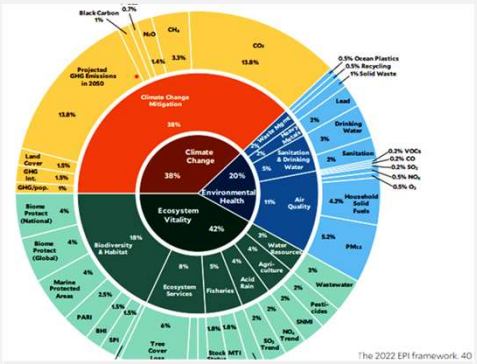
Indeksi

Mogućnost ili opasnost

Zorana Lužanin,
Prirodno-matematčki fakultet
Unverzitet u Novom Sadu





1

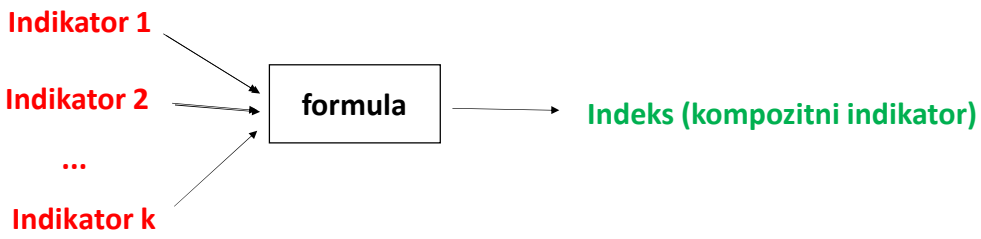
Indikator (pokazatelj) je obeležje koje se posmatra **sa posebnim ciljem**.

Indikator je obeležje koje merimo, a koja nam **daje predstavu o tome kako nešto izgleda**.

Indikator je merljiva informacija koja se **koristi da bi se utvrdilo da li program/mera/aktivnost daje očekivane rezultate**.Izbor indikatora je izuzetno važan korak u praćenju i evaluaciji efekata.

2

Indeks (kompozitni indikator) je agregirana mera koju čine više pojedinačnih indikatora.



3



- mogućnost sumiranja kompleksnih, višedimenzionalnih stanja u cilju pružanja podrške donosiocima odluka;
- smanjenje obima podataka bez gubitka osnovnih informacija;
- olakšavanje komunikacije sa javnošću (građanima, medijima itd.);
- mogućnost da korisnici efikasno upoređuju složene dimenzije.



- mogućnost dovođenja do pojednostavljenih zaključaka;
- mogućnost zloupotrebe;
- izbor indikatora i formule bi mogao biti predmet spora;

4

Primer 1

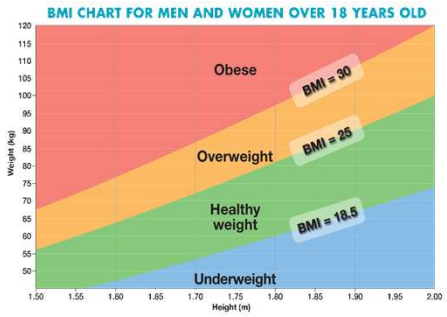
1972. godine istraživač po imenu dr. Ancel Keys skovao je pojam „**indeks telesne mase**“, „**bodi masa indeks**“

1985. godine Nacionalni institut za zdravlje (NIH) počeo je da koristi BMI za definiranje gojaznosti u Sjedinjenim Državama.

m-telesna masa [kg]

h – visina [m]

$$\frac{m[\text{kg}]}{h^2[\text{m}]} \rightarrow \text{BMI}= \frac{m[\text{kg}]}{h^2[\text{m}]}$$



5

Primer 2

Zakon o osnovnom obrazovanju i vaspitanju

Општи успех ученика

Члан 62.

Општи успех ученика од другог до осмог разреда утврђује се на крају првог и другог полугодишта на основу аритметичке средине позитивних закључних бројчаних оцена из обавезних предмета и оцене из владања почев од шестог разреда.

Ocena iz matematike

Ocena iz hemija

Ocena iz engleskog

…

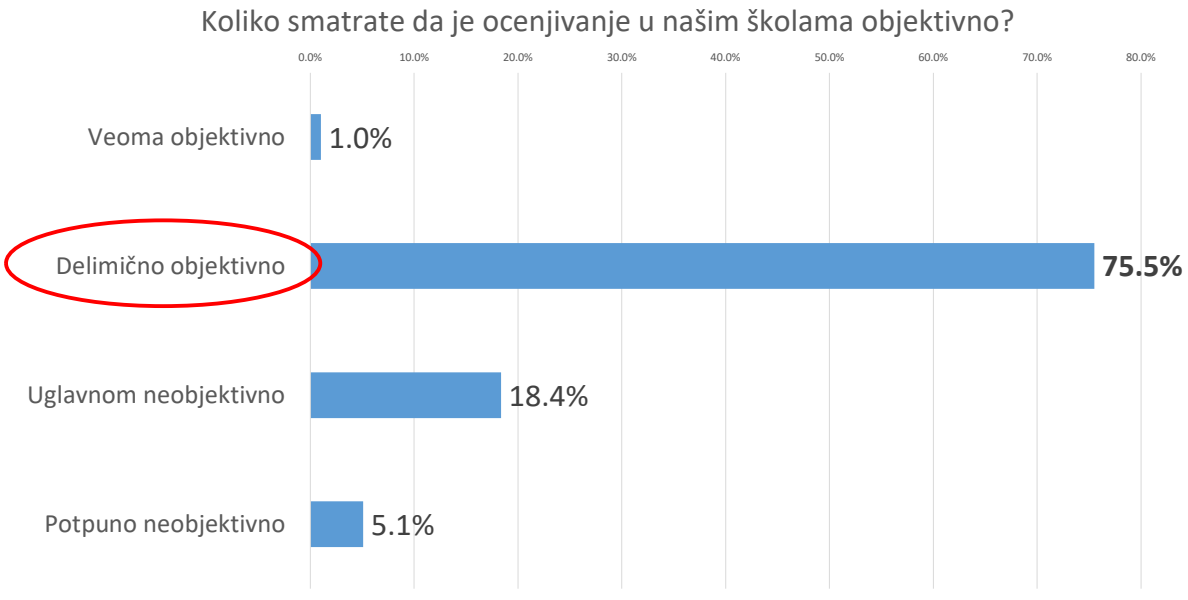
Ocena iz istorija

aritmetička sredina → **opšti uspeh**

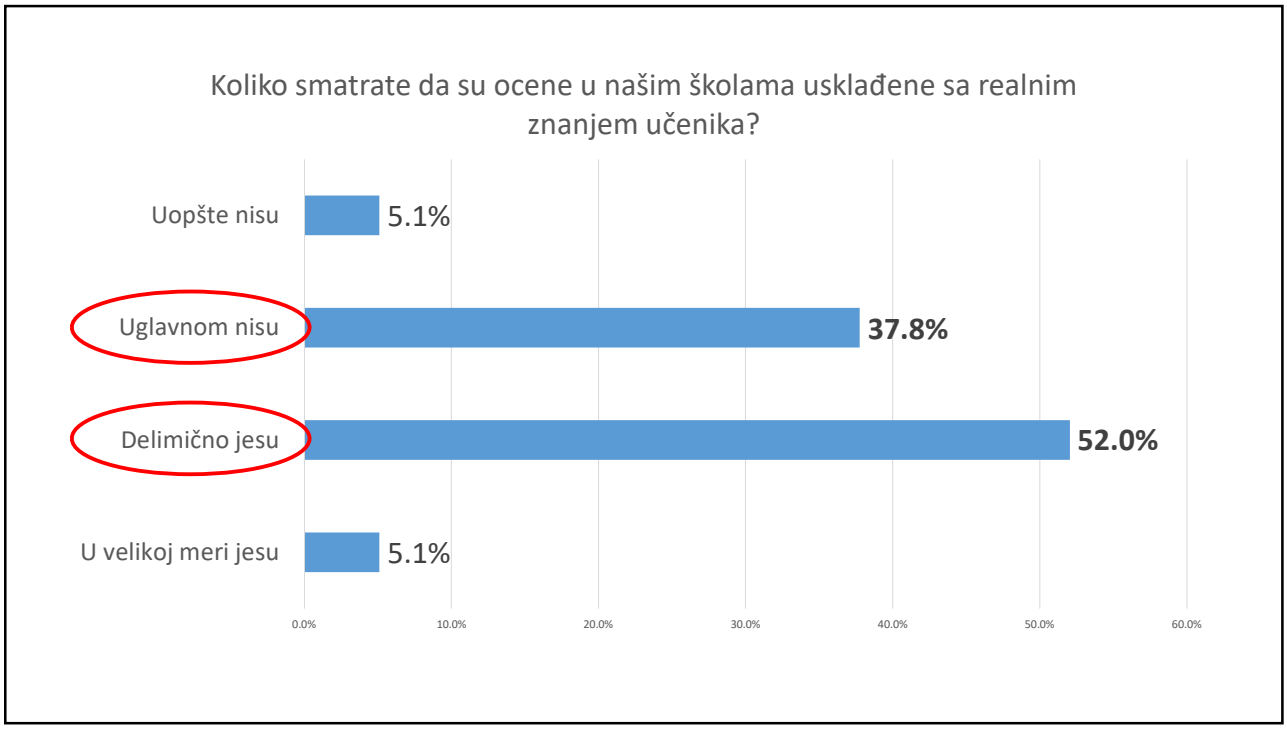
6

ŠTA KAŽETE VI?

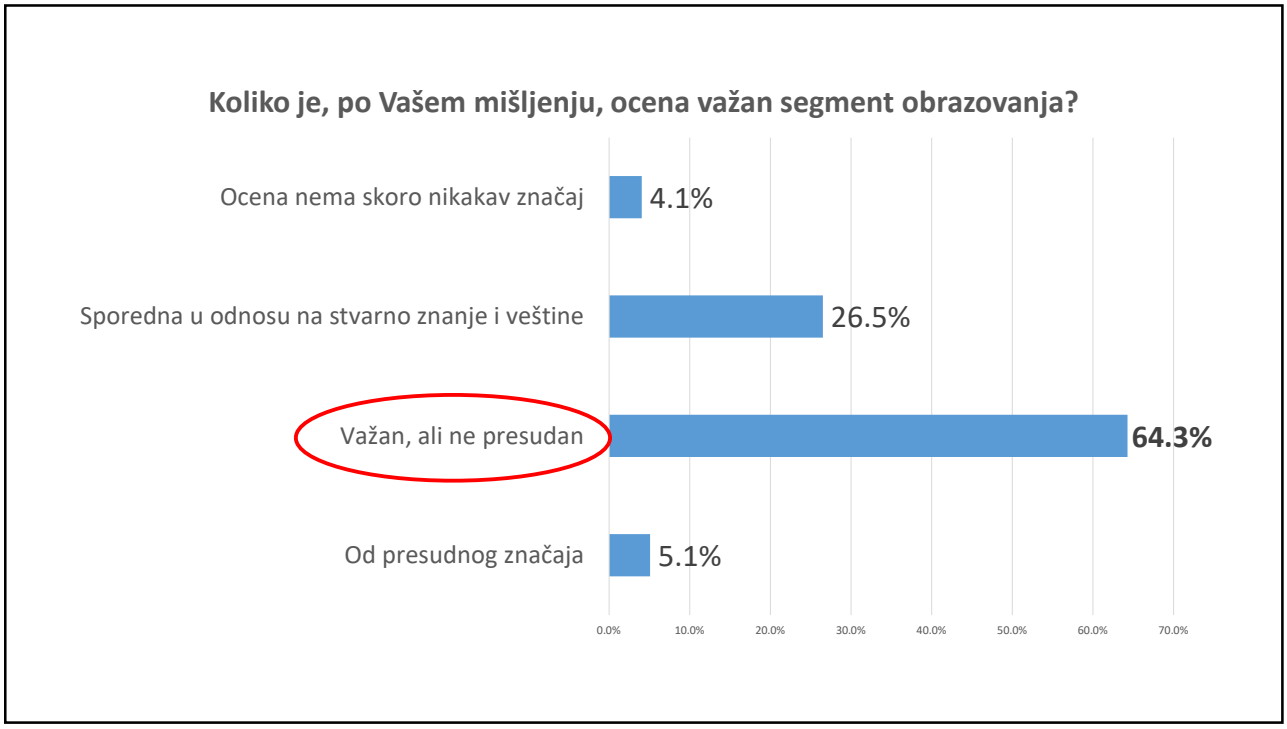
7



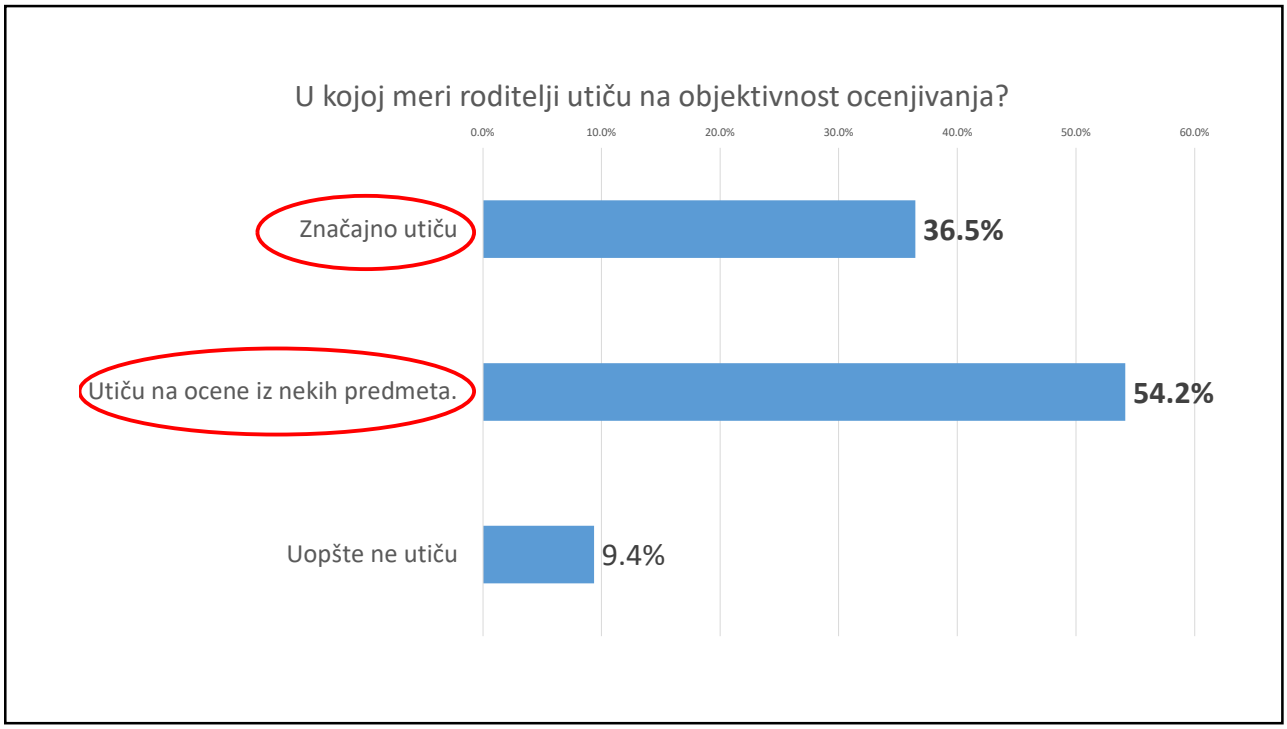
8


Koliko smatrate da su ocene u našim školama usklađene sa realnim znanjem učenika?
Uopšte nisu
5.1%
Uglavnom nisu
37.8%
Delimično jesu
52.0%
U velikoj meri jesu
5.1%
0.0%
10.0%
20.0%
30.0%
40.0%
50.0%
60.0%

9


Koliko je, po Vašem mišljenju, ocena važan segment obrazovanja?
Ocena nema skoro nikakav značaj
4.1%
Sporedna u odnosu na stvarno znanje i veštine
26.5%
Važan, ali ne presudan
64.3%
Od presudnog značaja
5.1%
0.0%
10.0%
20.0%
30.0%
40.0%
50.0%
60.0%
70.0%

10



11

ŠTA KAŽU PODACI?

12

	prosek
VI razred	4.12
VII razred	4.04
VIII razred	4.09

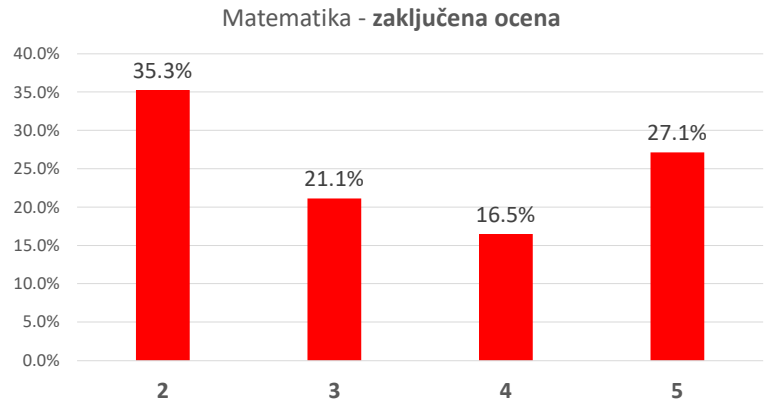
USPEH UČENIKA U OSNOVNOJ ŠKOLI
(populacija: učenici 8. razreda - 65.000 učenika)

	VI prosek	VII prosek	VIII prosek
Matematika	3.41	3.34	3.35
Hemija		3.55	3.46
Fizika	3.55	3.47	3.51
Strani 1	3.67	3.65	3.71
Maternji	3.66	3.66	3.71
Strani 2	3.76	3.70	3.75
Istorija	3.83	3.78	3.83
Geografija	3.83	3.82	3.85
Biologija	3.92	3.74	3.90
Tehničko	4.42	4.37	4.44
Muzičko	4.51	4.45	4.55
Likovno	4.59	4.60	4.66
Fizičko	4.75	4.74	4.78
Izborni sport	4.79	4.78	4.80
Vladanje	4.94	4.90	4.90

13

	VI prosek	VII prosek	VIII prosek
Matematika	3.41	3.34	3.35

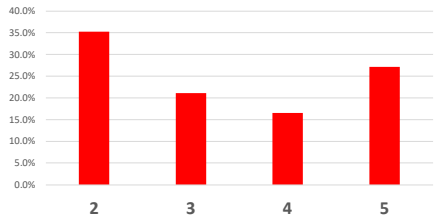
srednja vrednost	**3.35**
st. odstupanje	1.22
medijana	**3**
moda	2



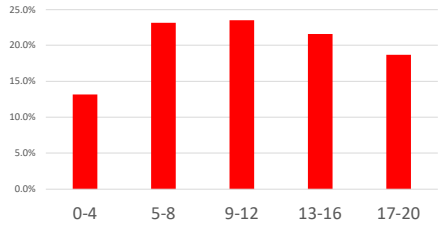
14

Više indikatora, koji je pravi?

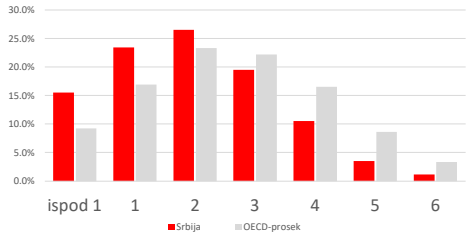
Matematika - **zaključena ocena**



Matematika - **završni ispit**

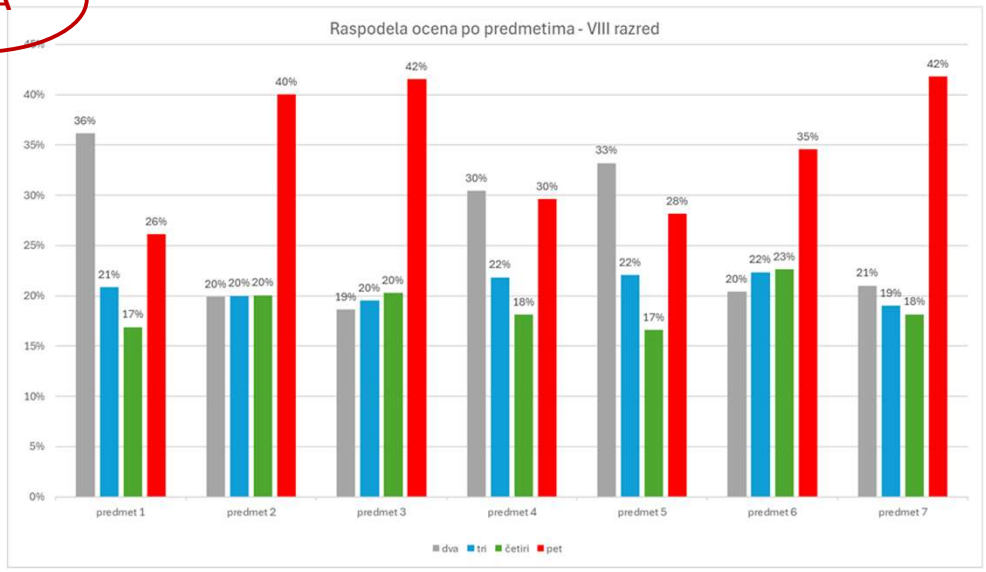


PISA (matematika) - **nivoi postignuća**



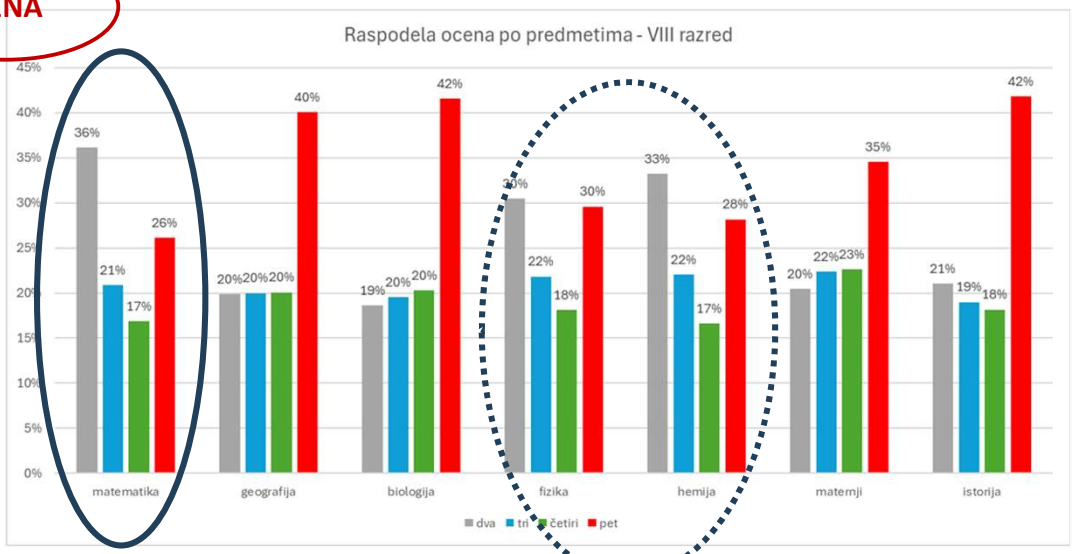
15

OCENA



16

OCENA

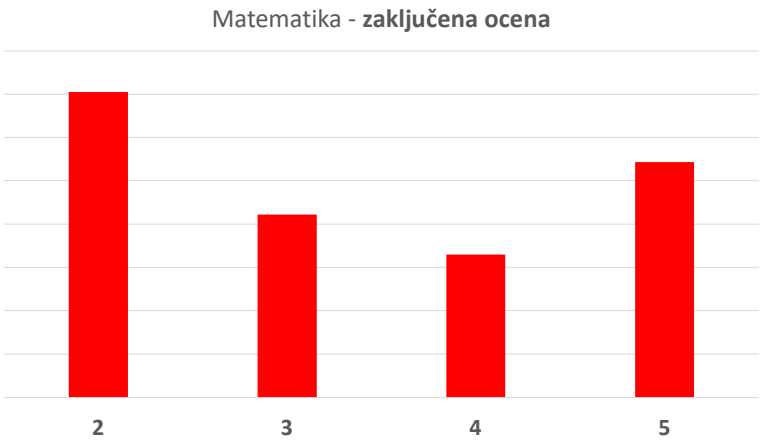


17

Ima li još nešto što treba da nas brine?

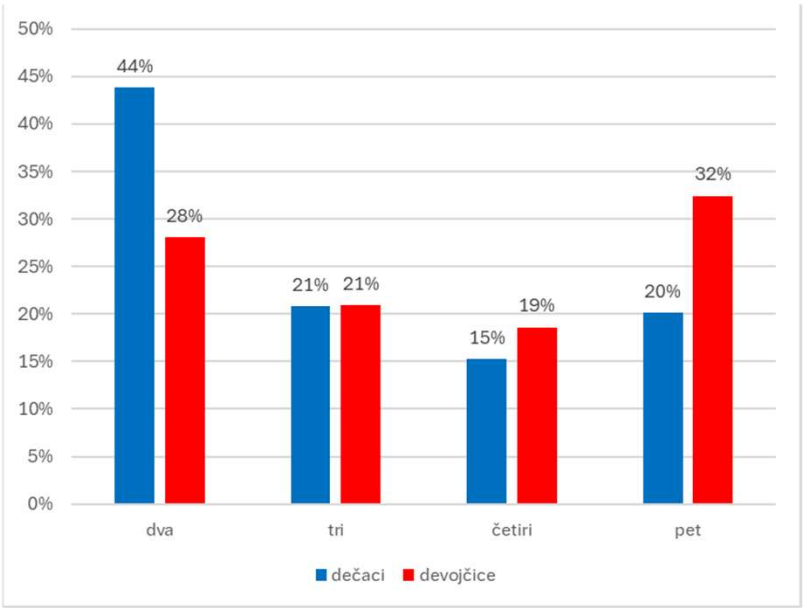
18

OCENA



19

OCENA

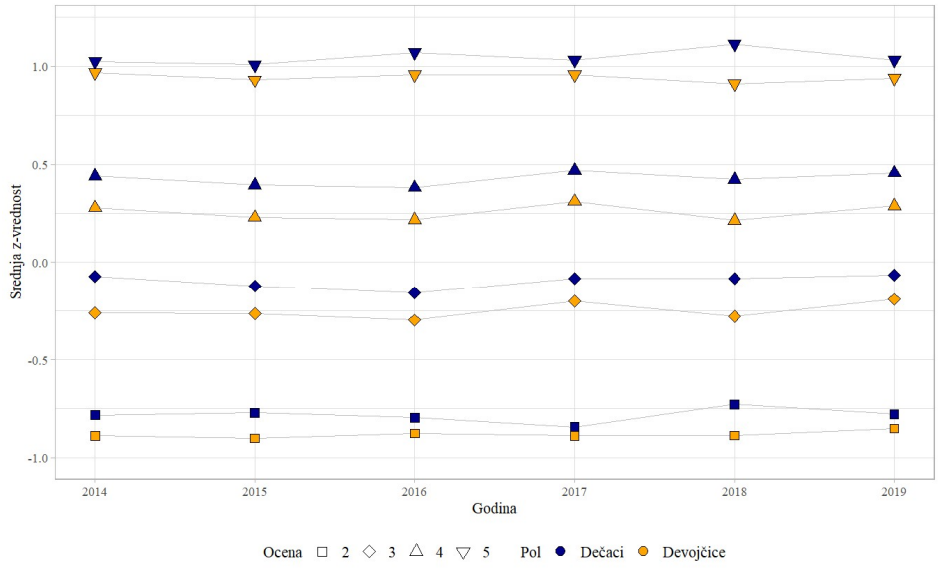


3.55

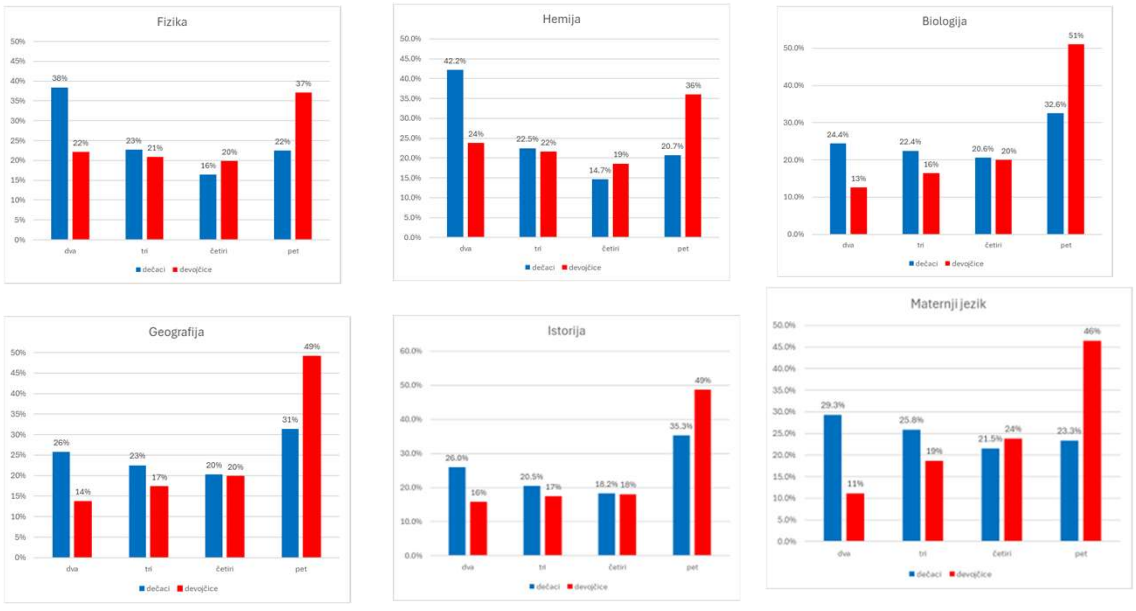
3.11

20

Verbić, S., Kaplar, M., Lužanin, Z., Trnavac, D. & Ranđelović, B. (2025). **Simpsonov paradoks u ocenama iz matematike: studija slučaja iz osnovnih škola u Srbiji**. *Zbornik Instituta za pedagoška istraživanja*, 57(1), 5−28. DOI: 10.2298/ZIPI2501005V.



21



22



"Nikola je bio odličan iz svih predmeta kao mali, samo je imao problem sa jednim jedinim koji ga je baš mučio.

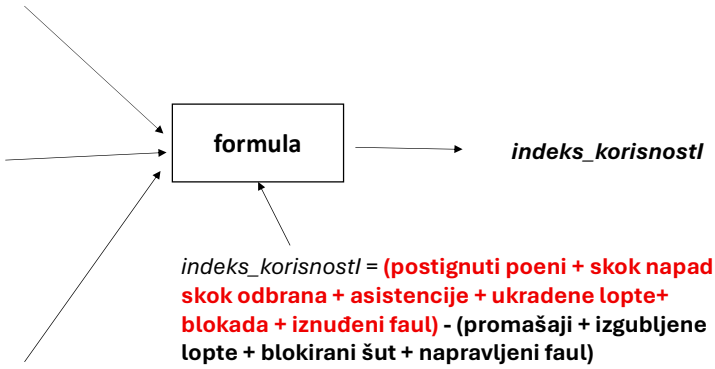
Nije mu išlo fizičko! Ali eto, borio se, borio i kao što vidimo izborio" - rekla je Gordana Ralević, Jokićeva nastavnica iz osnovne škole.

23

Primer 3

Indeks korisnosti (eng. Player Index Rating – PIR) - uveden je u Evroligi kao zbir pozitivnih i negativnih statističkih učinaka igrača. Služi da se kroz jedan broj pokaže koliko je igrač doprineo svom timu u utakmici, sezoni ili turniru.

postignuti poeni
skok napad
skok odbrana
asistencije
ukradene lopte
blokada
iznuđeni faul
promašaji
izgubljene lopte
blokirani šut
napravljeni faul



indeks_korisnostI = **(postignuti poeni + skok napad + skok odbrana + asistencije + ukradene lopte+ blokada + iznuđeni faul) - (promašaji + izgubljene lopte + blokirani šut + napravljeni faul)**

24

Zakon o osnovnom obrazovanju i vaspitanju

Општи успех ученика

Члан 62.

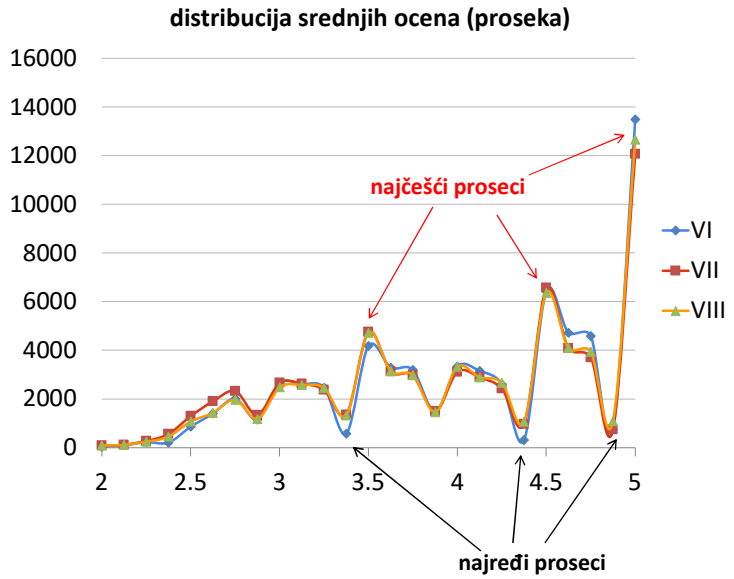
Општи успех ученика од другог до осмог разреда утврђује се на крају првог и другог полугодишта на основу аритметичке средине позитивних закључних бројчаних оцена из обавезних предмета и оцене из владања почев од шестог разреда.

Општи успех ученика је: одличан, врло добар, добар, довољан.

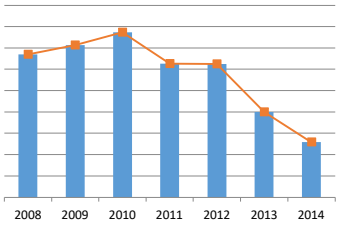
Ученик је постигао општи успех:

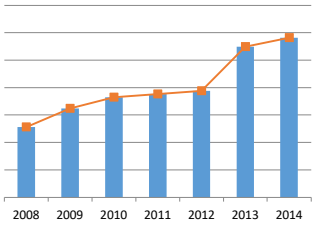
1) одличан – ако има средњу оцену најмање 4,50;
2) врло добар – ако има средњу оцену од 3,50 закључно са 4,49;
3) добар – ако има средњу оцену од 2,50 закључно са 3,49;
4) довољан успех – ако има средњу оцену до 2,49.

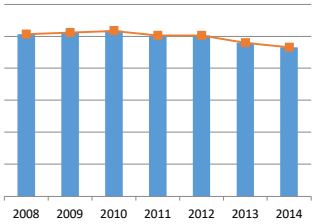
25

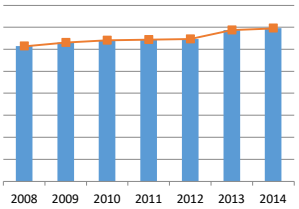


26









!?

27

godina	broj ucenika	broj vukovaca	udeo vukovaca
2008	82.549	10.138	12,28%
2009	81.040	10.226	12,62%
2010	80.694	10.347	12,82%
2011	78.037	10.052	12,88%
2012	77.659	10.049	12,94%
2013	69.824	9.598	13,75%
2014	66.991	9.317	13,91%

28



29

Primer 4: **rangiranje univerziteta**

Academic Ranking of World Universities

Šangajska lista

Organizator: Shanghai Ranking Consultancy, Kina

Fokus: Istraživačka izvrsnost i naučni uticaj

http://www.shanghairanking.com/

30

Criteria	Indicator	Code	Weight
Quality of Education	Alumni of an institution winning Nobel Prizes and Fields Medals	Alumni	10%
Quality of Faculty	Staff of an institution winning Nobel Prizes and Fields Medals	Award	20%
	Highly cited researchers in 21 broad subject categories	HiCi	20%
Research Output	Papers published in Nature and Science*	N&S	20%
	Papers indexed in Science Citation Index-expanded and Social Science Citation Index	PUB	20%
Per Capita Performance	Per capita academic performance of an institution	PCP	10%

http://www.shanghairanking.com/

31

Shangai Ranking			
Criteria	Indicator	Code	Weight
Education	Alumni of an institution winning Nobel Prizes and Fields Medals	Alumni	10%
Faculty	Staff of an institution winning Nobel Prizes and Fields Medals	Award	20%
	Highly cited researchers in 21 broad subject categories	HiCi	20%
Research	Papers published in Nature and Science	N&S	20%
	Papers indexed in Science Citation Index-expanded and Social Science Citation Index	PUB	20%
Per Capita Performance	Per capita academic performance of an institution	PCP	10%

Methodology of Greater China Rankings		
Criteria	**Indicator**	**Weight**
Education	Percentage of graduate students	5%
	Percentage of non-local students	5%
	Ratio of academic staff to students	5%
	Doctoral degrees awarded	10%
	Alumni as Nobel Laureates & Fields Medalists	10%
Research	Annual research income	5%
	Nature & Science Papers	10%
	SCIE & SSCI papers	10%
	International patents	10%
Faculty	Percentage of academic staff with a doctoral degree	5%
	Staff as Nobel Laureates and Fields Medalists	10%
	Highly cited researchers	10%
Resources	Annual budget	5%

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QS World University Rankings

Organizator: Quacquarelli Symonds (QS), UK
Fokus: Akademska reputacija, internacionalizacija, zapošljivost

Ključni indikatori:

- **Akademska reputacija** (40%) – na osnovu globalne ankete istraživača
- **Reputacija među poslodavcima** (15%)
- **Odnos broja nastavnika i studenata** (10%)
- **Citati po nastavniku** (20%) – kao indikator istraživačkog uticaja
- **Udeo međunarodnih nastavnika** (5%) i **međunarodnih studenata** (5%)
- **Zapošljivost diplomaca i održivost** (noviji dodaci)

https://www.topuniversities.com/qs-world-university-rankings

33

Times Higher Education (THE) World University Rankings

Organizator: Times Higher Education (UK)
Fokus: Istraživanje, nastava, internacionalizacija, citiranost

Ključni indikatori:

- **Nastava** (30%) – uključuje reputaciju, student-fakultet odnos, prihode
- **Istraživanje** (30%) – reputacija, prihod i produktivnost
- **Citiranost istraživanja** (30%)
- **Internacionalni outlook** (7.5%) – nastavnici, studenti, saradnje
- **Industrijski prihodi** (2.5%) – transfer znanja i inovacije

https://www.timeshighereducation.com/world-university-rankings

34

Primer 5: **HDI**

Human Development Index (HDI) – Indeks ljudskog razvoja

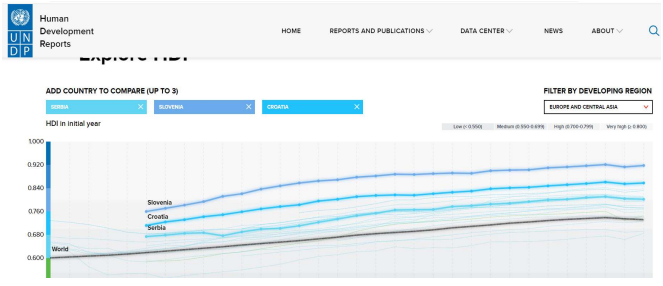
Uveden 1990. godine od strane UNDP-a

HDI izračunava UNDP svake godine i koristi se kao globalni pokazatelj nivoa razvoja i kvaliteta života u različitim zemljama.

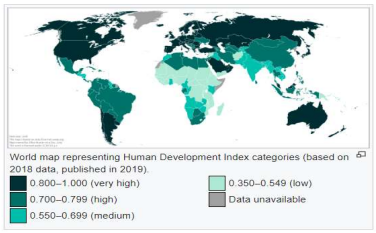
35

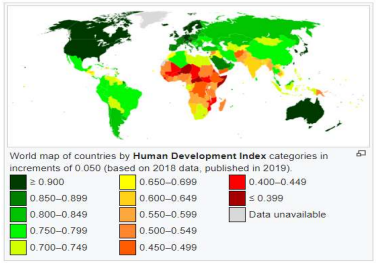
Human Development Index (HDI) :

http://hdr.undp.org/en/content/human-development-index-hdi

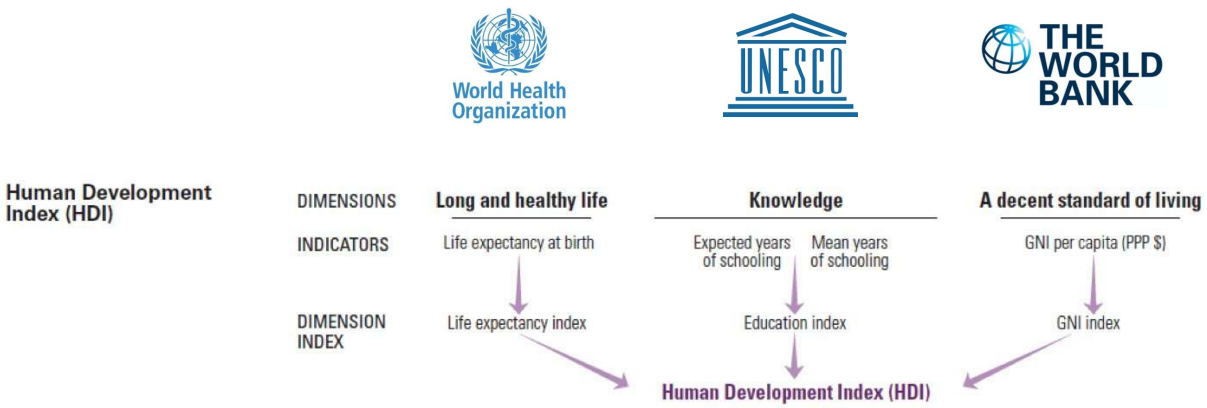


https://hdr.undp.org/data-center/country-insights#/ranks





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https://hdr.undp.org/data-center/country-insights#/ranks

Dimension	indicator	value
Health (Long and healthy life)	Life expectancy at birth (years)	74.2
Education (Knowledge)	Expected years of schooling (years)	14.4
	Mean years of schooling (years)	11.4
Decent standard of living	Gross national income per capita	19,123

	formula	
Health index	$i_h = \frac{xx - 20}{85 - 20}$	$i_h = \frac{74.2 - 20}{85 - 20} = 0.834$
Education index	$i_1 = \frac{xx - 0}{18 - 0}, \quad i_2 = \frac{xx - 0}{18 - 0} \quad i_e = \frac{i_1 + i_2}{2}$	$i_1 = 0.80, i_2 = 0.76, \quad i_e = \frac{0.80 + 0.76}{2} = 0.780$
Income index	$i_i = \frac{\ln(xx) - \ln(100)}{\ln(75{,}000) - \ln(100)}$	$i_i = \frac{\ln(19123) - \ln(100)}{\ln(75{,}000) - \ln(100)} = 0.794$

$$\boldsymbol{Human\ Development\ Index} = \sqrt[3]{i_h \cdot i_e \cdot i_i} = \sqrt[3]{0.834 \cdot 0.78 \cdot 0.794} = 0.802$$

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Indeks	Dimenzije	Indikatori	
		Pre 2010.	Posle 2010.
HDI	Zdravlje	Očekivano trajanje života na rođenju (LEB)	
	Obrazovanje	Stopa pismenosti kod odraslih (LR)	Prosečan broj godina obrazovanja populacije od 25 i više godina starosti (MYS)
		Kombinovana stopa obuhvata osnovnim, srednjim i visokim obrazovanjem (GER)	Očekivan broj godina školovanja za decu koja upravo polaze u školu (EYS)
	Životni standard	Bruto domaći proizvod po glavi stanovnika $(GDPPC)$	Bruto nacionalni dohodak po glavi stanovnika $(GNIPC)$

39

Indeks	Skr.	Izvor	God.
Indeks razvoja prema polu (engl. Gender Development Index)	GDI	UNDP	1995
Indeks rodnog osnaživanja (engl. Gender Empowerment Measure)	GEM	UNDP	1995
Relativni status žena (engl. Relative Status of Women)	RSW	Dijkstra and Hanmer	2000
Indeks rodnog jaza (engl. Global Gender Gap Index)	$GGGI$	World Economic Forum	2006
Indeks rodne jednakosti (engl. Gender Equity Index)		Social Watch	2007
Socijalne institucije i rodni indeks(engl. Social Institutions and Gender Index)	$SIGI$	OECD	2009
Indeks rodne ravnopravnosti EU (engl. European Union Gender Equality Index)		Plantenga et al	2009
Indeks rodne nejednakosti (engl. Gender Inequality Index)	GII	UNDP	2010
Indeks rodnog razvoja prilagođen nejednakostima (engl. Inequality-adjusted Human Development Index)	$IHDI$	UNDP	2010
Rodni odnos (engl. Gender Relative Status)	GRS	Beneria and Permanyer	2010
Indeks nedostatka žena, Women Disadvantage Index	WD	Permanyer	2013
Evropski indeks rodne jednakosti, European Gender Equality Index	$EGEI$	Bericat	2011
Mera rodnog jaza, Gender Gap Measure	GGM	Klasen and Schüler	2011
Indeks rodne jednakosti, Gender Equality Index	GEI	European Institute of Gender Equality	2013

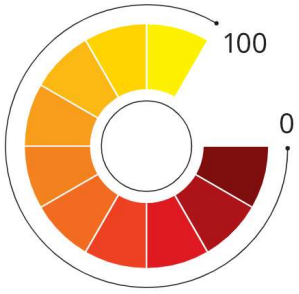
Tabela: Pregled indeksa koji mere rodnu ravnopravnost

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CORRUPTION PERCEPTIONS INDEX

The CPI ranks 180 countries and territories around the world by their perceived levels of public sector corruption. The results are given on a scale of 0 (highly corrupt) to 100 (very clean).

methodology: https://www.transparency.org/en/news/how-cpi-scores-are-calculated



THE CPI USES A SCALE FROM **0 TO 100**

100 is **very clean** and
0 is **highly corrupt**

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Ease of Doing Business

Description: https://databank.worldbank.org/metadataglossary/doing-business/series/IC.BUS.EASE.DFRN.DB16

Methodology: https://archive.doingbusiness.org/en/methodology

Data: https://archive.doingbusiness.org/en/rankings?region=europe-and-central-asia

The World Bank Group is formulating a new approach to assessing the business and investment climate in economies worldwide following the discontinuation of the Doing Business project. Updates on the development of the new Business Enabling Environment (BEE) project will be published on this website as they become available. In the interim, this website will act as a one-stop shop to spotlight a set of curated indicators and resources for users focused on improving the business environment.

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World Bank Group to Discontinue Doing Business Report

https://www.worldbank.org/en/news/statement/2021/09/16/world-bank-group-to-discontinue-doing-business-report

"Trust in the research of the World Bank Group is vital. World Bank Group research informs the actions of policymakers, helps countries make better-informed decisions, and allows stakeholders to measure economic and social improvements more accurately. Such research has also been a valuable tool for the private sector, civil society, academia, journalists, and others, broadening understanding of global issues.

After data irregularities on Doing Business 2018 and 2020 were reported internally in June 2020, World Bank management paused the next Doing Business report and initiated a series of reviews and audits of the report and its methodology. In addition, because the internal reports raised ethical matters, including the conduct of former Board officials as well as current and/or former Bank staff, management reported the allegations to the Bank's appropriate internal accountability mechanisms.

After reviewing all the information available to date on Doing Business, including the findings of past reviews, audits, and the report the Bank released today on behalf of the Board of Executive Directors, World Bank Group management has taken the decision to discontinue the Doing Business report. The World Bank Group remains firmly committed to advancing the role of the private sector in development and providing support to governments to design the regulatory environment that supports this. Going forward, we will be working on a new approach to assessing the business and investment climate. We are deeply grateful to the efforts of the many staff members who have worked diligently to advance the business climate agenda, and we look forward to harnessing their energies and abilities in new ways."

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Formiranje indeksa

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Prvi korak: razvoj teorijskog okvira

Drugi korak: izbor indikatora

Treći korak: obrada nedostajućih podataka

Četvrti korak: multivarijaciona analiza

Peti korak: normalizacija podataka

Šesti korak: određivanje težinskih koeficijenata (pondera) i agregacija

Sedmi korak: robusnost i osetljivost

Osmi korak: vraćanje na detalje

Deveti korak: povezanost sa drugim pokazateljima

Deseti korak: prezentacija i diseminacija

OECD metodologija

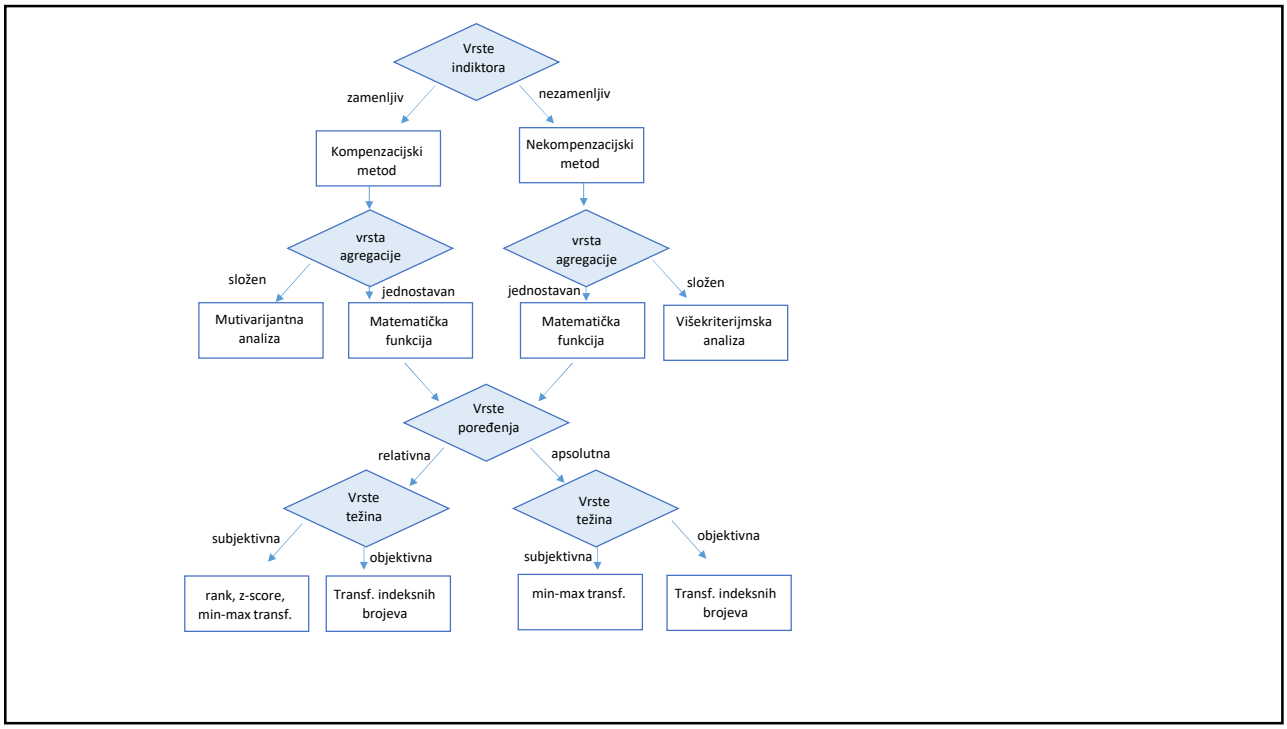
JRC metodologija

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Glavni faktori koje treba uzeti u obzir pri izboru metode za agregaciju pojedinačnih pokazatelja su sledeći:

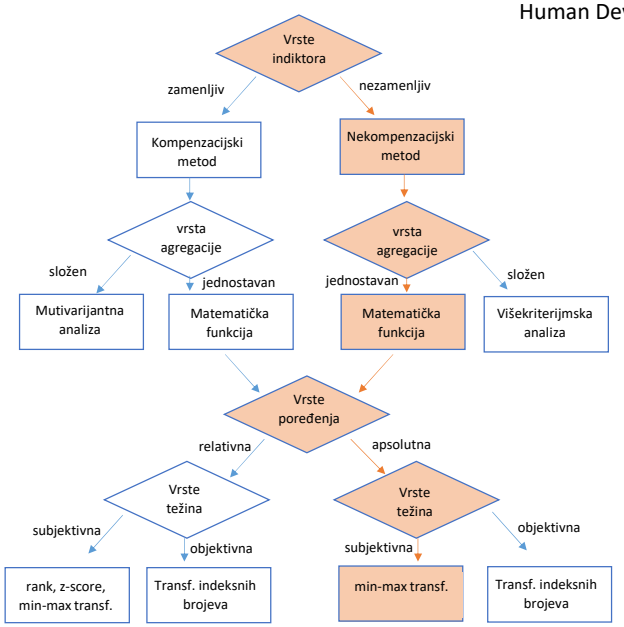
- vrsta indikatora (zamenljivi / nezamenljivi);
- vrsta agregacije (jednostavna / složena);
- vrsta poređenja (apsolutna / relativna);
- vrsta težine (objektivna / subjektivna).

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Human Development Index (HDI)



Dimenzija	Indikator	Min	max
Zdravlje	Očekivano trajanje života na rođenju	20	85
Obrazovanje	Očekivan broj godina školovanja	0	18
	Srednji broj godina školovanja	0	15
Životni standard	Bruto nacionalni dohodak po glavi stanovnika	100	75000

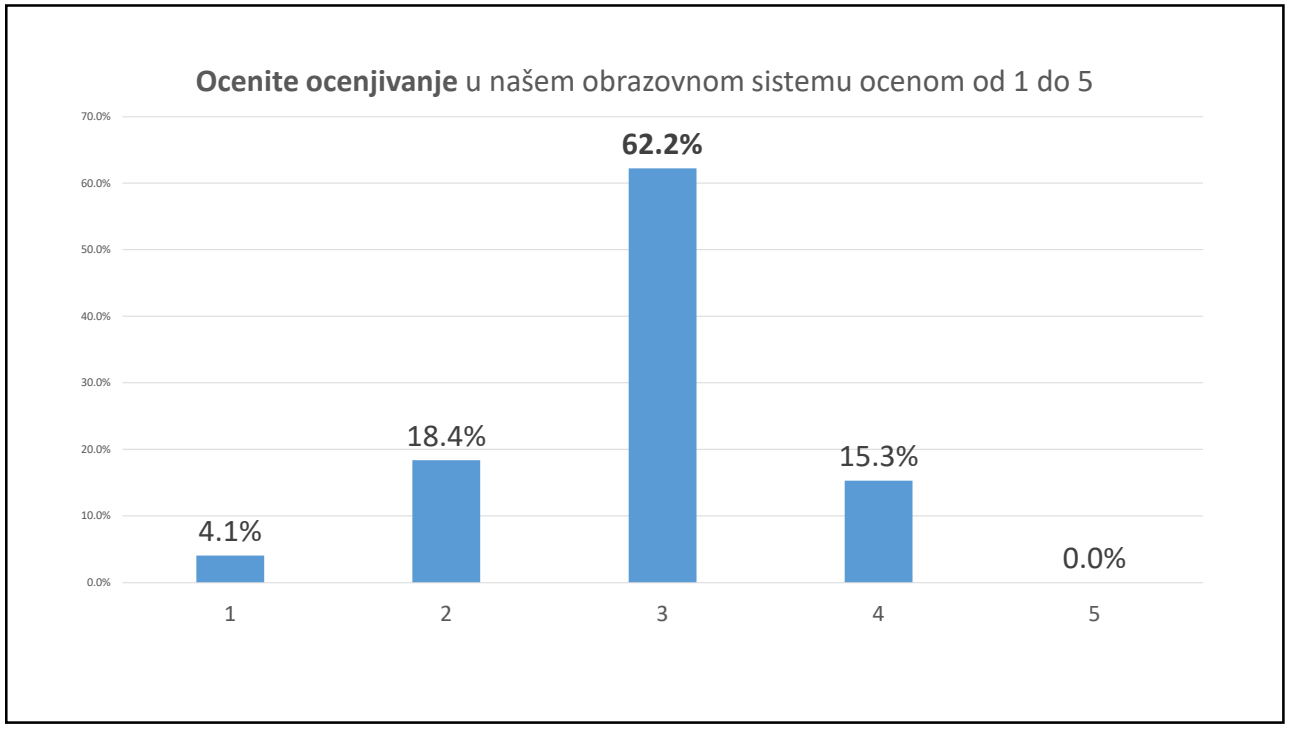
$$indeks\ dimenzije = \frac{aktuelna\ vrednost - min\ vrednost}{max\ vrednost - min\ vrednost}.$$

$$HDI = \sqrt[3]{IH \cdot \mathrm{IE} \cdot \mathrm{II}}$$

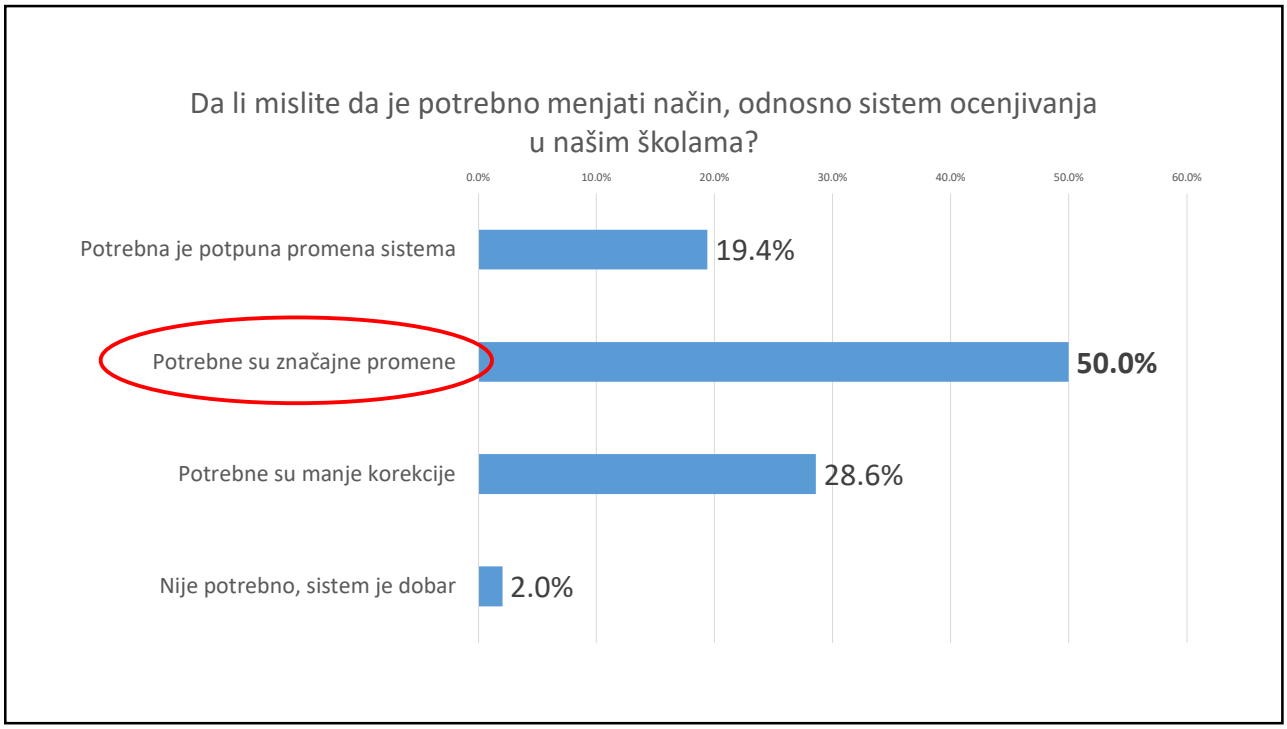
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Vratimo se na mišljenje...

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Udžbenik iz fizičkog - mediji

https://www.youtube.com/watch?v=V4WwqwyZVs4&t=2s

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