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EXPLORING PRIMARY SCHOOL STUDENTS' MOTIVATION AND ENJOYMENT IN LEARNING PROGRAMMING THROUGH GAMIFICATION

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Abstract: Globally, a growing trend and numerous initiatives are focused on reducing the age at which programming is introduced, leading to the implementation of updated computing curriculums in many countries. In Serbia, the informatics curriculum underwent a significant transformation in the 2017/2018 academic year, gradually becoming a compulsory course throughout all grades in elementary schools. Programming, a prominently featured subject, is primarily taught through gamification. Despite this, the research investigating the coding motivation and enjoyment among primary school students in Serbia when acquiring programming skills through gamification is fairly limited. These factors are crucial, given their documented influence on the practical application of games in programming. This study seeks to explore the variables that impact the motivation and enjoyment of primary school students in learning programming. Surveying 108 participants, a multiple linear regression analysis identified positive effects of enjoyment and social influence on students' motivation. Conversely, self-efficacy demonstrated no direct effect on motivation. Additionally, the results indicated a positive correlation between primary school students' self-efficacy and perceived enjoyment. The research offers practical insights for educators and policymakers. Understanding the motivational factors and enjoyment levels in learning programming through gamification can guide the design of effective teaching strategies. Educators can leverage these insights to tailor approaches, emphasizing the elements that enhance enjoyment and social interaction. Policymakers should consider these results when refining curriculum guidelines, ensuring alignment with students' motivation for a positive learning experience. Teacher training programs can incorporate these findings to better prepare educators for optimizing the gamified learning environment in programming education.

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INTRODUCTION

In today's tech-driven world, there's a growing need to develop skills for navigating the digital era. Computational thinking (CT) has become vital, fostering analytical and problem-solving skills crucial for coding proficiency (Wing, 2006; Tsai et al., 2019). Integrating programming skills into education can enhance CT abilities, that are essential for future readiness, particularly among primary school students (Popat & Starkey, 2019; ISTE, 2016).

Educational resources promoting CT include various tools like digital games, robotics, and programming platforms (Shute et al., 2017). Digital games provide special benefits for student-centered e-learning environments within traditional classrooms (Giannakoulas & Xinogalos, 2018).

Many nations are updating their computing curricula by introducing programming at younger ages (Education Bureau, 2016). In Serbia, a significant shift occurred in 2017/2018, making informatics mandatory across all elementary grades, with programming taught mainly through gamification (Regulation I-IV, 2023; Regulation V-VI, 2023; Regulation VII, 2023; Regulation VIII, 2023).

Numerous global initiatives have integrated coding games into elementary curricula, resulting in improved problem-solving, coding skills, and learning attitudes (Kazimoglu et al., 2012; Bachu & Bernard, 2011; Theodoropoulos et al., 2017). While the reasons behind children's motivation in coding activities are not fully understood, emotions likely play a crucial role, prompting more research in this area (Papavlasopoulou et al., 2020).

Studies have shown that students gain confidence and enjoy programming, especially in block-based environments (Seraj et al., 2020; Bishop-Clark et al., 2006). Enjoyment and motivation predict the usage of coding games for learning computational thinking, highlighting their importance in programming education (Zhang et al., 2023; Milutinović, 2024).

Factors influencing motivation for learning programming include individual attitudes, rewards, challenging goals, and social pressure (Hawi, 2010). Nevertheless, the underlying factors driving children's motivation to engage in such activities remain incompletely comprehended (Papavlasopoulou et al., 2020). Collaborative work also boosts motivation, yet little is known about its connection with positive attitudes like enjoyment and motivation (Sharma et al., 2019). A deficiency exists in understanding the precise emotions encountered and their functions within technology-driven learning settings (Graesser, 2020).

To fill this research gap, our study focuses on factors influencing perceived enjoyment and coding motivation among Serbian primary school students. By understanding these variables, we aim to shed light on the role of enjoyment in motivating students to learn programming, informing the development of more effective coding education programs tailored to students' needs.

LITERATURE REVIEW

Using Gamification in Programming Instruction

Gamification, an educational strategy where learners tackle challenges within game-based environments to meet specific learning goals (Wang & Zheng, 2020; Zhan et al., 2022), has gained traction in educational contexts, enhancing students' motivation and enjoyment in learning (Alsawaier, 2018). In Serbia, the informatics curriculum underwent significant changes in 2017/18, becoming mandatory for all elementary grades, with programming integrated into lessons from fifth to eighth grades and block-based programming introduced from first to fourth grades through platforms like Code.org, Micro:bit, and Scratch (Ristić et al., 2016). Despite this, research on Serbian primary students' enjoyment and motivation in gamified programming instruction remains scarce (Lambić et al., 2021).

Scratch, a widely used tool in schools, fosters computational thinking, problem-solving, creativity, and collaboration, offering an engaging and enjoyable learning experience (Dúo-Terrón, 2023). Our study investigates the factors influencing perceived enjoyment and coding motivation in programming education through games, addressing a gap in research on primary school students' engagement with coding through gamification (Ortiz-Rojas et al., 2017). While previous studies have employed the Technology Acceptance Model to examine coding games' efficacy in teaching computational thinking (Zhang et al., 2023), few have explored primary students' motivation and enjoyment in coding education through gamification. Thus, our research seeks to fill this void by examining these factors among primary school students in Serbia.

Coding Motivation and Perceived Enjoyment

Coding motivation, the internal drive to engage in coding activities, is influenced by intrinsic factors like personal interest and task satisfaction (Kong et al., 2018; Mason & Rich, 2020). Understanding factors that influence motivation is vital for promoting effective learning experiences in programming education, as motivation significantly impacts students' confidence and computational thinking skills (Kong et al., 2018). Social influences also play a crucial role, with studies showing their positive effect on coding interest and attitudes, particularly in gamified learning environments (Mason & Rich, 2020; Garcia et al., 2021). Additionally, research emphasizes the importance of social interactions, including those with family members, in fostering coding motivation and identity, underscoring the need for confidence-building activities in curricula (Garcia et al., 2023; Budiyanto et al., 2021).

The perception of enjoyment in coding activities, referring to individuals' subjective satisfaction from programming tasks, significantly influences attitudes and behaviors toward coding (Mason & Rich, 2020; Zhang et al., 2023). When coding is perceived as enjoyable, individuals are more likely to engage willingly and persistently (Mason & Rich, 2020; Zhang et al., 2023).

Studies show that students' acceptance of Scratch, a programming language, is strongly influenced by perceived enjoyment (Arpaci et al., 2019). Emotions like happiness positively affect students' participation in programming environments (Giannakos et al., 2014). While enjoyment indirectly influences learning perceptions, it does not directly impact learning outcomes (Tisza & Markopoulos, 2021). Frequent engagement in coding activities enhances perceived enjoyment and fosters a positive attitude toward coding (Mason & Rich, 2020). Understanding the relationship between students' confidence and enjoyment in programming can inform the design of effective coding education programs and materials.

METHOD

Built upon the literature review in programming education, this research aims to explore the factors shaping the motivation and enjoyment of elementary school students during a gamified programming instruction. The variables of interest encompass social influence (SI), coding confidence (CO), perceived enjoyment (PE), and programming motivation (MOTIV). This study endeavors to answer the following research questions:

1. To what degree do the variables SI and PE predict primary school students' coding motivation (MOTIV)?
2. How accurately do CO and MOTIV predict primary school students' perceived enjoyment (PE) while engaging in coding games?

Research Participants and Procedure

The study involved 108 students from Serbian primary schools, randomly selected from one urban primary school, including both the first and second cycles.

The students from grades 1 to grade 5, who were engaged in block-based programming and gamification, were chosen as respondents. Each student provided informed consent, ensuring voluntary participation and data anonymity. The researchers were committed to strict adherence to ethical principles like autonomy, respect, justice, confidentiality, and compassion. The questionnaires, available in Serbian, were administered, and the participants were informed of their right to withdraw. On average, the survey took approximately 10 minutes to complete. The sample comprised students aged 9.48 years on average (SD = 1.67), with 43.5% being male.

Instrument and data analysis

This study employed a two-part research questionnaire to examine the interrelationships between various variables. The initial section gathered demographic information such as age, gender, and grade. Gender was assigned numeric codes: 1 for males and 2 for females. The subsequent section focused on participant self-assessments regarding four factors: perceived enjoyment (PE), social influence (SI), programming confidence (CO), and motivation for programming (MOTIV). Each factor comprised specific subscales, and responses were rated on a six-point Likert scale ranging from 1 (strongly disagree) to 6 (strongly agree). The survey items were drawn from credible scholarly sources with established reliability (Zhang et al., 2023; Mason & Rich, 2020). Translation and validation of the scales were conducted by the author and a bilingual expert to ensure linguistic precision and cultural relevance.

To analyze the data, we utilized SPSS 17.0 and conducted statistical analyses, such as descriptive statistics, correlations, and hierarchical multiple linear regression.

RESULTS

Descriptive analysis

We used SPSS to analyze primary school students' motivation and enjoyment in learning programming through gamification. *Table 1* summarizes descriptive statistics for each construct, showing predominantly positive responses with mean scores exceeding 4 (out of 5). The standard deviations ranged from 1.49 to 1.53, indicating limited variability, while skewness and kurtosis values met acceptable levels of univariate normality (|3| and |10|, respectively), as recommended (Kline, 2011).

Table 1: Descriptive statistics of the constructs.

Variable	Mean	Std. Deviation	Skewness	Kurtosis	Cronbach's Alpha (a)
SI	4.61	1.462	-0.983	0.156	0.835
CO	4.10	1.486	-0.576	-0.723	0.828
MOTIV	4.67	1.418	-1.077	0.214	0.824
PE	4.61	1.533	-1.162	0.347	0.790

Note. SI = Social influence; CO = Feeling of coding Confidence (Competence); PE = Perceived feeling of enjoyment; MOTIV = Coding motivation.

Evaluation of the Measurement Model

Correlation and multiple regression analyses were employed to investigate the interconnections among variables. Initial assessments indicated that the assumptions of normality, linearity, homoscedasticity, and absence of multicollinearity remained unaltered.

*Table 2: Correlation coefficients among the constructs and the discriminant validity assessment; **p<0.05; *p<0.1*

	MOTIV	SI	CO	PE
MOTIV	**0.839**			
SI	0.242**	**0.861**		
CO	-0.007	-0.093	**0.763**	
PE	0.179**	-0.052	0.144**	**0.819**

Note. SI = Social influence; CO = Feeling of coding Confidence (Competence);
PE = Perceived feeling of enjoyment; MOTIV = Coding motivation.

We can observe from *Table 2* that perceived enjoyment (PE) and coding confidence (CO) show a positive correlation ($p < 0.05$), as do social influence (SI) and motivation (MOTIV), and perceived enjoyment (PE) and motivation (MOTIV). Additionally, the discriminant validity assessment, based on Fornell and Larcker's (1981) criteria, reveals that each construct's correlation with others in the model is less than its average variance extracted (AVE) or diagonal value, supporting the independence of latent factors. This indicates satisfactory discriminant validity, with each construct explaining more variation in its measures than in other constructs. Internal consistency, measured by Cronbach's alpha, ranged from 0.79 to 0.83, suggesting reliable results (De Vellis, 2003).

Regression analysis

As correlations were significant and positive between SI and MOTIV, and PE and MOTIV, we employed multiple regression analysis to test if SI and PE significantly predicted students' motivation to learn programming. The results of the regression indicated that the two predictors explained 7% of the variance in MOTIV ($R^2 = 0.07$, $F (2,105) = 3.957$, $p < 0.05$). It was found that SI predicted MOTIV ($\beta = 0.214$, $p < 0.05$), as did PE ($\beta = 0.165$, $p < 0.1$), although the significance of PE was only at the 0.1 level.

As seen in Table 2, PE was correlated with CO and MOTIV, and correlations were positive. Therefore, a second multiple regression analysis was used to test if CO and MOTIV significantly predicted students' perceptions of enjoyment in learning programming through gamification.

The multiple regression model with two predictors produced $R^2 = 0.056$, $F (2, 105) = 3.111$, $p < 0.05$, indicating that the two predictors explained 5.6% of the variance in PE. Predictor CO ($\beta = 0.177$, $p < 0.1$) had a significant positive regression weight, indicating that students with higher scores on this scale were expected to have higher perceived enjoyment in learning programming through gamification. The MOTIV scale did not contribute to the multiple regression model.

DISCUSSION

This study aimed to explore the determinants affecting the motivation and enjoyment of primary school students in gamified programming education, considering both prior studies on programming education and distinctive features of gamification. The variables examined encompassed social influence (SI), coding confidence (CO), perceived enjoyment (PE), and programming motivation (MOTIV).

Primary School Students' Motivation and Enjoyment

Our study findings indicated significant and positive correlations between social influence (SI) and motivation for programming (MOTIV) and perceived enjoyment (PE) and MOTIV, as well as enjoyment (PE) and coding confidence (CO). To delve deeper into these connections, we employed multiple regression analyses.

The first regression analysis aimed to ascertain whether SI and PE significantly predicted students' motivation to learn programming, addressing the primary research question. The findings revealed that together, both predictors accounted for 7% of the variance in MOTIV, with SI emerging as a significant predictor, while PE approached significance ($p < 0.1$). This finding is consistent with previous research (Mason and Rich, 2020), which found the positive impact of social influence on coding interest, perceived usefulness, and attitudes toward programmers. These results imply that the influence of peers and educators, alongside students' perceived enjoyment in programming tasks, significantly impacts their motivation to participate in programming education. When parents regard coding as a valuable skill and actively strive to convey its significance to their children, especially through the provision of immersive game-based learning experiences, it cultivates heightened motivation for children to engage in coding activities. Likewise, according to Social Comparison Theory, students evaluate their levels of motivation by measuring themselves against their peers, potentially spurring them to enhance their performance (Buunk & Gibbons, 2007).

The significant influence of enjoyment on motivation is in line with other studies (Mason & Rich, 2020; Zhang et al., 2023). Enjoyment significantly boosts primary school students' motivation for coding by making the learning process more engaging and fun. When students find coding enjoyable, they are more likely to participate actively, develop a positive association with the subject, and persist through challenges. This intrinsic motivation leads to greater creativity, exploration, and a deeper understanding of coding concepts.

Subsequently, a second regression analysis explored whether CO and MOTIV significantly predicted students' perceived enjoyment in learning programming through gamification, addressing the second research question. The results indicated that the two predictors collectively explained 5.6% of the variance in PE. Notably, coding confidence emerged as a significant predictor, suggesting that students with higher levels of coding confidence were more likely to experience greater enjoyment in learning programming through gamification. Therefore, efforts to enhance coding confidence among learners may contribute to fostering a more enjoyable and engaging learning environment in programming education, particularly when gamification strategies are employed. This finding aligns with the Expectancy-Value Theory of Achievement Motivation (Wigfield & Eccles, 2000). Additionally, Milutinović (2024) discovered that programming self-efficacy indirectly influences perceived enjoyment through perceived ease of use among primary school students. This implies that when students feel confident in coding, they perceive it as easier and more enjoyable.

Overall, these findings highlight the complex interplay between social influence, coding confidence, perceived enjoyment, and motivation in the context of gamified programming education. Educators can leverage these insights to design interventions and learning experiences that foster positive social interactions, enhance students' coding confidence, and cultivate an enjoyable learning environment, ultimately promoting greater motivation and engagement in programming education.

Implications for practice

The results of this research should assist policymakers and management at teacher training institutes, especially in Serbia, to devote particular focus on aspects that play a decisive role in enhancing positive motivation among students about programming. Future educational programs could benefit from emphasizing gamified learning environments to enhance motivation, focusing on improving coding skills to ease the learning process making it more enjoyable, and tailoring social influences that contribute to students' motivation to learn programming.

The implications of our findings highlight the crucial role of social influence and perceived enjoyment in motivation for programming education. Firstly, social influence has a major impact on students' motivation. This emphasizes how important it is for teachers to create friendly and cooperative learning environments. Students' motivation to actively participate in programming activities can be increased by fostering strong relationships with teachers and excellent peer interactions. The significant role of social impact, particularly from guardians and peers, in students' motivation for coding through gamification highlights the interconnectedness of social flow and learning experiences.

Furthermore, the significance of creating programming activities that are engaging and pleasurable for students is indicated by the impact of perceived enjoyment on motivation. Enhancing the overall learning experience can be achieved by incorporating gamification elements and providing opportunities for students to improve their coding skills. When students feel confident in coding, they perceive it as easier and more enjoyable (Milutinović, 2024). The research findings from Sevin and DeCamp (2016) highlight that engaging in video games significantly enhances both computer confidence and interest in computer science. This implies that exposure to video games as a recreational activity can improve players' proficiency in utilizing non-recreational coding and cultivate a more extensive interest in technology as a whole.

By leveraging parental support, peer influence, and gamification elements that enhance social impact, teachers can create a compelling and inclusive environment that fosters students' motivation for coding and promotes sustained engagement and learning. According to Milutinović's (2024) findings, addressing gender inequities and tailoring programming instruction to students' varying developmental stages are crucial components of developing a diverse and successful programming curriculum. Through the customization of programming gamified projects based on students' interests and skill levels, teachers may foster a pleasant learning environment that supports long-term engagement and intrinsic motivation.

In summary, these findings stress the significance of promoting favorable social interactions, fostering enjoyment, and instilling coding confidence in programming education. By addressing these aspects, educators can elevate students' motivation and enjoyment in learning programming, ultimately fostering a more positive and immersive learning journey.

Limitations of the Study and Future Research

The study's findings may not generalize to students in different grades or educational settings due to variations in motivation-influencing factors. Self-reported measures for coding competency, motivation, and perceived enjoyment may introduce biases or inaccuracies. The cross-sectional design limits establishing causal relationships between variables, and the low variance explained suggests other unmeasured factors may have a greater impact on motivation and enjoyment.

Future research should explore the evolving dynamics of social influence, coding competence, motivation, and enjoyment in programming education for elementary students. Longitudinal studies can track these factors over time, while comparative research across various educational settings and age groups can enhance generalizability. Qualitative methods like interviews can provide deeper insights, and investigating the impact of teaching practices on student motivation and enjoyment is crucial for refining pedagogical strategies.

CONCLUSION

This study explored factors influencing primary school students' motivation and enjoyment in learning programming in Serbia. The results showed that social influence and enjoyment significantly impacted motivation while coding competence influenced perceived enjoyment. These findings stress the importance of considering social influence and coding competence in programming education strategies for elementary students. This research contributes to understanding motivation in programming education, particularly in regions with lower technological advancement. It lays the groundwork for further investigation into elementary students' attitudes toward programming education, especially in culturally similar contexts with limited research.

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