Perceived Barriers and ICT-Related Attitudes among Secondary School Students in Croatia: An Exploratory Study

Marko Mikša
Alma Mater Europaea University, University of Applied Sciences Hrvatsko Zagorje Krapina, Croatia
Ivan Balabanić
Institute for Migration Research, Croatia
Sanja Sever Mališ
Ekonomski fakultet Zagreb, University of Zagreb, Croatia

Abstract

Background: This paper examines factors influencing students' engagement with information and communication technologies (ICT) in secondary education. While prior research typically distinguishes between intrinsic and extrinsic inhibitors, empirical evidence on their joint and differentiated effects remains limited, particularly in the context of transition economies. **Objectives:** The study aims to analyse the role of intrinsic inhibitors and external influences in shaping ICT-related attitudes and use among secondary school students, with a focus on their interrelationships. **Methods/Approach:** Data were collected from 187 high school students in Northern Croatia and the City of Zagreb. The analysis combines confirmatory factor analysis, network analysis, and structural equation modelling. **Results:** The results support a three-factor structure consisting of intrinsic inhibitors, external influences, and ICT use. External influences have a strong positive effect on intrinsic inhibitors, which, in turn, negatively affect ICT use. At the same time, external influences have a direct positive effect on ICT use, indicating the presence of competing effects. This suggests that external factors simultaneously increase exposure to ICT while generating psychological barriers that limit its effective use. **Conclusions:** The findings highlight the complex role of external influences in ICT adoption. Rather than acting solely as barriers, they also function as drivers of ICT exposure. Policy efforts should therefore focus not only on improving infrastructure and teacher preparedness but also on reducing students' psychological barriers to ICT use.

Keywords: information and communication technologies; ICT use; secondary education; intrinsic inhibitors; external influences; Croatia

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Introduction

The integration of Information and Communication Technologies (ICT) in educational environments has become an important component of contemporary learning. ICT tools enable more interactive, engaging, and flexible learning experiences, thereby enhancing both teaching practices and student outcomes. However, despite these advantages, many students encounter barriers that limit their ability to use ICT effectively in everyday educational activities.

In the literature, these barriers are commonly classified as first-order (external) and second-order (intrinsic) inhibitors. First-order barriers are infrastructural and technical constraints, such as insufficient hardware and software, limited device access, and unstable internet connectivity. Second-order barriers relate to internal factors, including students' digital competencies, teachers' pedagogical beliefs, and resistance to change (Shi, 2016). Empirical studies identify a wide range of inhibitors, including limited digital skills, perceived effort required to use ICT, and emotional responses such as anxiety or stress associated with technology use (Timotheou et al., 2022; Mairal-Llebot et al., 2023). In addition, inadequate ICT infrastructure, including poor-quality hardware and software, remains a persistent challenge. Accessibility issues, such as unequal access to devices and reliable internet, further contribute to the digital divide (Kumar, 2018). Technological constraints, including device incompatibility, shared access, and high data costs, also hinder students' engagement with digital learning platforms (Rahiem, 2020). Moreover, the lack of up-to-date educational resources and insufficient school facilities continues to limit the effective use of ICT (Mohd et al., 2024). Pedagogical challenges, such as misalignment between ICT tools and curriculum objectives and inadequate teacher training, further complicate ICT integration in education (Chama & Subaveerapandiyan, 2023; Msafiri et al., 2023; Mohd et al., 2024).

These barriers can significantly constrain the potential of ICT to improve learning outcomes, highlighting the need to understand better the mechanisms underlying students' engagement with digital technologies (Venkatesh et al., 2012; Aesaert et al., 2017; Scherer et al., 2019). While prior research has provided valuable insights into intrinsic and extrinsic inhibitors, two important limitations remain. First, most studies examine these factors independently, without analysing their joint and potentially interacting effects. Second, external factors are typically conceptualised solely as barriers, without considering their possible dual role in simultaneously shaping both exposure to and resistance toward ICT use.

This limitation is particularly relevant in transition economies, where structural inequalities in access to digital infrastructure coexist with rapid digitalisation processes. In the Croatian context, research on secondary education has primarily focused on infrastructural constraints, curriculum limitations, and insufficient teacher training, while psychological and motivational aspects remain less explored (Rogošić et al., 2021). The implementation of the e-Škole project aimed to improve ICT infrastructure and teacher competencies, thereby creating conditions for digital transformation in education (CARNET, 2023; Mijatović, 2023). However, recent findings indicate that, despite these improvements, significant barriers to ICT use persist (CARNET, 2023).

Against this background, this study addresses the identified gap by examining both intrinsic inhibitors and external influences within a unified analytical framework. In contrast to the dominant perspective, external factors are not treated exclusively as constraints, but as multidimensional influences that may simultaneously increase exposure to ICT while generating psychological barriers to its effective use. The broader relevance of this topic is also linked to youth employability, as Krpan, Gardijan Kedžo, and Žmuk (2023) show that educational attainment and labour market

outcomes among young adults differ substantially across European countries, highlighting the need for education systems to prepare students for changing skill demands.

Methodologically, the study contributes by combining confirmatory factor analysis, network analysis, and structural equation modelling, thereby enabling both the validation of the measurement structure and the examination of complex relationships between constructs.

The empirical analysis is based on a survey conducted among high school students aged 16 and above in the City of Zagreb and Northern Croatia. The sample includes 187 students from 12 general and vocational secondary schools. Data were collected during May and June 2024 using an online questionnaire.

The remainder of the paper is structured as follows. Section 2 presents the literature review and theoretical background. Section 3 outlines the research propositions. Section 4 describes the methodology. Section 5 presents the empirical results, followed by a discussion in Section 6. Section 7 concludes the paper with key findings, limitations, and directions for future research.

Literature Review

Intrinsic inhibitors, such as fear of technology (technophobia, technostress), low confidence, and low motivation, can significantly limit students' engagement with and use of digital tools (Rone et al., 2021). Psychological barriers of this kind are often compounded by students' limited exposure to digital technologies, particularly in under-resourced schools, which further reinforces their reluctance. Technophobia and technostress have developed in parallel with technological advancement, reflecting the increasing complexity of digital environments (Hang et al., 2022; Rehman et al., 2024). A study conducted in Ireland with 150 older adults and 291 undergraduate students examined levels of technophobia using instruments measuring anxiety, cognition, and attitudes toward computer technology. The findings indicate that technophobia is present among students and may negatively affect their willingness to use ICT in educational contexts (Hogan, 2009).

Psychological factors, particularly self-efficacy and perceived usefulness, also play a crucial role in shaping students' engagement with ICT (Venkatesh et al., 2012; Kulviwat et al., 2014). In the study by Sui et al. (2024), conducted with 262 eighth-grade students in the science field, technology-supported self-assessment tools were shown to significantly influence self-regulation, with self-efficacy operating through perceived usefulness. Similarly, a study of 267 students in Bahrain found that higher levels of computer self-efficacy are associated with a stronger intention to use ICT in education (Afari et al., 2023). These findings suggest that a lack of confidence and motivation can substantially reduce students' willingness to integrate ICT into their educational activities.

On the other hand, external constraints related to infrastructure and institutional conditions continue to shape ICT use in education. Unstable technical infrastructure, insufficient teacher preparedness, and limited access to reliable internet or ICT devices represent persistent challenges (Suryani, 2010; Tondeur et al., 2017). Beyond technical limitations, administrative policies and inadequate funding for digital education further reinforce these constraints, highlighting their systemic nature. The study by Rogošić et al. (2021), conducted in secondary vocational schools in the Zagreb and Zagreb County area with a sample of 29 teachers and 48 students, identifies inadequate school equipment, technical difficulties, and insufficient teacher training as key barriers to ICT use. In addition, the lack of financial resources and limited

availability of high-quality digital educational content further complicate the effective integration of technology in education (Rogošić et al., 2021).

The e-Škole project, implemented in Croatia between 2015 and 2022, aimed to digitally transform the educational system by introducing ICT infrastructure and supporting teacher training (Korda, 2023). Although this initiative significantly improved technical conditions, evidence suggests that important challenges persist. Despite a growing body of literature on the benefits of ICT in education, research focusing specifically on inhibitors in Croatian secondary education, particularly outside major urban centres, remains limited.

That these challenges remain is supported by several empirical studies. Research conducted on 152 university students and 118 high school students in Osijek between 2016 and 2020 shows that ICT use increased during the COVID-19 pandemic due to necessity; however, attitudes toward ICT, although more positive, remained only moderately favourable (Ivić & Blagojević, 2022). Similarly, Sudarić (2020) reports that, despite improvements in ICT infrastructure, persistent issues such as slow internet connections and difficulties in using specific applications continue to limit effective use. Students reported difficulties in navigating certain programs and required additional support (Sudarić, 2020). The relevance of digital tools in secondary and higher education is also supported by Pavić, Mijušković, and Žager (2022), who examine the dominance of Google, Microsoft, and Zoom tools in educational settings and show that the use of digital platforms became particularly visible during pandemic-related shifts to online teaching.

Further evidence from vocational high schools in Zagreb and Zagreb County indicates that teachers identify insufficient equipment, outdated curricula, and a lack of additional training as key barriers to ICT integration (Rogošić et al., 2021). From the students' perspective, difficulties include distinguishing between reliable and unreliable online information and low intrinsic motivation to use ICT (Rogošić et al., 2021). Teachers also emphasise that ICT should remain a complementary tool rather than a full substitute for traditional teaching methods, as many perceive it to have limited or even negative effects on learning outcomes (Rogošić et al., 2021). In addition, ICT use is associated with increased teacher preparation time and reduced student physical activity, while frequent technical problems disrupt teaching continuity (Rogošić et al., 2021). The lack of high-quality digital educational content further contributes to dissatisfaction among both students and teachers.

Overall, despite substantial improvements in infrastructure and policy initiatives, the effective use of ICT in education remains constrained. The evidence suggests that both internal psychological barriers and external contextual conditions continue to limit the full potential of ICT in educational practice.

Intrinsic Inhibitors

Intrinsic inhibitors include psychological and personal factors that shape an individual's willingness to engage with ICT tools (Teo, 2010; Pérez-Juárez et al., 2023). These barriers include a lack of intrinsic motivation, limited ICT skills, fear of failure, and low self-confidence in using technology (Scherer et al., 2019; Rowston et al., 2022). Students who lack a personal drive to acquire new digital skills or feel uncertain about their abilities may be more inclined to avoid technology altogether, perceiving it as a source of stress rather than a learning asset (Rowston et al., 2022). Similarly, research indicates that students with low self-efficacy are more likely to avoid using digital tools in school (Teo, 2010; Teo, 2012; Venkatesh et al., 2012; Kulviwat et al., 2014; Kolil & Achuthan, 2022).

This pattern is particularly evident in educational contexts where students do not perceive immediate benefits from digital engagement or lack positive reinforcement in their experiences with ICT. Supporting students' confidence in their ICT skills and fostering intrinsic motivation for learning through digital tools are therefore essential for reducing these barriers (Nurhabibah et al., 2018). Teachers can also help reduce students' anxiety by providing structured and encouraging opportunities for the gradual development of digital competencies (Teo, 2012; Kolil & Achuthan, 2022).

External Influences on ICT Use

External influences refer to contextual factors that shape students' engagement with ICT and are not directly related to psychological or personal characteristics. They capture the impact of the educational and social environment on ICT use. Key external influences include inadequate teacher support, teacher preparedness in using technology in the classroom, technical issues such as unstable internet connections, poor infrastructure, and insufficient access to quality equipment (Mumtaz, 2000; Suryani, 2010; Aesaert et al., 2017; Lomos et al., 2023).

A 2023 study in Luxembourg involving 420 teachers identified potential issues with the digitalisation of the teaching process during ICT implementation in schools (Lomos et al., 2023). Teachers' perceptions were assessed across four aspects: ICT infrastructure, digital learning materials, current level of expertise, and teachers' vision of ICT use (Lomos et al., 2023). In addition, teacher collaboration, school policies on ICT use, and support for ICT equipment are important factors (Lomos et al., 2023). These external conditions influence whether ICT is used effectively or perceived as an additional burden for teachers. The study found that teachers are not enthusiastic about ICT, but they do use it to some extent, with teacher expertise and perceived usefulness being key factors (Lomos et al., 2023).

For comparison, a Croatian study of schools in the Zagreb area found that teachers view ICT as an additional effort for which they are not sufficiently compensated or adequately supported (Rogošić et al., 2021). This is consistent with Pera, Hajdukiewicz, and Ferjanić Hodak (2022), who show that both university professors and high school teachers report varying levels of ICT knowledge and skills, indicating that teachers' digital competencies remain an important prerequisite for effective ICT integration in education. This attitude can spill over to students, who, influenced by teachers' experiences, may also exhibit resistance to ICT use in the classroom. Generally, external influences on ICT use in education are relatively similar across contexts. However, in Croatia, these issues still require more systematic attention.

Therefore, this study explores the most prominent factors associated with ICT-related attitudes and use among high school students in northern Croatia, with a particular focus on intrinsic inhibitors and external influences. By identifying these challenges, educational institutions can implement targeted interventions to promote more effective ICT adoption. Addressing both students' psychological barriers and the broader educational environment is essential for strengthening ICT engagement and designing more effective strategies for technology integration.

Research Propositions

Building on the preceding literature review, this section develops a set of research propositions that specify the relationships between intrinsic inhibitors, external influences, and ICT use. The aim is to translate the identified theoretical arguments into a structured model that captures both direct and indirect effects, in line with the multidimensional nature of ICT adoption in educational contexts. Particular attention

is given to the interplay between psychological constraints and contextual factors, which are expected to shape students' engagement with ICT jointly.

The literature review indicates that intrinsic inhibitors and external influences play a significant role in shaping ICT use in educational contexts. Intrinsic inhibitors are primarily linked to a lack of motivation, reluctance to use ICT, and fear of new technologies (Rone et al., 2021). Previous studies show that students often struggle to work independently with ICT due to insufficient motivation, confidence, skills, or experience (Sudarić, 2020; Yan, 2022). This may result in slower task performance, a greater need for assistance, and resistance to adopting new technologies (Sudarić, 2020; Yan, 2022). These challenges are closely related to limited digital skills and may lead to distrust in ICT, fear of digital tools, and the development of technophobia or technostress (Scherer et al., 2019; Rowston et al., 2022; Rone et al., 2021).

In this context, intrinsic inhibitors are expected to act as a direct constraint on ICT use. Therefore, the following research proposition is formulated:

- RP1: Intrinsic inhibitors have a statistically significant negative effect on ICT use among students.

External influences are factors originating in students' environments that shape their engagement with ICT. These influences include parents, peers, teachers, and media (Hakimi et al., 2024; Lomos et al., 2023). Social interactions play an important role, as peers influence one another through shared experiences, while parents serve as early role models, shaping attitudes toward technology. Teachers represent a key institutional factor, as their competence and preparedness can either facilitate or hinder ICT adoption (Rogošić et al., 2021; Lomos et al., 2023). In addition, media and digital platforms influence perceptions of ICT by shaping what is considered relevant or valuable (Stan, 2024).

Beyond social influences, structural conditions such as inadequate infrastructure, unstable internet connections, and complex digital tools can create additional constraints and frustration (Shi, 2016; Gunzo, 2020; Tondeur et al., 2017). However, unlike intrinsic inhibitors, these external influences do not operate exclusively as barriers. They may simultaneously increase exposure to ICT while also generating resistance, depending on their intensity and context.

Based on this reasoning, external influences are expected to shape ICT use both directly and indirectly through intrinsic inhibitors. Accordingly, the following research propositions are formulated:

- RP2: External influences have a statistically significant effect on intrinsic inhibitors.
- RP3: External influences have a statistically significant direct effect on ICT use.

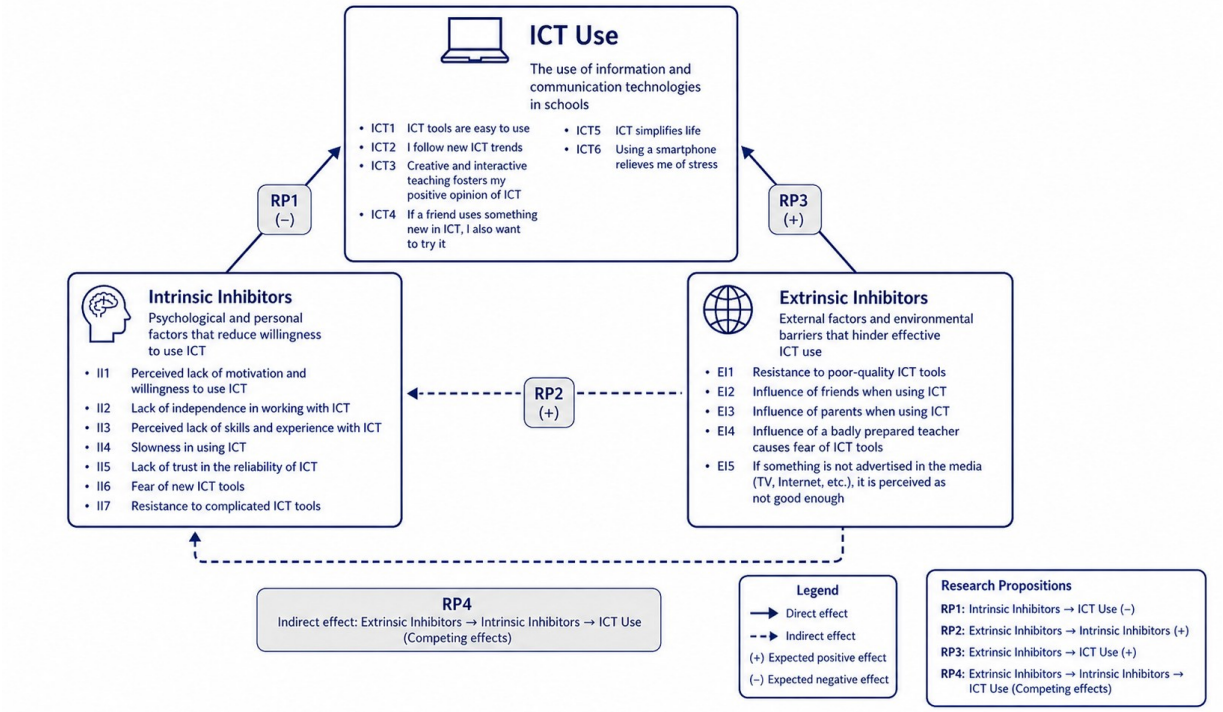
From a theoretical perspective, this dual mechanism is consistent with self-determination theory, which distinguishes between intrinsic and extrinsic sources of motivation (Ryan & Deci, 2000). External conditions may either support or undermine intrinsic motivation, depending on whether they are perceived as enabling or controlling. In the Croatian context, the e-Škole project improved infrastructure and teacher competencies (Mijatović, 2023), but empirical evidence suggests that challenges in ICT use persist (Ivić & Blagojević, 2022; Sudarić, 2020). Students continue to report technical difficulties and low motivation, while teachers highlight increased workload, technical instability, and lack of digital content (Rogošić et al., 2021).

These findings suggest that external influences may simultaneously increase ICT exposure while reinforcing intrinsic barriers. Therefore, the overall relationship between external influences and ICT use is expected to be complex and potentially characterised by competing effects:

- RP4: External influences have both a direct effect on ICT use and an indirect effect through intrinsic inhibitors, indicating the presence of competing effects.

The model in Figure 1 visually summarises the theoretical framework by linking intrinsic inhibitors, external influences, and ICT use in secondary education. Intrinsic inhibitors include psychological and motivational factors that may reduce students' willingness to use ICT, while external influences comprise contextual, social, and teacher-related factors that shape ICT engagement. The model assumes that intrinsic inhibitors negatively affect ICT use (RP1), while external influences affect intrinsic inhibitors (RP2) and ICT use directly (RP3). It also proposes an indirect effect of external influences on ICT use through intrinsic inhibitors, indicating the possibility of competing effects (RP4).

Figure 1
Proposed structural model of the relationships between intrinsic inhibitors, external influences, and ICT use (direct and indirect effects)



Source: Authors' work

Overall, the proposed framework conceptualises ICT use as an outcome of both internal and external determinants, where intrinsic inhibitors act as direct constraints. In contrast, external influences operate through both direct and indirect pathways. By integrating these mechanisms, the model extends prior research that has typically examined these factors in isolation and introduces the possibility of competing effects. This provides the analytical foundation for the subsequent empirical testing using confirmatory factor analysis, network analysis, and structural equation modelling.

Methodology

This research represents the first phase of a broader project aimed at testing the research instrument and gaining initial insight into patterns of ICT use among secondary school students. The study was limited to Northern Croatia and the City of Zagreb, which together represent a relatively developed educational context in terms of infrastructure, digital capacity, and institutional support.

The research was conducted during May and June 2024 in schools from the City of Zagreb and counties of Northern Croatia, according to the NUTS 2 statistical classification: Krapina-Zagorje County, Zagreb County, Varaždin County, Koprivnica-Križevci County, and Međimurje County (The NUTS Classification in Croatia, 2015). The City of Zagreb records a GDP per capita of approximately 109.4% of the European Union average, while Northern Croatia reaches about 48.43% (Total Croatia News, 2021). In addition, Zagreb and Northern Croatia are among the most densely populated regions in Croatia and have lower unemployment rates and less severe demographic decline than less developed areas (OECD, 2024). This regional focus was therefore selected to ensure access to a sufficiently large and relevant sample of respondents.

Sample and Data Collection

The target population consisted of students aged 16 and above attending secondary schools in Northern Croatia and the City of Zagreb. From each county, five schools were randomly selected and invited to participate. Schools were contacted via official email addresses obtained from the Croatian Employment Service's website and were provided with survey links to forward to students (Popis Srednjih Škola - HZZ, 2024). A total of 12 schools participated in the study.

Table 1
Sample structure

I. County		
	Respondents	**Percent**
Krapina-Zagorje County	71	37.97%
The City of Zagreb	42	22.46%
Zagreb County	34	18.18%
Varaždin County	27	14.44%
Koprivnica-Križevci County	11	5.88%
Međimurje County	2	1.07%
II. School program		
Four-year vocational	141	75.4%
General high school (gymnasium)	40	21.39%
Three-year vocational	6	3.2%
III. Grade		
First	44	23.53%
Second	43	22.99%
Third	28	14.97%
Fourth	72	38.50%

Source: Authors' work

The largest number of respondents comes from Krapina-Zagorje County (37.97%), while the smallest number is from Međimurje County (1.07%). Most of the sample consists of respondents from Krapina-Zagorje County and the City of Zagreb, which together represent nearly 60% of the sample. The regional distribution of respondents was uneven, with Krapina-Zagorje County and the City of Zagreb accounting for the largest share of the sample. This limitation is discussed in the concluding section.

Students from these regions were divided into two groups: general education schools (gymnasiums) and vocational schools. The sample included 40 gymnasium students and 147 vocational school students. The sample consisted of 187 high school students: 134 females (71.66%) and 53 males (28.34%), all aged 16 or older. The sample

has the highest number of first-year students (23.53%) and those attending a four-year vocational school (75.4%).

The introductory part of the survey included a request for explicit consent, in alignment with GDPR requirements, and the students were informed about the objectives of the study, future use of the data, guaranteed anonymity, and the potential benefits and risks of participating in the research.

Research instrument

Data were collected through a survey questionnaire distributed to the high schools, which conducted the survey independently, with responses directly saved into an online database. The survey included demographic items and measurement items for the following latent variables: intrinsic inhibitors, external influences, and ICT use.

Table 2
Research instrument description

Code	Item	Mean	Standard deviation
	Intrinsic Inhibitors		
II1	Perceived lack of motivation and willingness to use ICT	2.850	1.195
II2	Lack of independence in working with ICT	3.107	1.131
II3	Perceived lack of skills and experience with ICT	3.000	1.159
II4	Slowness in using ICT	2.824	1.212
II5	Lack of trust in the reliability of ICT	2.936	1.110
II6	Fear of new ICT tools	2.663	1.200
	External Influences		
EI1	Resistance to complicated ICT tools	3.021	1.155
EI2	Resistance to poor-quality ICT tools	3.455	1.088
EI3	Influence of friends when using ICT	2.877	1.214
EI4	Influence of parents when using ICT	2.797	1.258
EI5	Resistance to an unstable internet connection	4.166	0.967
EI6	The influence of a badly prepared teacher causes fear of ICT tools.	3.102	1.255
EI7	If something is not advertised in the media (TV, Internet, etc.), it is perceived as not good enough.	2.604	1.288
	ICT Use		
ICT1	ICT tools are easy to use	4.037	0.838
ICT2	I regularly follow new trends in ICT, software, and devices.	3.620	1.102
ICT3	Creative and interactive teaching with ICT fosters my positive opinion of ICT in education.	3.909	0.821
ICT4	If a friend uses something new in ICT, I also want to try it.	3.626	0.983
ICT5	ICT is something that simplifies life	3.947	0.795
ICT6	Using a smartphone relieves me of stress.	3.775	0.963

Source: Authors' work

The main section of the survey focused on students' intrinsic inhibitors, external influences, and self-reported experiences with ICT use in education. All items were measured on a five-point Likert scale, ranging from 1 = strongly disagree to 5 = strongly agree. Table 2 presents the research instrument together with descriptive statistics for each item. The items were developed based on existing theories and literature on ICT adoption in education (Hakimi et al., 2024) and adapted to reflect psychological, social, technical, and teacher-related factors relevant to secondary school students. ICT use in this study is operationalised as self-reported perceptions and attitudes toward ICT engagement, rather than direct behavioural measures.

The internal consistency of the scales was assessed using Cronbach's alpha. The intrinsic inhibitors scale showed acceptable reliability (α = 0.70), while the external influences scale also demonstrated acceptable reliability (α = 0.72). The ICT use scale showed slightly higher reliability (α = 0.78). These values indicate acceptable internal consistency for an exploratory study. Although all items in Table 2 were included in the original research instrument, EI5 was not retained in the final CFA and SEM models due to weak item performance during measurement model refinement.

To assess face and content validity, the questionnaire items were reviewed in relation to the relevant literature and evaluated by two psychologists. This helped ensure that the items were aligned with theoretical assumptions and previous research. As this is a pilot study for a broader doctoral project, the primary goal was to test the instrument, examine its measurement properties, and identify areas for further refinement.

Data Analysis

The analysis was conducted in three steps. First, confirmatory factor analysis (CFA) was used to assess the measurement model and examine whether the observed items adequately represented the three theoretical constructs: intrinsic inhibitors, external influences, and ICT use (Brown, 2015; Kline, 2023). Model fit was evaluated using standard fit indices, including the Comparative Fit Index (CFI), Tucker-Lewis Index (TLI), Root Mean Square Error of Approximation (RMSEA), and Standardised Root Mean Square Residual (SRMR). Factor loadings were inspected to assess item-level performance.

Second, network analysis was applied as an additional item-level procedure to explore relationships among the observed variables. Following Epskamp et al. (2018), this analysis was used to visually examine whether items clustered in line with the proposed constructs and to identify potential overlap or heterogeneity among indicators.

Third, structural equation modelling (SEM) was used to test the proposed relationships among the latent constructs (Kline, 2023). The structural model examined the direct effect of intrinsic inhibitors on ICT use, the effect of external influences on intrinsic inhibitors, and the direct effect of external influences on ICT use. In addition, the model assessed the indirect effect of external influences on ICT use through intrinsic inhibitors, enabling the identification of competing effects.

Given the study's cross-sectional design, the results should be interpreted as associations between latent constructs rather than as evidence of causal relationships. Data analysis was conducted using JASP 0.19.3, an open-source statistical software package.

Results

Measurement Model Assessment

The results of the confirmatory factor analysis indicate an acceptable overall model fit. The Comparative Fit Index (CFI = 0.917) and Tucker–Lewis Index (TLI = 0.903) exceed the commonly accepted threshold of 0.90, suggesting a satisfactory fit of the measurement model (Brown, 2015; Kline, 2023). The Root Mean Square Error of Approximation (RMSEA = 0.083) is slightly above the more conservative threshold of 0.08, but still within the range often interpreted as acceptable for applied research. The Standardised Root Mean Square Residual (SRMR = 0.086) is also slightly above the preferred threshold of 0.08, indicating moderate residual misfit.

These indices suggest that the three-factor measurement model provides an acceptable, though not perfect, representation of the observed data. Therefore, the proposed structure of intrinsic inhibitors, external influences, and ICT use can be retained for subsequent structural analysis.

Table 3 presents the standardised factor loadings, reliability, and convergent validity indicators for the three latent constructs. The final measurement model excludes EI5, which was not retained due to weak item performance. All factor loadings are statistically significant at the 1% level, indicating that the observed indicators are meaningfully related to their respective latent constructs.

Table 3
Factor loadings

Factor	Indicator	Std. estimate	Std. Error	z-value	AVE	Coefficient ω
Intrinsic Inhibitors	II1	0.813	0.028	28.905**	0.630	0.909
	II2	0.740	0.036	20.474**		
	II3	0.746	0.035	21.049**		
	II4	0.765	0.033	22.842**		
	II5	0.834	0.026	32.501**		
	II6	0.855	0.023	36.634**		
External Influences	EI1	0.802	0.029	27.845**	0.614	0.907
	EI2	0.567	0.052	10.921**		
	EI3	0.857	0.022	38.416**		
	EI4	0.921	0.015	61.297**		
	EI6	0.636	0.046	13.839**		
	EI7	0.816	0.027	29.994**		
ICT Use	ICT1	0.518	0.061	8.531**	0.454	0.826
	ICT2	0.707	0.045	15.614**		
	ICT3	0.754	0.041	18.299**		
	ICT4	0.737	0.043	17.281**		
	ICT5	0.584	0.056	10.489**		
	ICT6	0.659	0.049	13.329**		

Note: ** $p < 0.01$
Source: Authors' work

For intrinsic inhibitors, factor loadings range from 0.740 to 0.855, indicating strong and consistent item contributions. The Average Variance Extracted (AVE = 0.630) exceeds the recommended threshold of 0.50, suggesting good convergent validity, while the coefficient omega (ω = 0.909) indicates high internal consistency. Overall, this construct demonstrates robust psychometric properties.

For external influences, factor loadings range from 0.567 to 0.921. While most items show strong loadings, EI2 (0.567) and EI6 (0.636) are comparatively lower, though still within acceptable limits. The AVE (0.614) exceeds the recommended threshold, and composite reliability is high (ω = 0.907), supporting satisfactory convergent validity and internal consistency of the construct.

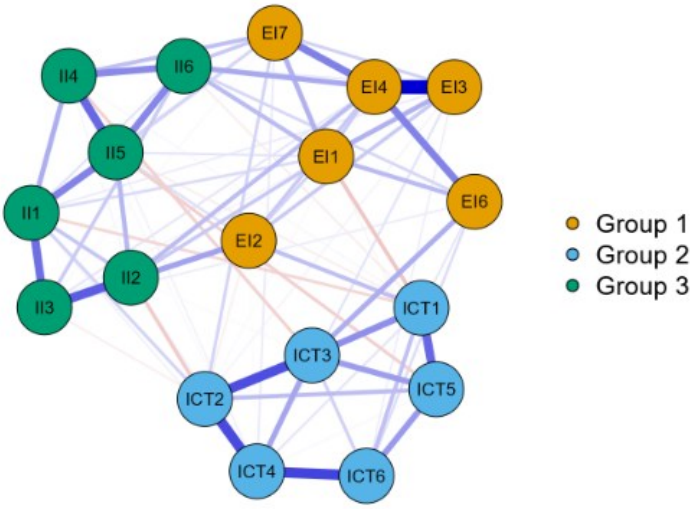
For ICT use, factor loadings are more heterogeneous, ranging from 0.518 to 0.754. The AVE (0.454) falls slightly below the recommended threshold of 0.50, indicating marginal convergent validity. However, composite reliability remains acceptable (ω = 0.826), indicating that the construct is adequately measured. Lower loadings for ICT1 and ICT5 indicate that these items contribute less strongly to the construct and may require refinement in future research.

Discriminant validity was additionally assessed using the heterotrait–monotrait ratio (HTMT). The HTMT value between intrinsic inhibitors and external influences

approached the upper threshold (≈ 0.88), indicating a strong association between the constructs, but remained within acceptable limits below 0.90 (Henseler et al., 2015). The HTMT values involving ICT use were substantially lower (≈ 0.18–0.21), supporting adequate discriminant validity of this construct.

Network analysis was used as a complementary item-level approach to examine the structure of relationships among the observed variables, following the logic of psychological network modelling (Epskamp et al., 2018). As shown in Figure 2, the estimated regularised network comprised 18 nodes and 84 non-zero edges, with a sparsity of 0.451, indicating a moderately dense association structure among items.

Figure 2
Item-level network structure of intrinsic inhibitors, external influences, and ICT use



Source: Authors' work

The visualisation shows that items cluster broadly into three conceptual domains: intrinsic inhibitors, external influences, and ICT use. Items within the same construct are generally more strongly connected than items across constructs, supporting the measurement structure identified in the CFA. The ICT use items form a relatively compact cluster, while external influences appear more dispersed, reflecting their broader conceptual scope.

Several cross-construct connections are visible, particularly between external influences and intrinsic inhibitors. This pattern suggests that contextual, social, and teacher-related factors are closely associated with students' psychological barriers to ICT use. The network results, therefore, provide additional item-level support for the proposed SEM framework, particularly in capturing both direct and indirect relationships among the constructs.

Overall, the findings support the adequacy of the measurement model, with strong evidence for intrinsic inhibitors and external influences, and acceptable, though comparatively weaker, support for the ICT use construct.

Structural Equation Model: Direct and Indirect Effects

The structural model was estimated to examine the hypothesised relationships between external influences, intrinsic inhibitors, and ICT use. The results provide insight into both direct and indirect pathways through which students' ICT engagement is shaped.

Table 4
Structural model results (SEM regression coefficients)

Outcome	Predictor	Estimate	Std. Error	z-value	p-value
ICT Use	External Influences	0.382	0.108	3.524	< .001
ICT Use	Intrinsic Inhibitors	-0.270	0.098	-2.755	0.006
Intrinsic Inhibitors	External Influences	0.914	0.083	10.993	< .001

Source: Authors' work

The results indicate that intrinsic inhibitors have a statistically significant negative effect on ICT use (β = -0.270, p = 0.006), consistent with RP1. This finding confirms that psychological barriers—such as a lack of confidence, fear of new technologies, and insufficient motivation—constrain students' willingness to engage with ICT. Although the effect is moderate, it is sufficiently strong to indicate that internal resistance remains an important limiting factor even in digitally equipped environments.

External influences show a strong positive effect on intrinsic inhibitors (β = 0.914, p < .001), providing clear support for RP2. This represents the strongest estimated relationship in the model, suggesting that environmental conditions play a decisive role in shaping students' internal perceptions of ICT. Factors such as teacher preparedness, social influence, and technical conditions do not remain external, but are internalised by students and translated into psychological barriers. This result is particularly relevant for educational contexts, as it indicates that environmental deficiencies may amplify internal resistance rather than simply limiting access.

At the same time, external influences have a statistically significant direct positive effect on ICT use (β = 0.382, p < .001), supporting RP3. This indicates that exposure to ICT through peers, teachers, and broader digital environments encourages engagement, even when certain barriers are present. The positive coefficient suggests that external conditions simultaneously act as enablers of ICT use.

The coexistence of these effects provides empirical support for RP4. External influences operate through two opposing mechanisms: a direct positive pathway that increases ICT use and an indirect negative pathway mediated by intrinsic inhibitors. Given the strength of the EI → II relationship, the indirect effect is non-negligible. It indicates that part of the positive impact of external exposure is offset by the psychological barriers it generates. This pattern reflects a structurally embedded tension between exposure and resistance, in which the same environmental conditions that promote ICT use may also inhibit it.

These results align with the theoretical expectation that ICT adoption in education is not a linear process. Instead, it is shaped by the interaction between contextual conditions and internal perceptions, with external influences acting as both drivers of engagement and sources of resistance.

Discussion

The results provide a more nuanced understanding of ICT use among secondary school students by highlighting the simultaneous role of psychological and environmental mechanisms. Given the applied cross-sectional design, the findings are interpreted as structural associations rather than causal effects, but they nevertheless offer important theoretical and practical implications.

The structural model confirms that intrinsic inhibitors have a statistically significant negative effect on ICT use, supporting RP1. This result aligns with prior research emphasising the importance of self-efficacy, motivation, and emotional responses in

technology adoption (Kulviwat et al., 2014; Scherer et al., 2019; Rowston et al., 2022). Students who experience uncertainty, fear, or lack of confidence are less likely to engage actively with ICT, even in environments where access is not a primary constraint. This suggests that intrinsic barriers remain relevant even in relatively well-equipped educational settings where access is not the primary constraint, and that digital readiness cannot be reduced solely to infrastructure availability. At the same time, the magnitude of this effect is moderate, indicating that intrinsic inhibitors represent only one part of a broader mechanism.

A key contribution of this study lies in the strong effect of external influences on intrinsic inhibitors, which provides clear support for RP2. This finding extends previous research by demonstrating that environmental factors are not merely external constraints but are internalised by students and translated into psychological resistance. In line with Rogošić et al. (2021), insufficient teacher preparedness, technical instability, and limited pedagogical integration of ICT may create uncertainty and reduce students' confidence in using digital tools. Similarly, social influences from peers and parents shape attitudes toward ICT through everyday interactions and shared experiences (Hakimi et al., 2024). This mechanism is consistent with broader theoretical perspectives suggesting that external conditions can either support or undermine internal motivation, depending on how they are perceived (Ryan & Deci, 2000). A similar pattern is reported by Çaro, Hasrama, and Sinjari (2024), who find that students recognise the importance of digital learning but still face psychological and infrastructural challenges that limit their readiness and willingness to engage with digital education.

External influences also show a direct positive effect on ICT use, supporting RP3. This result indicates that exposure to ICT—through school practices, peer behaviour, and broader digital environments—encourages engagement. Students who are more frequently exposed to ICT through their surroundings are more likely to perceive it as useful and relevant. This finding is consistent with research showing that social and institutional contexts play a central role in shaping technology acceptance (Lomos et al., 2023; Hakimi et al., 2024). It also reflects the reality that ICT use in education is often embedded in collective practices rather than purely individual decisions.

The coexistence of these relationships provides empirical support for RP4 and points to the presence of competing effects. External influences simultaneously increase ICT use directly while also strengthening intrinsic inhibitors, which in turn reduce ICT use. This dual mechanism helps explain inconsistencies in earlier findings, where external factors were often treated exclusively as barriers. The results suggest that the same conditions that promote ICT exposure—such as increased use in teaching or peer influence—may also generate frustration, fear, or resistance if not adequately supported. Similar tensions have been observed in studies conducted in the Croatian context, where infrastructure improvements did not fully eliminate challenges related to ICT use (Ivić & Blagojević, 2022; Sudarić, 2020). Students continue to report technical difficulties, while teachers emphasise increased workload and insufficient support (Rogošić et al., 2021).

The role of media influence presents an additional point of interest. While prior literature often highlights scepticism toward advertising (Boush et al., 1994; Stan, 2024), the results suggest that media exposure may still shape perceptions of ICT relevance, particularly when interpreted as a signal of value or social acceptance. This indicates that students' attitudes toward ICT are formed through a combination of formal educational experiences and broader cultural influences, which may not always align with theoretical expectations.

From a practical perspective, the findings suggest that interventions should not focus exclusively on improving infrastructure or access. Although technical conditions, such as internet stability, remain important, their effects are mediated by students' perceptions and experiences. Strengthening teachers' competencies is particularly critical, as teachers play a dual role: both facilitators of ICT use and key agents in shaping students' confidence and attitudes (Rogošić et al., 2021; Lomos et al., 2023). Although focused on organisational performance rather than education, Suparwadi et al. (2024) underline the importance of knowledge management and intellectual capital for innovation, which indirectly supports the argument that digital competencies should be treated as part of a broader capacity-building process. In addition, peer-based approaches and collaborative learning environments may help reduce resistance by normalising ICT use and reinforcing positive experiences (Hakimi et al., 2024). From a broader systems perspective, Pejić Bach et al. (2024) emphasise the changing role of higher educational institutions in periods of systemic transformation, which supports the view that educational institutions should be analysed as active actors in developing digital and adaptive capacities.

Addressing intrinsic inhibitors requires targeted efforts to build students' confidence and reduce anxiety about technology use. This includes structured learning activities, gradual skill development, and pedagogical approaches that emphasise usability and relevance. Previous research highlights that supportive environments and positive learning experiences are essential for overcoming fear of failure and increasing motivation (Kaminskienė et al., 2022).

In summary, ICT use in secondary education emerges as a complex outcome shaped by the interaction between external conditions and internal perceptions. External influences do not operate solely as barriers or facilitators but simultaneously perform both roles. Effective integration of ICT, therefore, requires a balanced approach that addresses technical, pedagogical, and psychological dimensions, with particular attention to how environmental conditions are translated into students' lived experiences.

Conclusion

This study shows that both intrinsic inhibitors and external influences shape ICT use among secondary school students. Intrinsic inhibitors negatively affect ICT use, while external influences play a dual role: they directly increase ICT use but also strengthen intrinsic inhibitors, which then reduce ICT engagement. This indicates the presence of competing effects and suggests that ICT adoption in education is not a simple linear process.

The findings suggest that external influences, including teacher preparedness, social influence, and contextual conditions, should not be treated only as barriers. They also increase students' exposure to ICT. However, when these influences are not supported by adequate pedagogical guidance and technical conditions, they may generate uncertainty, fear, or resistance. Therefore, improving ICT integration requires a balanced approach that combines better infrastructure, teacher training, and structured support for students' confidence and motivation.

The study has several limitations. The sample was limited to Northern Croatia and the City of Zagreb, so the results should be interpreted within this regional context. In addition, the study ensured respondents' anonymity by not collecting detailed data on school type or class, thereby limiting the possibility of examining school- or class-level effects. The cross-sectional design also prevents causal interpretation of the relationships among constructs.

Future research should include a broader national sample and allow comparisons between different Croatian regions, school types, and educational contexts. Additional qualitative interviews or focus groups with students, teachers, and school administrators would provide deeper insight into how external influences are translated into students' psychological barriers and ICT-related attitudes. A mixed-methods approach would therefore strengthen the understanding of ICT use in secondary education.

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About the authors

Marko Mikša is a lecturer at the University of Applied Sciences Hrvatsko Zagorje Krapina. He holds a PhD in Strategic Communication Management from Alma Mater Europaea University and a master's degree in informatics. His main research interests include e-learning, digital learning environments, and the adoption of information and communication technologies in education. He is actively engaged in academic work, with a particular focus on the development and implementation of digital learning environments. The author can be contacted at: **marko.miksa@vhzk.hr.**

Ivan Balabanić is a Senior Research Associate at the Institute for Migration Research. He has also been appointed as an Associate Professor in Sociology at the University of Zagreb and in Communication Sciences at Alma Mater Europaea University in Maribor. He is the course leader for several subjects in social research methodology and statistics at the undergraduate, graduate, and postgraduate levels at the University of Zagreb, the Croatian Catholic University, and Alma Mater Europaea University in Slovenia. The author can be contacted at: **ivanbalabanic@gmail.com**.

Professor Sanja Sever Mališ, PhD, has served as the Dean of the Faculty of Economics and Business at the University of Zagreb, a triple-crown institution (AACSB, EQUIS, AMBA) since 2022. As dean, she serves on peer-review teams for the accreditation of business schools (EQUIS). Her research and professional interests include accounting, auditing and fraudulent financial reporting. She has written more than 70 articles in international scientific journals, international conference proceedings, and national professional journals. She participated in advanced training at several scientific and professional workshops in the country and abroad, and teaches courses related to her field of interest. She is a co-author of university and scientific books. The author can be contacted at: **ssever@net.efzg.hr**.