.96% have under 20 years, which is about half the typical working lifespan in the country.

Table 3

The distributions of teachers' professional experience over four years (2020-2023)

Year	Years of experience							
	Under 10		11 to 20		21 to 30		Over 30	
	N	%	N	%	N	%	N	%
2020	25	31.25	15	45.45	1	20.00	1	100.00
2021	23	28.75	2	6.06	0	0.00	0	0.00
2022	25	31.25	14	42.42	4	80.00	0	0.00
2023	7	8.75	2	6.06	0	0.00	0	0.00
Total	80	100.00	33	100.00	5	100.00	1	100.00

However, there is a correlation between participants' age and educational experience. The correlation is shown in Figure 2 and measured by Pearson correlation coefficient *r*, which represents the strength and direction of the linear relationship between the two variables. The value *r* achieved 0.791, which means that there is a strong positive linear relationship, significant at the p=0.01 level.

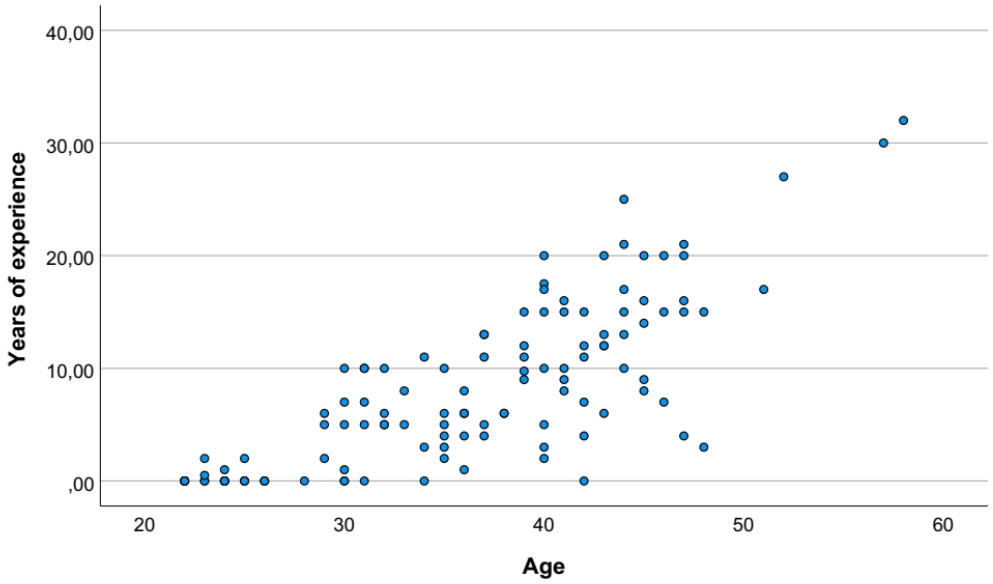

Figure 2. Participants' age and educating experience correlation

When we analyze the age of the children with whom the participants worked, there are four distinct age groups, as shown in Table 4. Of the participants, 83 work with children 3 to 7 years old, and 38 do not work directly with children. Approximately two-thirds (N=54 or 65.06%) work with preschoolers (5-7 years) and are able to efficiently apply the knowledge gained from the course "Programming for the Preschoolers."

Table 4

The distribution of teachers who work with children in kindergartens and preschools

Children age (years)	Number of teachers	%
3.0 to 4.0	15	12.40
4.0 to 5.0	14	11.57
5.0 to 6.0	36	29.75
6.0 to 7.0	18	14.88
With group	83	68.60
Without group	38	31.40
Total	121	100.00

We assumed that experienced teachers work with older children to teach them new technology skills. The non-parametric Spearman's Rank-Order Correlation test was used to analyze the strength and direction of the correlation between teachers´ experience and children's age. The null hypothesis proposes that there is no correlation between the observed variables. The test achieved positive rho=0.187 and p=0.09. Therefore, the null hypothesis is not rejected (rho>0 and p>0.05), and we can conclude that there is a weak positive correlation between teachers´ experience and children's age, but it is not statistically significant. This means that in the observed group, teachers of varying experience levels work with older children, not just the more experienced ones.

As we previously found that the course mainly engaged less experienced students (Table 3), and we did not find evidence that more experienced students worked with older preschoolers, we concluded that the "Programming for the Preschoolers" course drew younger participants who could later learn programming skills for preschoolers. This finding confirms the result from Table 5, where 60.33% of respondents stated that the reason for their attending the course was "Acquiring competencies for the future".

4.2. The Course Performance Analysis

The course “Programming for the Preschoolers” was conducted in two formats, depending on COVID-19 instructions: online and in-person. Both lectures and exercises were conducted in two formats.

When participants were asked to explain their motivation for enrolling in the course, most participants selected one of the five provided options (117 or 96.69%), while only 4 chose “Other.” The majority chose “to gain competencies for the future” (73 participants or 60.33%). The distribution by reasons for enrolling is presented in Table 5.

Table 5

The distribution of theachers by reasons for enroliing the course

Reason for enrolling in the course	N	%
By chance	1	0.83
Recommendation from a colleague	22	18.18
Expected ease of passing;	2	1.65
Relevance and modernity	19	15.70
Gaining competencies for the future	73	60.33
Other, unspecified	4	3.31
Total	121	100

Attendees’ satisfaction with all aspects of the course performance was of our primary interest. Therefore, nine Likert-type scale questions with an ordinal scale defined by five values (Unsatisfactory-1, Acceptable-2, Good-3, Very good-4, Excellent-5) were defined in the questionnaire. In addition to calculating single estimations (Table 6), the non-parametric Spearman’s Rank-Order Correlation test was used to analyze the strength and direction of the correlation between each of the nine variables and the final course mark, based on performance quality measured by the same five-point Likert-type scale. The questionnaire's reliability was assessed using Cronbach's alpha. For the "Satisfaction of the attendees" scale, the value $\alpha = 0.897$ was obtained, which indicates high internal consistency. All items had corrected correlations with a total score above 0.58.

Table 6

Satisfaction of the attenders with nine aspects of the course performance

Question	N	Min	Max	Mean	SD	Var
Syllabus Quality	121	2	5	4.07	1.01	1.02
Lectures in-person	116	2	5	4.15	0.77	0.60
Lectures online	121	1	5	4.02	1.01	1.02
Exercises online	121	1	5	3.93	0.99	0.99
Quality of the learning resources	120	1	5	4.25	0.84	0.71
The motivation of the lecturer	121	2	5	4.58	0.66	0.43
General expectations	120	2	5	4.48	0.79	0.62
Application capability after the course	120	1	5	3.87	0.87	0.76
Pre-exam assessment	121	1	5	4.04	0.99	0.97

The null hypothesis proposes that there is no correlation between the observed variables. The test achieved moderate positive rho values (0.56, 0.503, 0.448, 0.544, 0.510, 0.519, 0.434, 0.570, 0.526 respectively, and $p<0.001$). Therefore, the null hypothesis is rejected and we can conclude that there is a statistically significant positive correlation between the each of nine variables and the final performance quality mark. In other words, the performance quality mark is the result of the quality of each item and it achieved the following statistics: N=109, min=3, max=5, μ=4.62, s=0.574, SE=0.055.

Regarding hypothesis H1, there is a positive correlation between the perceived quality of course organization - including learning resources, syllabus design, lecturer's motivation - and teachers' overall satisfaction with the programming course. The lecturer was rated as highly motivated, and general expectations following the course were equally high.

Lower grades were assigned to the online lectures and the perceived applicability of the course content. Teachers who complete the course are expected to report higher self-efficacy and readiness to incorporate coding activities into their teaching practices, but the results related to hypothesis H3 (the lack of equipment in preschool facilities) may explain their reservations about the applicability of the course content.

4.3. The Using of ScratchJr Application Analysis

In the second research segment, the authors focused on the respondents' perceptions of the ScratchJr application, the primary tool used in the course. Twelve questions gathered the respondents' observations. Nine questions (Table 7) used a Likert-type scale with an ordinal scale defined by five values (Unsatisfactory -1, Acceptable -2, Good-3, Very good-4, Excellent-5), one question was a dichotomous variable concerning previous experience with ScratchJr, and two were nominal variable with 5 and 6 categorical values, respectively: one identifying the biggest obstacles for using ScratchJr in the respondent´s preschool, and the other about the devices and operating system used for ScratchJr. The final, thirteenth question referred to the overall grade of the ScratchJr application.

Reliability was assessed using Cronbach's alpha. For the "Satisfaction with ScratchJr" scale, the value $\alpha = 0.851$ was obtained, which indicates high internal consistency. All items had corrected correlations with a total score above 0.40.

When participants were asked about their prior experience with ScratchJr studio, most of them (110 or 90.91%) reported that they had never encountered the ScratchJr environment before taking this course.

Table 7

Central tendencies and dispersions of Likert-type scale nine variables regarding ScratchJr

Question	N	Min	Max	Mean	SD	Var
Ease of installing the ScratchJr environment	116	2	5	4.43	0.83	0.68
Simplicity of the ScratchJr user interface	114	1	5	4.25	0.89	0.79
Clarity of ScratchJr blocks	112	2	5	4.30	0.84	0.70
Quality of the character and background drawing editor	116	2	5	4.09	0.88	0.77
Ability of children in the group you currently work with to use the ScratchJr environment	105	1	5	3.23	1.20	1.45
Potential of ScratchJr in supporting children's language, speech, and early literacy development	117	1	5	3.77	0.95	0.90

Potential of ScratchJr in developing logic and early mathematical concepts	117	2	5	4.21	0.75	0.57
Potential of ScratchJr in introducing children to their environment	117	1	5	4.13	0.92	0.84
Potential of ScratchJr in fostering children's artistic development	116	1	5	4.23	0.89	0.79

Respondents do not assess (with a moderate coefficient of variation) that using ScratchJr with the children they teach is possible because the mean value is μ=3.23. When the analysis includes only the respondents (N=54) whose group consists of children aged 5 years and older, the outcome is somewhat improved, with μ=3.48.

They also (with a moderate coefficient of variation) do not consider ScratchJr useful for teaching preschoolers their native language, both spoken and written (μ=3.77).

The lack of highly positive respondents' evaluation of the possibility of using ScratchJr with the children they teach can be attributed to their responses to the question about the greatest obstacle to using ScratchJr in their institutions. Based on five reasons rated on a Likert-type scale from 1 (the least significant reason) to 5 (the most significant reason), we found the distribution shown in Table 8. Although the questions were grouped to represent various obstacles that were explored, they actually measure different aspects or dimensions of the issues. As a result, reliability analysis and correlation calculations were not conducted, as these questions do not form a coherent scale that would allow for such analyses. Instead, the results in Table 8 reflect the levels of the identified problems, providing a descriptive overview of the severity or frequency of the obstacles.

Table 8

Obstacles for using ScratchJr in the preschool where a respondent works

Obstacles for using ScratchJr in the preschool where a respondent works	N	Min	Max	Mean	SD	Var
Lack of equipment (tablets)	106	1	5	4.78	0.73	0.53
Lack of time in the current education program	92	1	5	3.01	1.08	1.18
Insufficient competence of educators	94	1	5	3.20	1.22	1.50
Negative attitude of parents	93	1	5	2.74	1.10	1.22
Children's lack of interest	92	1	5	1.57	0.98	0.95

Children and parents are interested in learning coding. Overloaded education programs and teachers' competencies do not affect the use of ScratchJr. The main reason is the lack of equipment. This confirms our assumption set in hypothesis H3.

The final estimation mark for ScratchJr App. is given as a Likert-type scale variable with an ordinal scale defined by five values (Unsatisfactory -1, Acceptable -2, Good -3, Very good -4, Excellent -5). We wanted to find whether there was a correlation between a final mark for ScratchJr and nine individual questions (Table 7) related to different ScratchJr segments. Instead of using Spearman's Rank Correlation Coefficient, we used Kendall's Tau, which also measures the strength and direction of a correlation but is more robust small sample sizes.

We found a statistically significant high positive correlation (at the 0.01 level) between eight variables and the final mark, and a weak and insignificant correlation between the variable related to the ability of children in the respondent´s current group to use the ScratchJr environment and the final mark. The final mark for ScratchJr achieved the following statistics: N=86, min=1, max=5, μ=4.52, s=0.731, SE=0.079.

Also, we used Proportional Odds Logistic Regression for Ordered Category Outcomes to predict the probability of each final mark for ScratchJr based on nine variables. The new ordinal

variable, generated from the prediction, was compared to the final mark for ScratchJr, showing a strong and statistically significant ($p<0.01$) Kendall's Tau correlation ($\tau b=0.927$). The results suggest that those nine variables are good predictors of the final mark when using ScratchJr.

Teachers' attitudes toward coding education are shaped by their perceptions of the ease of use and educational benefits of ScratchJr, supporting the validity of our hypothesis H2.

4.4. The Curriculum "Animated Genres" Analysis

Finally, we aimed to estimate the respondents' attitudes towards the "Animated Genres" curriculum.

According to the curriculum, participants were assigned to create an activity for children in the format of a seminar paper, based on their preferred module, "Story" or "Game." The majority (N=86, 71.07%) opted for "Story", while 27 (22.31%) selected "Game", and 8 participants did not provide a preference.

A key finding is related to the respondents' views on the curriculum's applicability within their groups. Most participants, 88 (72.73%), believe the curriculum is relevant for working with children. In contrast, 20 respondents (16.53%) consider it not applicable, while 13 chose not to express their opinion.

Four questions (Table 9) were Likert-type scale with an ordinal scale defined by five values (Unsatisfactory -1, Acceptable -2, Good-3, Very good-4, Excellent-5). Cronbach's alpha was $\alpha = 0.898$, and all items had corrected item-total correlations above 0.78.

To find if there is a correlation between an overall curriculum rating and four individual questions about the curriculum, Kendall's Tau is used to measure the strength and direction of a correlation.

We found a statistically significant high positive correlation (at the 0.01 level) between four variables and the overall curriculum rating. The overall curriculum rating achieved the following statistics: N=102, min=2, max=5, μ=4.56, s=0.638, SE=0.063.

Also, we used Proportional Odds Logistic Regression for Ordered Category Outcomes to predict each value probability. The new ordinal variable, generated as a result of the prediction, was compared to the final mark for overall curriculum rating, and we found a high Kendall's Tau correlation ($\tau b=0.506$) statistically significant ($p<0.01$).

Table 9

Central tendencies and dispersions of Likert-type scale nine variables regarding the course curriculum

Question	N	Min	Max	Mean	SD	Var
Methodical approach of Module 1 "Collage"	113	1	5	4.07	0.82	0.67
Methodical approach of Module 2 "Story"	114	2	5	4.23	0.81	0.66
Methodical approach of Module 3 "Game"	114	2	5	4.31	0.74	0.55
Comprehension of curriculum translation	115	2	5	4.44	0.74	0.55

The "Animated Genres" curriculum is perceived as an effective and practical guide for implementing coding activities with preschoolers, which is in accordance with hypothesis H4. Teachers positively evaluated the curriculum's methodological approach, clarity, and applicability in real classroom settings.

4.5. Comparison with International Models of Teacher Training in Early Childhood Programming

Most research reveals positive attitudes toward the usefulness and ease of use of ScratchJr across different learning systems and countries in Europe and worldwide and Kalogiannakis, and Papadakis in [28, 29], Bers in [27], Bers and Resnick in [30], and Flannery et al. in [32] offered results of these explorations.

Bers in [27] provided precise, systematic analytics and statistical distributions of the use of ScratchJS across geographical areas, world regions, and countries.

One can conclude that "ScratchJr is an appropriate educational environment for pre-service kindergarten teachers" in Greece [28, 29], as well as in Europe [27], the USA [30,32], the UK and the EU, and the Nordic countries [27]. Kalogiannakis and Papadakis in [29] concluded, as we did in our study, that teaching ScratchJr can help teachers. However, they explored in Greece the use of CT and programming as instructional tools in other subject areas (e.g., mathematics and physics). According to Bers [27], "sixteen European countries integrate coding in the curriculum at the national, regional, or local level," and, at that moment, ScratchJr was translated into twelve languages.

Preschoolers and second graders in the USA have shown a significant level of utilization of ScratchJr, which aligns with the results of our study. According to [32], "there were distinct variations in teaching practices across grades and across lessons based on variable physical classroom environments, students' social dynamics, times of day, and other contextual factors". Moreover, Bers in [27] points out that "while students are home for winter vacation, they are not using ScratchJr frequently. There is also a dip in usage during the summer months. The data indicate that ScratchJr is used mainly in school settings."

All the mentioned observations indicate further activities to improve the overall approach, methods, and use of ScratchJr as a tool in CT development in preschool education.

4.6 Contributions of the Study

By analyzing the conducted research, we sought answers to the hypotheses outlined in section 2.4. Figure 3 presents summarized statistical findings. The results confirm what many previous studies have shown: ScratchJR is a powerful educational tool for preschoolers, and teachers enjoy using it. This research concludes that small countries with limited resources and equipment can improve their use of this tool, and the answer lies in effectively organizing courses for future teachers and in motivating young people to improve their knowledge from the very beginning of their careers.

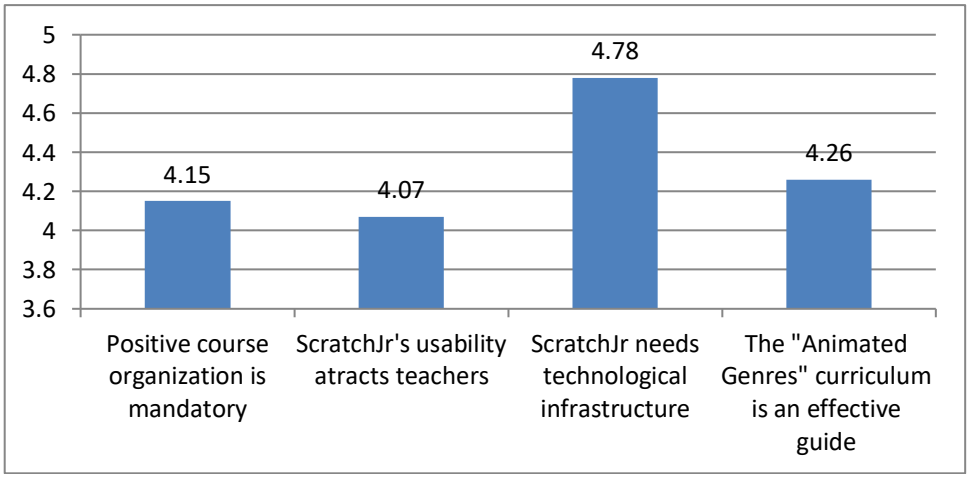

Figure 3. Summarized statistical findings (respondents' attitudes on the scale 1 to 5

4.7. Limitations of the Study

The course was partially conducted during the period of COVID-19 pandemic, which disrupted the usual teaching conditions. The lack of experience and equipment for remote teaching along with the emotional state of both students and lecturers affected the course during that period. The Master's studies course was the main emphasis of the questionnaire.

Hence, the other limitation of the research was the small sample size which could not be adjusted as it reflected the typical number of students for the observed degree of study.

5. CONCLUSIONS AND PROSPECTS FOR FURTHER RESEARCH

By examining preschool teachers' attitudes toward the course related to the programming for preschoolers, the ScratchJr platform, and the "Animated Genres" curriculum, this study aims to comprehensively understand the factors influencing coding education in early childhood environments.

The study was carried out over four years (2020-2023) using a questionnaire administered to master's students who had already obtained a degree in preschool teaching, after each academic year.

The data was evaluated using non-parametric statistics with the inferential data analysis divided into three sections. The first section focuses on attendees' satisfaction with the course's performance. The second section examines the opinions on the ScratchJr application, which was the primary tool used in the course. The third section investigates perceptions of the curriculum titled "Animated Genres."

The research investigates the motivations behind the respondents' decision to enroll in the program, their evaluation of the course content and structure, and their overall satisfaction with in-person and online lectures and practical exercises. Furthermore, it assesses their opinions on the provided literature and learning resources, the alignment of the course with their expectations, and their confidence in utilizing the skills learned in their teaching environments.

Our findings indicated that the course was predominantly attended by less experienced students, and we did not establish that the more experienced participants were specifically engaged with older preschoolers. This led us to conclude that the course primarily appealed to younger participants who would subsequently develop programming skills for preschool education. Satisfaction analysis among course attendees showed that the course was effectively organized. High ratings were given for the quality of learning resources, the syllabus, and the lecturer's motivation. In contrast, online activities received the lowest scores, and the ability to apply the skills gained in practical settings was also rated poorly, prompting an investigation into the underlying causes. Given the current conditions, this was closely linked to the low score regarding the feasibility of implementing software tools in preschools with most respondents identifying the lack of equipment as the main reason (μ=4.78).

The low positive feedback regarding the possibility of using ScratchJr with the children can be attributed to respondents´ perceptions of the biggest obstacle to the implementation of ScratchJr in their institutions—the lack of equipment. Both children and parents show enthusiasm for learning coding. The lack of time in overloaded educational programs and the skills of teachers do not affect the use of ScratchJr.

The finding about the respondents' perceptions of the applicability of the "Animated Genres" curriculum for their groups is a key area of interest. The majority of those interviewed believe the curriculum can effectively engage, motivate, and educate children.

To summarize, the course received strong ratings over four years of evaluation: Acceptable quality performance score μ=4.62, the selected software tool (final score for ScratchJr μ=4.52), and the curriculum (μ=4.56).

The findings can offer valuable insights for educators, curriculum developers, and policymakers seeking to enhance coding instruction for young learners.

In the future, the research can be expanded to other locations, and the research topics can be adjusted, especially in light of new developments such as the procurement of equipment, the introduction of new program foundations for kindergartens in Serbia that promote integrative approaches, and the growing parental interest in children mastering modern technologies from an early age.

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CRediT AUTHORSHIP CONTRIBUTION STATEMENT

Aleksandar Spasić: Writing – original draft, Writing – review & editing, Methodology, Conceptualization, Investigation, Data curation, Supervision. **Miljana Mladenović:** Writing – review & editing, Methodology, Formal analysis, Data curation, Supervision. **Bratislav Nikolić:** Data curation, Visualisation, Supervision.

DECLARATION OF GENERATIVE AI AND AI-ASSISTED TECHNOLOGIES IN THE WRITING PROCESS

During the preparation of this work, the authors used ChatGPT, Quillbot and Grammarly in order to improve the readability of the manuscript. After using this tool, the authors reviewed and edited the content as needed and take full responsibility for the content of the publication.

DECLARATION OF COMPETING INTEREST

The authors declare that they have no known competing financial or personal conflicts of interest that could have influenced the work reported in this paper.

DATA AVAILABILITY

Data will be made available on request.

APPENDIX A: QUESTIONNAIRE

1. Basic Data of the Respondents

1.1	Age		
1.2	Years passed from completion of undergraduate studies		
1.3	Years of professional work experience (if applicable; if not, enter 0)		
1.4	Age group of children you currently work with (if applicable) – age of the children		
1.5	Gender	M	F
1.6	Previous experience with any form of programming	Yes	No

2. Information About the Course "Programming for preschoolers"

2.1	What is your reason for choosing this course?	1. By chance; 2. Recommendation from a colleague; 3. Expected ease of passing; 4. Relevance and modernity; 5. Gaining competencies for the future; 6. Other, specify: _____
2.2	How do you rate the topics and content of the course?	1. Unsatisfactory; 2. Acceptable; 3. Good and useful 4. Very good and applicable; 5. Excellent and inspiring
2.3	How do you rate in-person lectures?	1. Unsatisfactory; 2. Acceptable; 3. Good; 4. Very good; 5. Excellent
2.4	How do you rate online lectures?	1. Unsatisfactory; 2. Acceptable; 3. Good; 4. Very good; 5. Excellent
2.5	How do you rate online practical exercises?	1. Unsatisfactory; 2. Acceptable; 3. Good; 4. Very good; 5. Excellent
2.6	How do you rate the quality of the provided literature and the availability of learning resources (software, examples, etc.)?	1. Unsatisfactory; 2. Acceptable; 3. Good; 4. Very good; 5. Excellent
2.7	How do you rate the lecturer's motivation?	1. Unsatisfactory; 2. Acceptable; 3. Good; 4. Very good; 5. Excellent
2.8	To what extent did the course meet your expectations?	1. Unsatisfactory; 2. Acceptable; 3. Moderate; 4. Almost complete; 5. Complete
2.9	9 How do you rate your ability to apply the knowledge and skills acquired in this course?	1. Unsatisfactory; 2. Acceptable; 3. Good; 4. Very good; 5. Excellent
2.10	How satisfied are you with the pre-exam assignments and assessments?	1. Unsatisfactory; 2. Acceptable; 3. Good; 4. Very good; 5. Excellent
2.11	Overall course rating:	1 2 3 4 5

3. Information About „ScratchJr“ Studio

3.1	Have you encountered the "ScratchJr" environment before taking this course?	1. No 2. Yes
3.2	How do you rate the ease of installing the ScratchJr environment?	1. Unsatisfactory; 2. Acceptable; 3. Good; 4. Very good; 5. Excellent
3.3	On which device and operating system did you use ScratchJr during the course?	1. Tablet iPad; 2. Tablet w/Android; 3. PC w/desktop version; 4. PC w/Android emulator; 5. Smartphone iPhone; 6. Smartphone w/Android
3.4	How do you rate the simplicity of the ScratchJr user interface?	1. Unsatisfactory; 2. Acceptable; 3. Good; 4. Very good; 5. Excellent
3.5	How do you rate the clarity of ScratchJr blocks?	1. Unsatisfactory; 2. Acceptable; 3. Good; 4. Very good; 5. Excellent
3.6	How do you rate the quality of the character and background drawing editor?	1. Unsatisfactory; 2. Acceptable; 3. Good; 4. Very good; 5. Excellent
3.7	How do you assess the ability of children in the group you currently work with to use the ScratchJr environment?	1. Unsatisfactory; 2. Acceptable; 3. Good; 4. Very good; 5. Excellent
3.8	How do you rate the potential of ScratchJr in supporting children's language, speech, and early literacy development?	1. Unsatisfactory; 2. Acceptable; 3. Good; 4. Very good; 5. Excellent
3.9	How do you rate the potential of ScratchJr in developing logic and early mathematical concepts?	1. Unsatisfactory; 2. Acceptable; 3. Good; 4. Very good; 5. Excellent
3.10	How do you rate the potential of ScratchJr in introducing children to their environment?	1. Unsatisfactory; 2. Acceptable; 3. Good; 4. Very good; 5. Excellent
3.11	How do you rate the potential of ScratchJr in fostering children's artistic development?	1. Unsatisfactory; 2. Acceptable; 3. Good; 4. Very good; 5. Excellent

3.12	Rate from 1 (lowest) to 5 (highest) what you consider the greatest obstacle to using ScratchJr in your institution.	____ Lack of equipment (tablets) ____ Lack of time in the current education program ____ Insufficient competence of educators ____ Negative attitude of parents ____ Children's lack of interest
3.13	Overall rating of ScratchJr	1 2 3 4 5

4. Information About the Curriculum „Animated genres“

4.1	Do you believe the curriculum can be applied in practice with your group?	1. No 2. Yes
4.2	How do you rate the methodical approach of Module 1 "Collage" – (first 4 lessons)?	1. Unsatisfactory; 2. Acceptable; 3. Good; 4. Very good; 5. Excellent
4.3	How do you rate the methodical approach of Module 2 "Story" – (lessons 5 and 6)?	1. Unsatisfactory; 2. Acceptable; 3. Good; 4. Very good; 5. Excellent
4.4	How do you rate the methodical approach of Module 2 "Game" – (lessons 7 and 8)?	1. Unsatisfactory; 2. Acceptable; 3. Good; 4. Very good; 5. Excellent
4.5	How do you rate the clarity of the curriculum translation you received?	1. Unsatisfactory; 2. Acceptable; 3. Good; 4. Very good; 5. Excellent
4.6	What is the area from which is topic of your seminar paper?	2. Story; 3. Game
4.7	Overall curriculum rating	1 2 3 4 5

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ОЦІНЮВАННЯ СПРИЙНЯТТЯ ВЧИТЕЛЯМИ ПРОГРАМУВАННЯ ШОДО ЙОГО ВПРОВАДЖЕННЯ У ДОШКІЛЬНУ ОСВІТУ

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Анотація. Це дослідження присвячене вивченню думки вихователів дошкільних закладів про курс програмування, розроблений спеціально для педагогів, які працюють з дітьми дошкільного віку, з акцентом на платформі ScratchJr та навчальній програмі «Анімовані жанри». Дослідження проводилось протягом чотирьох навчальних років з 2020 по 2023 рік і передбачало опитування з 37 запитань, адресоване студентам магістратури, які раніше отримали кваліфікацію вихователя дошкільних закладів. Опитування було розділене на чотири частини: демографічні дані, результати респондентів у курсі, їхні думки про ScratchJr та їхні оцінки навчальної програми «Анімовані жанри». Для аналізу даних були застосовані непараметричні описові та інференційні статистичні методи.

Учасники дали високі оцінки організації курсу, особливо навчальним матеріалам, програмі та ентузіазму викладачів. Однак потенціал застосування навичок, отриманих у класі, отримав нижчі оцінки. Головною перешкодою було визнано відсутність необхідного обладнання в

дошкільних закладах (μ=4,78), що заважало використанню таких інструментів, як ScratchJr. Ці проблеми не мали значного впливу на оцінку ScratchJr. Крім того, багато респондентів вважали навчальну програму «Анімовані жанри» ефективним методом залучення, мотивації та навчання дітей.
У підсумку протягом чотирирічного періоду оцінювання курс отримав високі оцінки (оцінка якості виконання μ=4,62), як і інструмент ScratchJr (μ=4,52) та навчальна програма (μ=4,56). Ці висновки надають важливу інформацію для освітян, розробників навчальних програм та політиків, які прагнуть поліпшити освіту в галузі програмування для учнів дошкільних навчальних закладів, підкреслюючи необхідність повністю усунути інфраструктурні обмеження, щоб скористатися перевагами раннього навчання програмуванню.
Дослідження виявило технологічні, освітні та соціальні можливості, а також обмеження викладання програмування в сербських дошкільних закладах.

Ключові слова: навчання програмуванню в ранньому дитинстві; сприйняття вихователів дошкільних закладів; обчислювальне мислення в дошкільних закладах; ScratchJr: навчальна програма з анімованих жанрів.

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