

# Education for innovation and research

How to stimulate the research spirit and curiosity among children and young people? How to involve the children's and youth's voices in the creation and evaluation of educational policies and practices?

**Section Editor:** izv. prof. dr. sc. Nevenka Maras

- Usporedba kurikula Hrvatskoga jezika u osnovnoj školi u Republici Hrvatskoj i u Bosni i Hercegovini / Comparative analysis of Croatian language curricula in Croatia and Bosnia and Herzegovina
- Evaluation of high school Biology teachers' satisfaction with the reformed Biology curriculum: A case study from Croatia
- Physics students' ideas about inquiry-based-education: A qualitative approach
- Leading quality changes in the education system of the Republic of Croatia - supernatural aspiration or compelling reality?
- Kako potaknuti istraživački duh i kreativnost učenika osnovnoškolskoga obrazovanja / How to stimulate the research spirit and creativity in primary school students?
- Nastavna sredstva i pomagala u metodi simulacije / Teaching aids in the Simulation Method
- Generativna umjetna inteligencija i igrifikacija u obrazovanju / Generative artificial intelligence and gamification in education
- Sources of stress among teachers in primary schools
- Verbal associations of preschool children to the names of certain colors and feelings – stereotypes and changes

- Student' self-assessment of asking questions in class
- Pessimism, optimism, and defensive pessimism as predictors of school success, school and life satisfaction of high school students
- Curriculum of vocational education institutions
- LASSO and RIDGE linear regression - better prediction or much more?
- Obvezno obrazovanje u Republici Hrvatskoj i Estoniji: komparativna analiza kurikula matematike / Compulsory education in the Republic of Croatia and Estonia: A comparative analysis of the

# Usporedba kurikula Hrvatskoga jezika u osnovnoj školi u Republici Hrvatskoj i u Bosni i Hercegovini / Comparative analysis of Croatian language curricula in Croatia and Bosnia and Herzegovina



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**Odgoj i obrazovanje za inovaciju i istraživanje**

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## **Sažetak**

Materinski je jezik idiom koji se stječe u najranijoj dobi bez svjesnoga učenja. Hrvatskim se jezikom kao materinskim jezikom služi više od 5,5 milijuna ljudi. Službeni je jezik u Republici Hrvatskoj i jedan od službenih jezika u Bosni i Hercegovini. Kao materinski jezik hrvatski se uči i poučava u hrvatskim školama i u dijelu škola u Bosni i Hercegovini. Učenje i poučavanje materinskoga jezika u školama determinirano je sustavom odgoja i obrazovanja određene države, odnosno pravnim regulativama i kurikulskim dokumentima. U ovom su radu istaknute osobitosti odgojno-obrazovnih sustava u Republici Hrvatskoj i u Bosni i Hercegovini te izvori na koje se kao takve oslanjaju. Posebnu pozornost zauzima Hrvatski jezik kao temeljni nastavni predmet (materinski jezik) i u hrvatskome i u dijelu odgojno-obrazovnoga sustava Bosne i Hercegovine. Budući da je riječ o istome (materinskome) jeziku, struktura, svrha, ciljevi i ishodi učenja predviđeni kurikulskim dokumentima ne bi trebali imati značajnija odstupanja i razlike. Kvantitativnom i kvalitativnom analizom kurikula Hrvatskoga jezika kao materinskoga jezika u Republici Hrvatskoj i kurikula Hrvatskoga jezika kao materinskoga jezika u Bosni i Hercegovini pokazalo se odstupanje u kvantiteti odgojno-obrazovnih ishoda. Razlike su prvenstveno proizašle iz činjenice da je osnovnoškolsko obrazovanje u Republici Hrvatskoj osmogodišnje, a u Bosni i Hercegovini devetogodišnje. Analiza dokumenata pruža uvid u navedene odmake i poziva da se odgojno-obrazovni ishodi i sadržaji kurikula materinskoga jezika približe sličnim vrijednostima (posebice u značajnijim raskoracima) ili da se ponude znanstvena i teorijska uporišta njihove opravdanosti.

## **Ključne riječi**

*materinski jezik; odgojno-obrazovni ishodi; odgojno-obrazovni sustav; predmetna područja*

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## **Abstract**

The mother tongue is an idiom that is acquired at an early age without conscious learning. More than 5.5 million people speak Croatian as their mother tongue. It is the official language in the Republic of Croatia and one of the official languages in Bosnia and Herzegovina. As a mother tongue, Croatian is learned and taught in Croatian schools and in some schools in Bosnia and Herzegovina.

The learning and teaching of the mother tongue in schools is determined by the system of education of a particular country, that is, by legal regulations and curriculum documents. This paper highlights the peculiarities of the educational system in the Republic of Croatia and in Bosnia and Herzegovina and the sources they rely on as such. Special attention is paid to the Croatian language as a basic teaching subject (mother tongue) both in Croatian and in the part of the educational system of Bosnia and Herzegovina. Since it is the same (mother tongue) language, the structure, purpose, goals and learning outcomes provided for in the curriculum documents should not deviate and differ significantly. A quantitative and qualitative analysis of the curriculum of the Croatian language as a mother tongue in the Republic of Croatia and the curriculum of the Croatian language as a mother tongue in Bosnia and Herzegovina showed a discrepancy in the quantity of educational outcomes. The differences primarily stemmed from varying lengths of primary school education in the two countries: eight years in Croatia and nine in Bosnia and Herzegovina. The analysis of the documents provides insights into the aforementioned developments and suggests that the educational outcomes and content of the mother tongue curriculum should be aligned more closely with similar values, particularly where significant gaps exist. Additionally, it calls for a strong foundation of scientific and theoretical principles to justify any curricular changes.

## **Key words**

*mother tongue, educational outcomes, educational system, subject areas*

# Evaluation of high school Biology teachers' satisfaction with the reformed Biology curriculum: A case study from Croatia



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## **Abstract**

In many countries, including Croatia, attempts are being made to improve the quality of education through curricular reforms. The Croatian educational reform, guided by global trends, introduced a student-centered, conceptual approach to biology education that differs from the previous thematic model. The new approach starts with broader, observable concepts before delving into microscopic subtleties, reflecting a fundamental shift in educational philosophy. It also emphasizes flexibility and teacher autonomy. Despite the benefits, implementation is challenging, especially for teachers who are used to the previous framework. The aim of this study was to assess teacher satisfaction by comparing the new biology curriculum with the previous thematic approach and examining the perception of greater content autonomy. The study also investigates whether the teachers' different professional experience influences their views. The study involved 78 biology teachers from high schools in Croatia, who were divided into four groups based on their professional teaching experience (over 21 years, 11 to 20 years, 6 to 10 years, 2 to 5 years, < 2 years of teaching experience). An anonymous online questionnaire was developed for this study. The results indicate that experienced teachers prefer the previous thematic approach, which points to the need for a possible adaptation of the biology curriculum taking into account teacher feedback. The results of the study have the potential to contribute to a thorough re-evaluation and restructuring of the Croatian biology curriculum and to influence global educational considerations and reforms in science education. The study also highlights the need for a comprehensive support system to help teachers manage the transition.

## **Key words**

*curriculum enhancement, curriculum evaluation, science education, teacher feedback, teaching methodology*

# Physics students' ideas about inquiry-based-education: A qualitative approach



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**Education for innovation and  
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## **Abstract**

In this paper, we analyzed the issue of Physics teaching in the context of Inquiry-Based-Education. The primary focus of the research was on investigating the perspectives of prospective Physics teachers. The introductory section addressed the concerning trend of declining student enrollment in fields related to this research. On one hand, there is a shortage of young people choosing teaching as a career, while on the other, there is a decline in student interest in STEM subjects. In this context, the area of future Physics teachers stands out as particularly deficient. Such circumstances influenced the possibilities of recruiting respondents and the scope of the sample. Based on the qualitative research, the paper presents the experience of two students of the Master's program Professor of Physics and Informatics at the Faculty of Science, University of Kragujevac, Republic of Serbia. The context in which the interviewees decided to become Physics teachers and their ideas and experiences in the field of Inquiry-Based-Education were studied through narrative inquiry. The implemented approach has been based on the ideas that the experiences from primary and secondary school and the attitudes that future teachers develop in these stages of education significantly influence the assessment of the "importance and usefulness" of the knowledge they learn at colleges, as well as later during their teaching careers and their continuous professional development. The obtained findings indicate that the respondents express an intrinsic motivation for the decision to become Physics teachers, that they deeply believe in the influence of teachers on supporting students' interest in a specific subject, and that they expect to apply the inquiry approach in their teaching work.

## **Key words**

*future teachers, narrative inquiry, physics, shortages of teachers, STEM*

# Leading quality changes in the education system of the Republic of Croatia - supernatural aspiration or compelling reality?



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## **Abstract**

New signs that are constantly influencing the system of upbringing and education make it necessary to pay more attention to the changes in the system of educational practices and to reflect on the possibilities of their efficient implementation. It is not possible to ensure a continuous process of change through the detached management of reformists or the dissemination of changes through deductive methods. The aim of this study is to analyze the (non)implementation of changes in the education system of the Republic of Croatia over the past two decades. A systematic analysis and review of prior national and international research that are available to the authors shows the essential direction of change required in the education system. The findings emphasize that the central premise for ensuring change should be set by expert's pedagogues, preschool teachers, and primary teachers who will actively implement the changes in the immediate pedagogical practice. Drawing from an excellent inspirational basis for (international) guidance on educational policies, the study advocates for a revised direction in change management within the Republic of Croatia. The revised approach should consider contextual, demographic, and cultural factors in the field of education, aiming to bridge the gap between theory and practice. Working on highlighted limitations becomes a collective responsibility of all stakeholders in the educational process, who will ensure the capacity for changes in their field of work through their work, and through networking with other experts, in the entire education system. This analysis contributes to elevating the status of the education and teaching profession by synthesizing inspiring strategies. It underscores the importance of respecting the educational profession in society and optimizing the key role of pedagogues, preschool teachers, and primary teachers in driving meaningful changes within the education.

## **Key words**

educational policy, preschool teachers, primary teachers, professional assistant pedagogues, reforms

# Kako potaknuti istraživački duh i kreativnost učenika osnovnoškolskoga obrazovanja / How to stimulate the research spirit and creativity in primary school students?



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**Odgoj i obrazovanje za inovaciju i istraživanje**

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## **Sažetak**

Suvremeni kurikuli usmjereni su na učenika i na učenje istraživanjem, suradničko učenje te zajedničko učenje propitivanjem i otkrivanjem, a suvremeni odgojno-obrazovni proces teži razvoju kreativnosti. Učenik je aktivni kreator nastavnoga procesa, a najveću ulogu u poticanju njegove kreativnosti ima nastavnik. Učitelj koji je radoznao i teži za nečim novim može stvoriti pozitivno ozračje za razvoj kreativnosti jer kreativni nastavnik preuzima ulogu voditelja i savjetnika (Nickerson, 1999 prema Dubovicki, 2012) te je njegova zadaća uočiti talent svakog učenika i voditi ga prema razvoju njegova talenta i kreativnosti (Petrović, 2010).

Cilj je rada uz teorijski kontekst pokazati i praktičan primjer projektne nastave koja potiče istraživački duh i kreativnost učenika, a realizirana je kroz integriranu i suradničku nastavu.

U radu se donosi praktičan primjer poticanja istraživačkoga duha i kreativnosti učenika osnovnoškolskoga obrazovanja kroz korelaciju nastave Hrvatskoga jezika, Geografije i Tjelesne i zdravstvene kulture te kroz suradnju predmetne i razredne nastave. Cilj projekta bio je stjecati znanja o raznolikosti prirode s naglaskom na maritimnoj raznolikosti rodnoga kraja i prikupiti anegdote i crtice iz života njegovih stanovnika u prošlosti te tako sačuvati i njegovati tradiciju. Učenici su razvijali kritičko mišljenje, pridonijelo se razvoju kreativnoga razmišljanja i rješavanja problema, osnažila se ljubav prema materinskom jeziku i mjesnom govoru. Učenici su aktivno djelovali u školi i zajednici te ih se osposobilo za korištenje informacijske i komunikacijske tehnologije.

U radu će se prikazati faze i tijek projekta koji je rezultirao izdavanjem knjige i snimljenim filmovima. Građu su prikupljali učenici kroz istraživanje i suradnju s lokalnim stanovnicima. Učenici su svoju kreativnost razvijali i kroz ilustracije knjige.

## **Ključne riječi**

*integrirana nastava; projektna nastava; suradničko učenje*

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## **Abstract**

Modern curricula are focused on the student and on learning through research, collaborative learning and joint learning through questioning and discovery, and the modern educational process tends to develop creativity. Students are active creators of the teaching process, and the teacher plays the biggest role in stimulating their creativity. A teacher who is curious and strives for something new can create a positive atmosphere for the development of creativity, because a creative teacher assumes the role of leader and advisor (Nickerson, 1999 according to Dubovicki, 2012) and his task is to spot the talent of each student and guide him towards the development of his talent and creativity (Petrović, 2010). This paper aims to demonstrate, alongside the theoretical context, a practical example of project-based teaching that fosters a spirit of research and creativity among students. The approach involves integrated and collaborative teaching methods.

The work provides a practical example of stimulating the spirit of research and creativity among elementary school students through the correlation of Croatian language, geography and physical and health education, and through the cooperation of subject and classroom teaching. The goal of the project was to acquire knowledge about the diversity of nature with an emphasis on the maritime diversity of the native region and to collect anecdotes and sketches from the lives of its inhabitants in the past, thus preserving and nurturing the tradition. This contributed to the development of creative thinking and problem solving, simultaneously strengthening their love for their mother tongue and local speech. The students were active in the school and community and were trained in the use of information and communication technology.

The paper will present the phases and course of the project that resulted in the publication of the book and films. The materials were collected by students through research and cooperation with the local population. The students also developed their creativity through the illustrations inside the book.

## **Key words**

*cooperative learning, integrated teaching, project teaching*

# Nastavna sredstva i pomagala u metodi simulacije / Teaching aids in the Simulation Method



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**Odgoj i obrazovanje za inovaciju i  
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## **Sažetak**

Dinamičan razvoj tržišta rada u strukovno obrazovanje donosi potrebu za dodatnom prilagodbom u primjeni specifičnih nastavnih sredstava i pomagala koja odgovaraju potrebama pojedinoga zanimanja. Suvremena istraživanja ukazuju da ovaj trend zahtijeva kontinuirano praćenje i implementaciju novih tehnologija i metoda s ciljem osiguravanja relevantnosti obrazovnih programa i njihove usklađenosti sa zahtjevima tržišta rada. Ovaj je rad usmjeren na prikaz nastavnih sredstava i pomagala koja se mogu koristiti u metodi simulacije u obrazovanju medicinskih sestara/tehničara. Svrha je istraživanja analizirati raznolikost i učinkovitost ovih sredstava i pomagala u metodi simulacije. Pregledom literature, analizom postojećih istraživanja i primjenom metode fokus grupe identificirani su najvažniji elementi uspješne primjene metode simulacije u nastavi zdravstvene njege. Uzorak čine nastavnici zdravstvene njege, a rezultati ukazuju da kvalitetna nastavna sredstva i pomagala imaju ključnu ulogu u uspješnoj primjeni metode simulacije u obrazovanju medicinskih sestara/tehničara. Ovo istraživanje omogućuje važan pregled stanja i smjernice za buduća istraživanja i praksu u području obrazovanja medicinskih sestara/tehničara.

## **Ključne riječi**

*metoda simulacije; nastavna sredstva i pomagala; obrazovanje medicinskih sestara/tehničara; strukovno obrazovanje*

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**Abstract**

The dynamic development of the labor market in vocational education brings the need for adapting the application of specific teaching aids that correspond to the needs of a particular profession. Contemporary research indicates that this trend requires continuous monitoring and implementation of new technologies and methods with the aim of ensuring the relevance of educational programs and their compliance with the requirements of the labor market. This paper is focused on the presentation of teaching aids that can be used in the simulation method in the education of nurses/technicians. The purpose of the research is to analyze the diversity and effectiveness of these tools and aids in the simulation method. By reviewing the literature, analyzing existing research, and applying the focus group method, the most important elements for a successful application of the simulation method in the teaching of health care were identified. The sample consists of health care teachers, and the results indicate that quality teaching aids play a key role in the successful application of the simulation method in the education of nurses/technicians. This research provides an important overview and direction for future research and practice in the field of nurse/technician education.

**Key words**

*education of nurses, simulation method, teaching aids, vocational education*

# Generativna umjetna inteligencija i igrifikacija u obrazovanju / Generative artificial intelligence and gamification in education



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**Odgoj i obrazovanje za inovaciju i istraživanje**

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## **Sažetak**

Generativna umjetna inteligencija jest polje koje je u posljednje vrijeme doživjelo značajan rast i napredak. Prihvatanjem i upotrebom toga polja započelo je gotovo u svim područjima počevši od industrije, zdravstva, inženjerstva, medija, proizvodnje, inovativnih usluga proizvoda, turizma, zabavi, ali i obrazovanja. Značajan napredak u generativnoj umjetnoj inteligenciji pojavio se 2023. godine kada su se počeli uključivati generativni jezični modeli, povećano usvajanje istoga na svim područjima te brz rast generativnih alata umjetne inteligencije. Jedan od takvih razvoja koji je pridonio neviđenu priliku za tvrtke i pojedince, a posebice kada govorimo o obrazovanju jest i igrifikacija. Na taj se način otvorila mogućnost iskorištavanja generativne umjetne inteligencije za inovacije i rast.

Svrha je ovoga rada istražiti stavove učitelja primarnoag obrazovanja o generativnoj umjetnoj inteligenciji i igrifikaciji u svojem nastavnom radu. Metoda istraživanja je anketni upitnik koji se provodio na 628 učitelja primarnoga obrazovanja. Rezultati istraživanja pokazali su kako učitelji u manjem postotku koriste generativnu umjetnu inteligenciju u svojem nastavnom radu te u izrazito visokom postotku koriste metodu igrifikacije. Učitelji primarnoga obrazovanja u visokom postotku nisu upoznati sa svim oblicima generativne umjetne inteigencije te bi voljeli biti iako smatraju da neće pridonijeti kvaliteti obrazovanja. U manjem postotku ima učitelja koji smatraju da upotreba generativne umjetne inteligencije u obrazovanju pridonosi boljitku obrazovanja.

Na temelju provedenoga istraživanja opravdano je zaključiti kako generativna umjetna inteligencija i igrifikacija doprinose razvoju tehnologije i stvaraju nove mogućnosti za inovaciju i rast iako velika većina ispitanika smatra da će podjednako donijeti i niz rizika koji će zahtijevati pažljivo razmatranje.

## **Ključne riječi**

*generativna umjetna inteligencija; igrifikacija; obrazovanje*

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**Education for innovation and research**

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## **Abstract**

Generative artificial intelligence is a field that has seen significant growth and progress in recent times. The acceptance and use of this field permeated almost all areas starting with industry, healthcare, engineering, media, production, innovative product services, tourism, entertainment, and education. Significant progress in generative artificial intelligence emerged in 2023, characterized by the widespread adoption of generative language models and the rapid proliferation of artificial intelligence tools. One such development that has contributed to an unprecedented opportunity for companies and individuals, especially when we talk about education, is gamification. In this way, the possibility of using generative artificial intelligence for innovation and growth has opened up.

The purpose of this paper is to investigate the attitudes of primary education teachers about generative artificial intelligence and gamification in their teaching work. The research method is a survey questionnaire that was administered to 628 primary education teachers. The results of the research showed that a smaller percentage of teachers use generative artificial intelligence in their teaching work, and an extremely high percentage use the gamification method. A significant percentage of primary education teachers are unfamiliar with the full spectrum of generative artificial intelligence, yet express a desire to learn more, despite concerns about its potential impact on educational quality. In a smaller percentage, there are teachers who believe that the use of generative artificial intelligence in education contributes to the improvement of education.

Based on the conducted research, it is justified to conclude that generative artificial intelligence and gamification contribute to the development of technology and create new opportunities for innovation and growth, although the vast majority believe that they will also bring several risks that will require careful consideration.

## **Key words**

*education, gamification, generative artificial intelligence*

# Sources of stress among teachers in primary schools



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**Education for innovation and research**

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## **Abstract**

The aim of this research was to determine the sources of stress among primary school teachers in the Republic of Croatia, i.e. to determine whether there is a statistically significant difference in the sources of stress between classroom teachers and subject teachers with regard to the years of work experience in school, gender of the teacher, the number of students in the class and the school environment (urban or rural). For this research the Scale for measuring sources of stress in teachers was used. It was adapted to the Croatian conditions and it consisted of 25 statements. The questionnaire was filled out by 677 teachers (100 male and 577 female teachers) in 21 counties. Given that the difference in the sources of stress between classroom and subject teachers was researched, 268 classroom teachers and 409 subject teachers participated in the research. The research confirmed that subject teachers, female teachers, teachers who teach in classes with a larger number of students and in urban areas are more exposed to stress than classroom teachers, male teachers, teachers who teach in classes with a smaller number of students and in rural areas. It is interesting that the research found that there are no statistically significant differences between teachers with shorter and longer work experience. Additionally, the research confirmed that teachers are exposed to various sources of stress and emphasized the need for interventions to reduce these stressors and enhance teacher job satisfaction.

## **Key words**

*classroom teaching, school experience, subject teaching*

# Verbal associations of preschool children to the names of certain colors and feelings – stereotypes and changes



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**Education for innovation and research**

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## **Abstract**

This presentation will focus on the specifics of studying preschool children's verbal associations and the challenges that researchers face during both data collection and data processing. It employs a psycholinguistic research method aimed at examining the mental lexicon, which is significant for educators as it provides insights into children's perspectives on the world. The research will involve a sample of 200 preschool-aged children (ages 5-7) exposed to eight stimuli words representing colors and feelings. The collected data will undergo qualitative thematic analysis. Initially, analysis will involve categorizing responses into standardized themes, focusing on both syntagmatic and paradigmatic relationships to the stimuli words. At the preschool age, non-systemic reactions are common in children's responses and can be categorized into several themes: associations based on collective non-linguistic experiences, associations based on personal non-linguistic experiences, associations reflecting the child's need to define a term, and responses not linked to the semantic field of the stimulus word. The results will be compared with previous research conducted in the same linguistic region to document changes in conceptualization of the examined terms and identify persistent stereotypes in the most frequent reactions.

## **Key words**

*associative method, mental lexicon, reactions, stimulus word, stereotype*

# Student' self-assessment of asking questions in class



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## **Abstract**

Student questions are key to classroom interaction. Two-way communication encourages the active participation of teachers and students, contributing to their joint educational process. By asking questions, students seek new knowledge, express interest in education, and provide feedback on lessons. Creating a stimulating environment enables the development of creativity, curiosity, and critical thinking. The research conducted on 187 high school students aims to analyze attitudes about the importance and frequency of student questions, as well as anxiety related to asking questions. The results show neutral attitudes towards questions, with a more favorable attitude among male students. In terms of the frequency of asking questions, students estimate a lower frequency and the orientation of questions to seek explanations. Anxiety is below average, and gender differences indicate a lower level in male students. The importance of asking questions was rated above average, with differences according to educational attainment. Students with lower achievement consider them less important. Further research could investigate the connection between students' attitudes and the reasons why they do not choose to ask questions, contributing to the improvement of learning.

## **Key words**

*questions in class, students, teachers teaching*

# Pessimism, optimism, and defensive pessimism as predictors of school success, school and life satisfaction of high school students



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## **Abstract**

The aim of this research is to examine the extent to which and the way in which pessimism, optimism, and defensive pessimism in high school students are related to school variables: school success, school satisfaction and life satisfaction. Since there is a lack of research on high school students, this research will be a scientific contribution to research on this population. About 200 students of the second and third grade of the Zagreb high school will participate in the research. The following questionnaires will be applied: The Youth Life Orientation Test (Ey et al., 2005), Defensive Pessimism Questionnaire (Norem, 2001; according to Lim, 2009), Student Life Satisfaction Scale - SLSS (Students' Life Satisfaction Scale; Huebner, 1991b), Quality of School Life Questionnaire (Ainley & Bourke, 1992 according to Leonard, 2002) and general success as an indicator of school success.

## **Key words**

*defensive pessimism, optimism, pessimism, satisfaction with life, satisfaction with school*

# Curriculum of vocational education institutions



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## **Abstract**

"Nothing can improve a community's quality of life like a quality school" is the fundamental tenet of W. Glasser (2020), who sees quality youth education as a prospect for the well-being of society and economic progress. Vocational education institutions educate students for particular occupations, develop generic and key competences in students and carry out their educational role. For the successful realization of these roles, it is necessary to ensure the quality of the institution. Vocational education is carried out based on the national curriculum for vocational education, sectoral curricula, vocational curricula and the curriculum of the institution for vocational education, which defines the process, ways, and conditions for acquiring qualifications at levels 2 to 5 of the Croatian Qualifications Framework. The curriculum of the institution for vocational education is developed and adopted by the institution for vocational education. It is developed based on sectoral and vocational curricula in cooperation with vocational education stakeholders at the local and regional level. According to ASOO (2021), the Curriculum of the Vocational Education Institution sets out the plan and timeline of acquiring learning outcomes with related teaching topics, learning and teaching methods, ways of monitoring, evaluation and evaluation, and joint activities and cross-curricular topics contributing to the acquisition of learning outcomes. The curriculum of the vocational education institution provides recognition of the vocational education institution. The vocational curriculum is based on a modular approach to learning that, in addition to guided learning and teaching, also contains work-based learning in a vocational education institution, at employers or in a regional competence center. The success of the application of new vocational curricula and the development of the institution's curriculum depends on the competences and willingness of teachers to change, and it is necessary to prepare teachers, professional associates, and directors for a new modular approach in the implementation of vocational curricula. The aim of this paper is to show the development of the curriculum of the institution and the connection of the curriculum of the institution with the recognition of the institution for education.

## **Key words**

*institution curriculum, quality, vocational education*

# LASSO and RIDGE linear regression – better prediction or much more?



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## **Abstract**

The paper examines the use, limitations, and prerequisites for implementing LASSO (Least Absolute Shrinkage and Selection Operator) and RIDGE linear regression techniques. These techniques aim to improve the traditional regression method by reducing the sum of squared errors between observed and predicted values (OLS). LASSO and RIDGE introduce a penalty term to the regression equation to address overfitting. These two techniques differ in their penalty term (L1 for LASSO and L2 for RIDGE,) and their impact on the coefficients (RIDGE tends to reduce coefficients towards zero but not entirely, while LASSO can force some coefficients to be exactly zero. In a certain empirical example, the results of the regression line of linear regression with RIDGE and LASSO are analyzed and compared. The paper presents the issue of graphical overfitting in classical regression and its resolution using the mentioned regression procedures to reduce variance. The paper also examines the L1 and L2 regularization (cost function) procedures and their role in solving the problem of predictor multicollinearity in the example. Hybrid elastic Net regression that combines both L1 (LASSO) and L2 (RIDGE) regularization in cases when  $\lambda_1 > 0$ , and  $\lambda_2 > 0$ , are also discussed.

## **Key words**

*L1, L2 regularization, LASSO regression, overfitting, RIDGE regression, the sum of squared residuals*

# Obvezno obrazovanje u Republici Hrvatskoj i Estoniji: komparativna analiza kurikula matematike / Compulsory education in the Republic of Croatia and Estonia: A comparative analysis of the



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## **Sažetak**

Rezultati međunarodnih istraživanja u obrazovanju često su poticaj za daljnji razvoj i poboljšanje obrazovnih sustava diljem svijeta. Prema rezultatima posljednjega PISA 2022 istraživanja, Estonija je ostvarila najbolji rezultat među europskim zemljama. Potaknuti time u ovom radu prikazat će se usporedba obveznoag obrazovanje Republike Hrvatske i Estonije te glavna obilježja obrazovnih sustava obje države. Uz pregled literature, važeće zakone i propise, prikazat će se komparativna analiza nacionalnih kurikula Matematike za obvezno obrazovanje Republike Hrvatske i Estonije. Analizom kurikula Matematike prikazat će se usporedba godišnjega broja nastavnih sati Matematike objiu država kako bi se vidjelo opterećenje učenika na kraju obveznoga obrazovanja u objema državama. U drugom dijelu analize kurikula prikazat će se usporedba odgojno-obrazovnih ishoda i sadržaja učenja matematike u obveznom obrazovanju (ISCED 1 i ISCED 2). Ovo istraživanje pružit će nove informacije i znanja koja se mogu koristiti za daljnji razvoj nastavnoga predmeta Matematike u obveznom obrazovanju Republike Hrvatske.

## **Ključne riječi**

*komparativno istraživanje; matematika; nacionalni kurikulum; obvezno obrazovanje*

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**Abstract**

The results of international research in education are often a stimulus for further development and improvement of educational systems around the world. According to the results of the latest PISA 2022 survey, Estonia achieved the best result among European countries. Motivated by this, this paper will present a comparison of the compulsory education of the Republic of Croatia and Estonia and the main features of the education systems of both countries. Along with a review of the literature, current laws and regulations, a comparative analysis of the national mathematics curricula for compulsory education in the Republic of Croatia and Estonia will be presented. The analysis of the mathematics curriculum will show a comparison of the annual number of mathematics teaching hours of both countries to see the workload of students at the end of compulsory education in both countries. In the second part of the curriculum analysis, a comparison of educational outcomes and the content of mathematics learning in compulsory education (ISCED 1 and ISCED 2) will be presented. This research will provide new information and knowledge that can be used for the further development of the subject of mathematics in the compulsory education of the Republic of Croatia.

**Key words**

*comparative research, compulsory education, mathematics, national curriculum*