

KONSTRUKTIVISTIČKA NASTAVA

Teorija i empirijska istraživanja

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CONSTRUCTIVIST TEACHING

Theory and empirical research

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Predgovor

Pod nazivom „Nastava i škola za net-generacije“: unutarnja reforma nastave u osnovnoj i srednjoj školi realiziran je od 1. rujna 2014. do 31. kolovoza 2017. godine znanstveni projekt u programu istraživačkih aktivnosti Učiteljskoga fakulteta Sveučilišta u Zagrebu, a koji je novčano pomagala Hrvatska zaklada za znanost. Ova je monografija rezultat višegodišnjega proučavanja uloge digitalnih medija u informalnom učenju i nastavi koju škole organiziraju za pripadnike net-generacija, ali u knjizi su prezentirani i rezultati najnovijih istraživanja troje članova istraživačke skupine „Nastava i škola za net-generacije“. Ti su rezultati prikupljeni na uzorcima učenika i nastavnika osnovnih i srednjih škola u Hrvatskoj. Empirijski su rezultati stavljeni u kontekst teorija nastave i učenja koje se nalaze u novijoj didaktičkoj i psihološkoj literaturi. Autori monografije ovom prigodom izražavaju zahvalnost Hrvatskoj zakladi za znanost i Učiteljskom fakultetu Sveučilišta u Zagrebu na novčanoj pomoći za provedbu empirijskih istraživanja te pripremu i objavljivanje rezultata.

Zahvalnost dugujemo osnovnim i srednjim školama u kojima su prikupljeni podaci koje objavljujemo u ovoj monografiji ili koji su objavljeni u našim drugim radovima (Matijević i suradnici, 2016). Autori posebnu zahvalnost duguju učenicima, učiteljima te ravnateljima i stručnim suradnicima sljedećih osnovnih škola: Osnovna škola Đulovac; Osnovna škola Ljubo Babić, Jastrebarsko; Osnovna škola Lipik; Osnovna škola braće Radića Pakrac; Osnovna škola Vjenceslava Novaka, Zagreb; Osnovna škola Antuna Gustava Matoša, Zagreb; Osnovna škola Lijepa naša, Tuhelj; Prva osnovna škola, Varaždin; Osnovna škola Ostrog, Kaštel Lukšić; Druga osnovna škola, Bjelovar. Veliku zahvalnost za pomoć i suradnju dugujemo ravnateljima, nastavnicima i stručnim suradnicima srednjih škola koje smo posjećivali radi prikupljanja podataka i razmjene mišljenja o organizaciji poučavanja i učenja za pripadnike net-generacija. To su ove srednje škole: Gospodarska škola, Čakovec; Srednja škola Matije Antuna Reljkovića, Slavonski Brod; Srednja strukovna škola Vinkovci te Veterinarska škola, Zagreb.

Autori također zahvaljuju recenzentima na korisnim savjetima i kritičkim primjedbama.

Popis odabranih radova koje su članovi ovoga istraživačkog tima objavili tijekom trajanja projekta objavljen je u drugoj monografiji koju su priredili članovi ovoga istraživačkog tima (vidi Matijević, 2017, str. 344-347).

Autori

Foreword

Funded by the Croatian Science Foundation, the scientific project entitled *School for the Net-generation: Internal Reform of Primary and Secondary School Education* was carried out in the period from 1 September 2014 to 31 August 2017, within the framework of research activities of the Faculty of Teacher Education (University of Zagreb). This monograph is the result of long-term research on the role of digital media in informal learning environments created by schools for members of the so-called Net generation; however, only the results of more recent empirical research conducted by three members of the *School for the Net-generation* research team among Croatian primary and secondary school students and teachers are presented herein. Empirical results are contextualised within theories of education and learning presented in recent scholarly writings on didactics and psychology. The authors of the present monograph would like to take this opportunity to thank the Croatian Science Foundation and the Faculty of Teacher Education (University of Zagreb) for providing financial assistance necessary to conduct the empirical research, and to prepare and publish the results.

We are also grateful to the primary and secondary schools where data presented in this monograph and our other publications (Matijević et al., 2016) were collected. We owe special thanks to the students, teachers, principals and other experts employed in the following primary schools: “Đulovac” Primary School; “Ljubo Babić” Primary School, Jastrebarsko; “Lipik” Primary School; “Braća Radić” Primary School, Pakrac; “Vjenceslav Novak” Primary School, Zagreb; “Antun Gustav Matoš” Primary School, Zagreb; “Lijepa naša” Primary School, Tuhelj; First Primary School, Varaždin; “Ostrog” Primary School, Kaštel Lukšić; and the Second Primary School, Bjelovar. We would also like to acknowledge the assistance and cooperation of the principals, teachers and experts employed in secondary schools we visited in order to collect data and exchange opinions on teaching and learning for the Net generation. They include the following: Economics Secondary School, Čakovec; “Matija Antun Reljković” Secondary School, Slavonski Brod; Secondary Trade School, Vinkovci; and the Veterinary Secondary School, Zagreb.

The authors would also like to thank the reviewers of this books for their useful advice and critical remarks.

A list of selected publications produced by members of the research team in the course of this project has been included in a different monograph, prepared by the research team members (cf. Matijević, 2017, pp. 344–347).

The Authors

Konstruktivistička nastava: teorija i empirijska istraživanja

Konstruktivizam nije moguće jedinstveno definirati ni objasniti, on je istovremeno teorija o učenju i teorija o znanju. Konstruktivizam i konstruktivističke teorije učenja imaju svoja utemeljenja u ontologiji i epistemologiji. Teze i hipoteze koje su predstavljene konstruktivističkom pozicijom o genezi stvarnosti, znanja i učenja nisu nove i originalne. Ono što je novo je način prezentiranja i perspektiva tumačenja stvarnosti, znanja i učenja. Tako, povijesno gledano, prepoznajemo polazišta koja navode kako se konstruktivistička teorija formira u 20. stoljeću (Watzlawick, 1984, 2003; Ernst, 1998, 2005; Piaget, 2002, 2005; Vygotsky, 1977)¹. S druge strane neki autori (Palekčić, Vollstädt, Terhart i Katzenbach, 1999; Pritchard i Woollard, 2010; Von Glasersfeld, 2003) prepoznaju dugu povijest razvoja ideje, još od vremena prije nove ere, dok postoji tumačenje da je konstruktivističko učenje poznato od prije nešto više od stotinjak godina (Schweizer, 2007).

S obzirom na to kako pristupaju području konstruktivizma, Null (2004) dijeli teoretičare konstruktivizma na tri skupine sukladno razinama koje istražuju i propituju. U prvu skupinu Null stavlja teoretičare koji propituju znanje na epistemološkoj razini: *kako? zašto? kada i gdje?* nastaje (je konstruirano) znanje u društvu. Vrlo često ovi teoretičari propituju socijalni, politički i ekonomski kontekst. Druga razina odnosi se na istraživanje lokalne i individualne konstrukcije znanja u pojedinom razredu i od strane pojedinoga učenika. Ovi teoretičari i istraživači konstruktivizma istražuju procese učenja i poučavanja te često naglašavaju da učenje nije linearno i da je učeničko pridavanje smisla osnova procesu učenja. Treća skupina istraživača, najjednostavnije rečeno, razmatra konstruktivizam tako da propisuje odgovarajuće postupke. Sveukupnu teorijску i znanstvenu raspravu svode na određeni broj tehnika i savjeta koje bi učitelji trebali implementirati u nastavi. Tako postoje naznake pokušaja propisivanja onoga što učitelj „mora“ učiniti kako bi organizirao nastavu na teorijskim spoznajama konstruktivizma (Null, 2004, str. 181–182).

No, postoje i različiti teorijski pristupi i vrste konstruktivizma. Tako je konstruktivizam moguće sagledati u vidu tri teorije: filozofske (ontološ-

¹ Reference se u tekstu navode prema pravilima APA sustava.

ke i epistemološke); psihološke teorije učenja i didaktičke teorije nastave (Kanselaar, de Jong, Andriessen i Goodyear, 2002).

Filozofski pristup je usmjeren na ontologiju i epistemologiju. Stoga se u ontološkom pogledu propituje pitanje i priroda stvarnosti te načini njezine spoznaje. U tom se pogledu postavlja pitanje spoznaju li svi ljudi stvarnost i svijet oko sebe na isti način i u istim sadržajnim formama? Drugi je teorijski pristup koje je razvijen tijekom 20. stoljeća. U tom se pogledu na konstruktivizam gleda kao na psihologijsku teoriju učenja. Glavna premisa ove teorije učenja je da se proces učenja događa zahvaljujući ljudskoj aktivnosti, upotrebljavanje predmetima, interakcijom s fizičkom i društvenom okolinom. Psihološka konstruktivistička teorija učenja značajan razvoj doživljava u posljednja tri desetljeća, posebice implikacijom njezinih spoznaja u kontekst odgoja i obrazovanja. Treći pristup konstruktivizmu, a stariji od psihološkoga, je s aspekta didaktičke teorije. U tom pogledu ukazuje se na obilježja i načine organiziranja nastave, odnosno poučavanja i učenja. Naglasak konstruktivističke nastave i učenja u odnosu na neke druge didaktičke pristupe je što se njime naglašava aktivnost učenika. Konstruktivistički pristup u didaktici je u suprotnosti s dominirajućom paradigmom razredno-predmetno-satnoga sustava te frontalne nastave gdje učenici šute, sjede, slušaju i gledaju.

Postoji više konstruktivističkih teorija učenja. Phillips (1995) navodi tri aspekta promišljanja konstruktivističkoga učenja: *Individualno ili socijalno konstruiranje znanja*; *Stvaranje ili otkriće* te *Intelektualno ili fizičko konstruiranje znanja*. Stoga ne čudi postojanje brojnih podjela konstruktivizma, a i pojam je često shvaćen kao sinteza postojećih pravaca: kognitivni konstruktivizam, personalni konstruktivizam, socijalni konstruktivizam, kritički konstruktivizam i radikalni konstruktivizam. Pravci koji su najviše utjecali na organizaciju nastave usmjerene na učenika jesu kognitivna konstruktivistička teorija učenja i socijalna teorija učenja, odnosno socijalni konstruktivizam. Konstruktivističko je učenje definirano kao samoregulirani, interpretativni i nelinearni proces građenja spoznaja potpomognut aktivnom interakcijom s okolinom – fizičkom i socijalnom (Fosnot i Perry, 2005, str. 34). Učenje je pak u konstruktivističkoj paradigmi shvaćeno kao konstruktivni i situacijski proces gdje je nastava promatrana kao pružanje potpore, poticanje i savjetovanje učenika u njihovom procesu učenja (Palekčić, 2002; Babić, 2007). Uloga učitelja je

organizirati aktivnosti učenja, iskustva učenja i okolinu u kojoj se učenje treba događati. Konstruktivistička didaktika osigurava uvjete i okolnosti koji podupiru samostalno učenje (konstruiranje znanja). Terhart (2003) objašnjava da su principi konstruktivističke didaktike prepoznati i utemeljeni već početkom 20. stoljeća u pravcima reformske pedagogije.

Naravno, nije izostala kritika ovih teorija učenja. Kirchner, Sweller i Clark (2006) ukazuju na nekoliko slabih točaka konstruktivističke nastave. Naime, oni smatraju da je konstruktivistička nastava, poglavito učenje istraživanjem i rješavanjem problema, temeljena na procesima znanstvene spoznaje i na znanstvenoj metodologiji pojedine znanstvene discipline (uglavnom područja prirodnih znanosti). Kirchner (1992) objašnjava da način na koji stručnjak (u znanosti) dolazi do znanstvene spoznaje nije ekvivalent nastavi i didaktičkom osmišljanju procesa poučavanja i učenja. Mayer (2004), Kirchner, Sweller i Clark (2006), Rosenshine (2009) i drugi smatraju da nema dostatnih empirijskih činjenica koje podupiru superiornost konstruktivističkoga učenja nad učenjem u okolnostima direktnoga poučavanja.

No, bitno je prepoznati da je konstruktivističko učenje usmjereno na budućnost. Ono je anticipacijsko učenje koje stvara temelj za kompetenciju *učiti kako učiti*. Bez obzira na različit pristup onome što nazivamo teorijama učenja, konstruktivistički pristup moguće je prepoznati u svim navedenim oblicima reformskih pedagoških i didaktičkih ideja. Pod utjecajem umjetničkoga odgoja i radne škole, razvila se i ideja nove škole. Smatra se da je konstruktivizam zahvatio umjetničko područje početkom dvadesetoga stoljeća, prvo u Rusiji, a kasnije u ostalom dijelu Europe. Konstruktivizam kao umjetnički stil i pristup zahvaća najprije slikarstvo, a kasnije se javlja kao način pristupa projektiranju u arhitekturi. Sve to nije moglo ostati izvan nastave umjetnosti, a po slobodi izražavanja, poticanju estetskoga uočavanja i doživljavanja te poticanju kreativnosti i divergentnoga mišljenja. Kreativno umjetničko izražavanje, učenička individualnost i kreativnost u umjetničkim područjima, stekli su punopravno mjesto na listi sadržaja i aktivnosti u školskim kurikulumima općeobrazovnih i strukovnih škola, što je bio značajan i neophodan otklon od naglašenoga didaktičkog intelektualizma iz devetnaestoga stoljeća (<http://www.enciklopedija.hr/>).

Konstruktivizam u didaktici i pedagogiji implicira aktivnost svih subjekata, a prije svega, aktivnost učenika. Predstavnici jednoga od original-

nih pedagoških reformnih pokreta (pokret radne škole) koji se javio krajem 19. i početkom 20. stoljeća zauzimaju se za aktivan i samostalan rad učenika. Pobornici pokreta radne škole zagovaraju organiziranje što više aktivnoga učenja, uz naglasak na ručni rad učenika. Pokret radne škole odvija se u periodu intenzivnih traganja za novim didaktičkim strategijama koje će zadovoljiti potrebe i očekivanja od školskih ishoda u vrijeme druge industrijske revolucije u kada Maria Montessori, Dewey, Freinet, Feriere, Petersen, Parkharstova, Claparede, Decroly, Cousinet i drugi intenzivno provjeravaju didaktičke scenarije i strategije u kojima su naglašene raznovrsne aktivnosti učenika – individualno i u grupama, a koje se odnose na samostalno istraživanje i otkrivanje te rješavanje problema (Batinić, 2014).

Oni nude promjene u promišljanju kurikuluma, procesa učenja i poučavanja i vrednovanja. Izradi kurikuluma pristupaju na osnovu prijašnjih učeničkih iskustava, a izbjegavaju standardizirani kurikulum. Učenje i poučavanje organizirano je kao proces smislenih aktivnosti tijekom kojega učenici stječu nova znanja s obzirom na prijašnja iskustva i mogućnosti koje pospješuju uz pomoć i u suradnji s drugima. Strategije poučavanja osiguravaju propitivanje, istraživanje, refleksiju i praktične aktivnosti, a izbjegavaju zapamćivanje činjenica. Ovakav pristup utječe, naravno, i na metode i principe vrednovanja koji postaju dijelom procesa učenja. Standardizirano vrednovanje i ocjenjivanje učenika gubi svaki smisao. Zajedničko obilježje ovdje prikazanih projekata i pedagoga vidimo i u traženju ravnoteže između samostalnih individualnih aktivnosti te grupnoga i suradničkoga samostalnog rada učenika. U svim prikazanim oblicima traži se učitelj koji je organizator, moderator i suradnik, a ne učitelj predavač. No, i pored tih stogodišnjih spoznaja i u praksi provjerenih rješenja, mnogo je nastavnčkih fakulteta na kojima je naglasak na pripremanju predavača koji realiziranju program u vidu predavačko-prikazivačke, a ne konstruktivističke nastave.

Novi poticaj promjenama u nastavi dogodio se implementacijom računalnih tehnologija i novih medija. U prvobitnim istraživanjima uloge i učinka računalne tehnologije prevladavala je euforija i mišljenje da će mediji sami po sebi podići kvalitetu nastave i učenja (Tamim i sur., 2011; Timmermann i Kruepke, 2006). Takvi rezultati su se tumačili činjenicom da je nastava s medijima u najmanju ruku jednako učinkovita ili učinkovitija

od nastave bez medija (Schmidt i sur., 2009; Torgerson i Elbourne, 2002; Zhao, 2003). Razvojem i intenziviranjem istraživanja tijekom 1980-ih i do otprilike polovine 1990-ih godina ta veličina učinka opada, odnosno istraživanja počinju ukazivati da je nastava s (digitalnim) medijima jednako učinkovita kao i ona bez medija. Istraživanja iz 1990-ih su ukazivala, a ona od 2000-ih potvrđuju da su (digitalni) mediji tek jedan u nizu mnogih čimbenika koji međupovezanošću (međudjelovanjem, multivarijantnošću) po potrebi mogu pospješiti kvalitetu nastave te podići razinu postizanja pojedinih ishoda učenja (npr. Tamim, 2009; Tamim i sur., 2011).

Uzimajući u obzir važnost (socio)konstruktivističkoga učenja, samoreguliranoga, kontekstualnoga i suradničkoga učenja, a podržano digitalnim tehnologijama, prvenstveno internetom i Web 2.0 tehnologijama te u kontekstu relativiziranja formalnoga i naglašavanja informalnoga učenja (bilo kada i bilo gdje), formirao se diskurs o onome što se naziva „digitalnim svjetovima učenja“ (njem. *Digitale Lernwelten*) (Hugger i Walberg, 2010). Digitalni svjetovi učenja okvirno označavaju mogućnost samoreguliranoga, samostalnoga, ali i suradničkoga učenja koje potpomažu digitalne tehnologije.

Promišljajući o obilježjima suvremene nastave koja se zasniva na konstruktivističkim teorijama učenja i multimedijskoj nastavi, nije moguće istražiti njezine odrednice, a da se ne istraži računalna samodjelotvornost učenika i učitelja te motivacija za implementiranje digitalnih medija. Istraživanja su potvrdila kako za uspješno obavljanje poslova s digitalnom tehnologijom kao alatom, bitnu ulogu imaju stavovi prema njoj te percepcija vlastite sposobnosti njezinoga korištenja. Osobna percepcija vlastitih sposobnosti obavljanja određenih poslova i aktivnosti pomoću digitalne (računalne) tehnologije definirana je kao računalna samodjelotvornost (engl. *computer self-efficacy*). Računalna djelotvornost je razvijena iz teorijskoga koncepta samodjelotvornosti (engl. *self-efficacy*) Alberta Bandure (1977, 1982, 1993, 1997). Važno je napomenuti da se pokazalo da je samodjelotvornost bitan čimbenik motivacije i samoreguliranoga učenja, nezvano radi li se o općoj ili nekoj specifičnoj samodjelotvornosti (Pintrich, 2004; Pintrich i De Groot, 1990; Schunk, 2005; Torrano Montali i Tores, 2004; Usher i Pajares, 2008).

S obzirom da se radi o specifičnom fenomenu i procesu u koji se pokušava implementirati digitalna tehnologija, tj. radi se o odgoju i obrazo-

vanju, nastavi, učenju, poučavanju, školi i školovanju, pa je *teorija vrijednosti i očekivanja* izrazito korisna suradnicima (npr. Eccles, 2005; Eccles i Harold, 1991; Wigfield i Eccles, 2000), pokazalo se da je upravo ova teorija optimalan teorijski i praktični okvir kojim je moguće objasniti niz implementacija inovacija u odgojno-obrazovni kontekst (npr. Marušić, Jugović i Pavin Ivanec, 2011; Pavlin-Bernardić, Rovani i Marušić, 2017; Wozney, Venkatesh i Abrami, 2006).

Cilj istraživanja čiji su rezultati ovdje prikazani bio je ispitati obilježja upotrebe digitalnih medija i konstruktivističke nastave sa stajališta učenika i nastavnika osnovnih i srednjih škola u Republici Hrvatskoj. Odnosno, htjelo se ispitati posjedovanje pojedinih digitalnih medija, opremljenost škole digitalnim medijima, poticanje njihova korištenja, učestalost korištenja pojedinih digitalnih medija u nastavi, razinu računalne samodjelotvornosti, razloge korištenja digitalnih medija u nastavi (motivacija za njihovim korištenjem) te konstruktivističko učenje s aspekta viđenja učenika i nastavnika. Za prikupljanje podataka o računalnoj samodjelotvornosti korištena je Skala računalne samodjelotvornosti (engl. *Computer self-efficacy scale*) koju su konstruirali Teo i Ling Koh (2010). Kako bi se istražile odrednice konstruktivističke nastave korištena je skala konstruktivističkoga učenja (engl. *Constructivist learning environment scale*), a konstruirali su je Taylor, Fraser i Fischer (1997). Kako bi se utvrdila motivacija za korištenje digitalnih medija u nastavi korišten je upitnik implementacije digitalne tehnologije (engl. *Technology implementation questionnaire*) koji su konstruirali Wozney, Venkatesh i Abrami (2006) za ispitivanje razloga, odnosno motivacije korištenja i digitalne tehnologije i medija u nastavi. Instrument su konstruirali na polazištima teorije vrijednosti i očekivanja, odnosno motivacije (npr. Eccles, 2005; Eccles i Harold, 1991; Wigfield i Eccles, 2000). Također, namjera je bila ispitati obilježja svih navedenih varijabli s obzirom na pojedina demografska obilježja i učenika i nastavnika. Na kraju, željeli smo ispitati postoje li razlike u svim istraživanim varijablama između učenika i nastavnika.

Podatci su prikupljeni na uzorku skupina ($N = 880$) razine cijele Republike Hrvatske. Time se pokušalo obuhvatiti škole svih regija Hrvatske kako bi se dobio što reprezentativniji uzorak. Uzorkom su obuhvaćeni učenici ($n = 512$) i nastavnici osnovne i srednje škole ($n = 368$). Podatci su prikupljeni u siječnju i veljači 2016. godine metodom papir-olovka. Istra-

živanje je provedeno u skladu s Etičkim kodeksom istraživanja s djecom i mladima te je bilo u potpunosti anonimno i dobrovoljno. Samo istraživanje vrlo je opsežno i ovdje su prikazani samo neki od rezultata detaljne analize s obzirom na nezavisne varijable.

Deskriptivna je analiza pokazala da gotovo svi učenici posjeduju računalo, internet, mobilni telefon, pametni telefon i profil na nekoj od društvenih mreža. Nešto manje, ali i dalje u velikoj mjeri, posjeduju multimedijске softver, dok u nešto manjoj mjeri posjeduju tablet-računala. Ovi rezultati u skladu su s rezultatima OECD-a (2015) koji pokazuju kako digitalna podjela s obzirom na sociodemografske odrednice više nije realan problem u obrazovanju. Značajna razlika u posjedovanju digitalnih medija utvrđena je s obzirom na spol učenika, odnosno, učenice posjeduju mobilni telefon ($\chi^2 = -0,141$; $df = 1$; $p = 0,001$) i profile na društvenim mrežama ($\chi^2 = -0,103$; $df = 1$; $p = 0,019$) češće od učenika. Značajna razlika u posjedovanju medija s obzirom na razinu obrazovanja potvrđena je isključivo za tablet-računalo koji češće posjeduju učenici osnovnih škola nego učenici srednjih škola ($\chi^2 = 0,181$; $df = 1$; $p = 0,000$). S obzirom na školski uspjeh, učenici su prethodni razred završili s dovoljnim prosječnim uspjehom i u nešto manjoj mjeri od ostalih učenika posjeduju računalo ($\chi^2 = 0,526$; $df = 3$; $p = 0,022$) i internet ($\chi^2 = 1,930$; $df = 3$; $p = 0,039$). Istražujući razlike s obzirom na program škole koji učenici pohađaju, pokazalo se da učenici gimnazija u nešto većoj mjeri posjeduju neki multimedijски softver ($\chi^2 = 0,143$; $df = 1$; $p = 0,019$), nego učenici strukovnih škola. U pogledu procjene potrebne opremljenosti škole pojedinim medijima pokazalo se da su u prosjeku škole *donekle opremljene* računalima, internetom, potrebnim računalnim programima i projektorima, dok su u nešto manjoj mjeri opremljene pametnim pločama, a *u potpunosti nisu opremljene* računalima. Učeničke procjene ukazuju da su srednje škole nešto bolje opremljene internetom ($U = 27607,0$; $z = -3,346$; $p = 0,001$) i pametnim pločama ($U = 29279,0$; $z = -2,276$; $p = 0,023$), dok su osnovne bolje opremljene tablet- računalima ($U = 29649,5$; $z = -2,292$; $p = 0,022$). Učenici procjenjuju da su u nastavi organizirane takve aktivnosti učenja koje od njih iziskuju da *veoma često* komuniciraju internetom (63,7%), traže informacije na internetu (56,6%) i koriste društvene mreže (60%). S druge strane, veliki broj učenika procjenjuje da su u nastavi organizirane takve aktivnosti učenja gdje oni *nikada* ne prikazuju videosnimke (54,3%), prezentiraju audiosnimke (73,8%), koriste internetske platforme

učenja (66,8%) i programiraju (63,5%). Analizirajući pedagošku praksu u 174 studije slučaja, Kozma (2003) je utvrdio da se učenici u većini slučajeva u nastavi koriste alatima za izradu proizvoda poput prezentacija (78%), web-izvora (71%), multimedijiskoga softvera (52%). U pogledu poticanja korištenja digitalnih medija u nastavi i učenju, učenici procjenjuju da ih nastavnici uglavnom ne potiču na korištenje digitalnih medija u nastavi i učenju ($M = 2,33$; $SD = 0,89$), ali procjenjuju da su roditelji ti koji ih uglavnom potiču na korištenje digitalnih medija ($M = 2,85$; $SD = 0,92$).

Kada su u pitanju nastavnici, pokazalo se da gotovo svi nastavnici osobno kod kuće posjeduju računalo (99,7%), pristup internetu i mobilni telefon. U nešto manjoj mjeri posjeduju pametne telefone, multimedijiski softver (64%) i profile na društvenim mrežama (65%), dok u najmanjoj mjeri posjeduju tablet-računala (56%). U pogledu opremljenosti škole pojedinim digitalnim medijima nastavnici u prosjeku procjenjuju da su škole u kojima rade donekle opremljene računalima, potrebnim računalnim programima, projektorima i pametnim pločama i tablet-računalima. Od 605 nastavnika njih 50% procjenjuje da su im škole u potpunosti opremljene projektorima, pristupom internetu i računalima. Nešto više od polovine njih procjenjuje da su im škole donekle opremljene pametnim pločama, iako preko 40% njih kaže da im u potpunosti nisu njima opremljene. Vidljivo je i da preko 60% nastavnika procjenjuje da su im škole u potpunosti neopremljene tablet-računalima.

Utvrđeno je da od 30% do 60% nastavnika ukazuje da ih ravnatelji potiču na korištenje digitalnih medija, dok ih od 30% do 45% iskazuje da ih potiču stručni suradnici. S druge strane, oko tridesetak posto ih iskazuje da se za korištenje digitalnih medija u nastavi osposobljavaju na stručnim aktivima učitelja, s time da ih preko petine iskazuje da nisu osposobljavani.

Testirajući razlike u procjeni posjedovanja medija učenika i učitelja/nastavnika Mann-Whitneyjev U-test potvrdio je značajnu razliku u posjedovanju računala ($U = 91704,0$; $z = -2,909$; $p = 0,004$); interneta ($U = 91264,0$; $z = -3,420$; $p = 0,001$); multimedijiskoga softvera (CD, DVD) ($U = 69688,0$; $z = -9,436,432$; $p = 0,000$); pametnoga telefona ($U = 78728,0$; $z = -7,572$; $p = 0,000$) i profila na društvenim mrežama ($U = 65632,0$; $z = -11,925$; $p = 0,000$), ali ne i mobilnoga telefona ($U = 93504,0$; $z = -0,984$; $p = 0,325$) i tablet-računala ($U = 90456,0$; $z = -1,181$; $p = 0,238$). Učitelji

navode značajno češće da kod kuće posjeduju računalo i pristup internetu od njihovih učenika, dok učenici značajno češće navode da posjeduju multimedijски softver, pametni telefon i profil na društvenim mrežama.

Procjenjujući konstruktivističko učenje u školi na skali od 4 stupnja (gdje je 1 = u potpunosti se ne odnosi na mene; 4 = u potpunosti se odnosi na mene) učenici procjenjuju da su im u nastavi organizirane aktivnosti učenja koje im uglavnom omogućuju zainteresiranost za učenje, prepoznaju osobnu važnost učenja ($M = 2,99$), kritičko mišljenje ($M = 3,07$) te suradničko učenje (učeničko pregovaranje) ($M = 2,73$). No, učenici procjenjuju da im nije omogućena kontrola vlastitoga procesa učenja (individualizacija i samoregulirano učenje) ($M = 2,43$). Baš kao i učenici i učitelji/nastavnici općenito procjenjuju da nastava koju oni organiziraju učenicima ima konstruktivistička obilježja. Odnosno, oni procjenjuju da nastava koju organiziraju omogućuje učenicima osobnu važnost učenja (povezanost onoga što poučavaju sa stvarnim životnim situacijama) ($M = 3,36$), kritičko mišljenje ($M = 3,44$), kontrolu učenja ($M = 2,96$) i učeničko pregovaranje (suradničko učenje) ($M = 3,8$).

Analizom rezultata utvrđeno je da ne postoji značajna razlika u procjeni konstruktivističkoga učenja s obzirom na spol učitelja. Nastavnici koji su završili nastavnički smjer na nekom drugom fakultetu značajno negativnije procjenjuju učeničku mogućnost kontrole učenja i učeničku mogućnost pregovaranja (od učitelja koji su završili učiteljski fakultet / učiteljsku akademiju ili neki drugi studij uz naknadnu pedagoško-psihološku izobrazbu. Isto tako postoje značajne razlike u procjeni prepoznavanja osobne važnosti učenja, kritičkom mišljenju učenika i mogućnosti pregovaranja učenika kada je u pitanju proces učenja. Učitelji u osnovnim školama procjenjuju ove elemente značajno više od kolega koji rade u srednjoj školi. S obzirom na vrstu srednje škole utvrđeno je da postoji značajna razlika i kod faktora kontrole. Nastavnici u gimnazijama značajno niže procjenjuju učeničku mogućnost kontrole učenja od učitelja u osnovnim školama i nastavnika u strukovnim školama. Kada su u pitanju godine staža ne postoji statistički značajna razlika u procjeni konstruktivističkoga učenja.

Analizirajući razlike u procjeni prilika za konstruktivističko učenje u školi od strane učenika i učitelja/nastavnika Mann-Whitneyjevim U-testom utvrđene su značajne razlike u svim faktorima. Učenici procjenjuju

značajno niže razinu osobne važnosti učenja ($U = 56914,0$; $z = -10,026$; $p = 0,000$), kritičkoga mišljenja ($U = 56060,0$; $z = -10,293$; $p = 0,000$) mogućnosti kontrole učenja ($U = 49094,5$; $z = -12,155$; $p = 0,000$) i mogućnosti pregovaranja učenika kada je u pitanju proces učenja ($U = 59788,0$; $z = -9,292$; $p = 0,000$) nego nastavnici.

Rezultati istraživanja pokazali su da učenici pozitivno procjenjuju vrijednost korištenja digitalnih medija u nastavi ($M = 2,89$), imaju isto takva očekivanja u pogledu postizanja ishoda učenja koristeći digitalne medije ($M = 2,83$) te da upotreba digitalnih medija u aktivnostima učenja od njih ne iziskuje dodatno ulaganje napora ($M = 2,83$). Pokazalo se da su nastavnici relativno visoko motivirani za korištenje digitalnih medija u nastavi. Odnosno, nastavnici procjenjuju višu razinu vrijednosti digitalnih medija ($M = 3,03$) te pretpostavljaju da će moći uspješno organizirati nastavu koristeći i digitalne medije ($M = 3$). Također, smatraju da organizacija nastavnih aktivnosti uz pomoć digitalnih medija od njih ne iziskuje ulaganje dodatnoga napora ($M = 2,97$). Utvrđeno je da ne postoji značajna razlika u procjeni učitelja/nastavnika i učiteljica/nastavnica s obzirom na spol. Razlike u rezultatima s obzirom na inicijalno obrazovanje učitelja i nastavnika značajne su za procjenu vrijednosti implementacije digitalnih medija i ulaganja napora u korištenje digitalnih medija koje nastavnici koji su završili nastavnički smjer na nekom drugom fakultetu od učitelja koji su završili učiteljski fakultet / učiteljsku akademiju ili neki drugi studij uz naknadnu pedagoško-psihološku izobrazbu procjenjuju negativnije. Ne postoji značajna razlika učitelja i nastavnika u procjeni implementacije digitalnih medija s obzirom na obrazovnu razinu škole u kojoj rade, obrazovni program i godine staža učitelja/nastavnika.

Istražujući razlike u procjeni motivacije za implementacijom digitalne tehnologije učenika i učitelja/nastavnika Mann-Whitneyjevim U-testom potvrđene su značajne razlike. Učenici značajno negativnije procjenjuju vrijednosti i dobrobiti implementacije medija u nastavu ($U = 86060,0$; $z = -2,193$; $p = 0,028$), očekivanja uspjeha u implementaciji digitalnih medija ($U = 79907,0$; $z = -3,855$; $p = 0,000$) i ulaganje napora u korištenje digitalnih medija ($U = 84942,0$; $z = -2,497$; $p = 0,013$).

Rezultati istraživanja potvrdili su da učenici procjenjuju iznadprosječnu razinu računalne samodjelotvornosti u svim njezinim dimenzijama, tj. u pogledu temeljnih računalnih vještina ($M = 3,63$), vještina korištenja

računalnih programa ($M = 2,74$) te vještinama korištenja interneta ($M = 3$). Pokazalo se da nastavnici procjenjuju djelomično visoku razinu svoje računalne samodjelotvornosti. Naime, oni iznadprosječno procjenjuju svoje temeljne vještine korištenja računala ($M = 3,69$) te vještine korištenja interneta ($M = 3,03$), ali ispodprosječno procjenjuju svoje vještine korištenja računalnih programa ($M = 2,01$). Učitelji/nastavnici značajno pozitivnije procjenjuju svoju računalnu samodjelotvornost od svojih kolegica. Zanimljivo je da učitelji koji su završili učiteljski fakultet / učiteljsku akademiju procjenjuju svoje temeljne računalne vještine značajno niže od nastavnika koji su završili nastavnički smjer na nekom drugom fakultetu ili neki drugi studij uz naknadnu pedagoško-psihološku izobrazbu. Značajne razlike postoje u procjeni računalne samodjelotvornosti s obzirom na to rade li učitelji/nastavnici u osnovnoj ili srednjoj školi. U oba slučaja nastavnici u srednjim školama značajno višom procjenjuju svoju računalnu samodjelotvornost. Kada je u pitanju procjena računalne samodjelotvornosti s obzirom na godine rada u školi, potvrđene su značajne razlike u samoprocjeni temeljnih računalnih vještina i vještina korištenja računalnih programa. Ove faktore učitelji s najviše staža procjenjuju najnegativnije. Ne postoje značajne razlike u procjeni vještine korištenja interneta.

Pri analizi podataka Mann-Whitneyjevim U-testom utvrđeno je da djelomično postoje značajne razlike u samoprocjeni računalne samodjelotvornosti učenika i učitelja/nastavnika u procjeni vještina korištenja računalnih programa ($U = 55863,5$; $z = -19,364$; $p = 0,000$) i u samoprocjeni vještina korištenja interneta ($U = 53416,0$; $z = -11,045$; $p = 0,000$). Naime, učenici značajno pozitivnije procjenjuju svoje vještine korištenja računalnih programa i vještine korištenja interneta. Ovakvi rezultati da učenici, i općenito mlađe generacije, procjenjuju vlastitu računalnu samodjelotvornost višom od učitelja, odnosno starijih generacija, samo potvrđuju prethodne spoznaje ove problematike (Europska komisija, 2013; Topolovčan i Matijević, 2014; Topolovčan, Matijević i Dumančić, 2016; Whitley, 1997).

Prethodno prikazani zaključci te rezultati nekih drugih istraživanja ukazuju na potrebu radikalnijih promjena u didaktičkim scenarijima koji se nude pripadnicima net-generacija u današnjim školama (Matijević, 2015; Topolovčan, Matijević i Dumančić, 2016; Matijević, 2017). Konstruktivistička nastava, koja ima korijene u pokretima i pravcima reform-

ske pedagogije od prije stotinjak godina, daje optimistične šanse i poticaje za promjene u didaktici koja treba dominirati u suvremenoj školi. U toj ponudi ima mnogo prostora za implementaciju digitalnih medija u školske i izvanškolske aktivnosti. Uvažavajući spoznaje multimedijske didaktike te kurikulskih teorija, teorija višestrukih inteligencija i spoznaja obrazovne neuroznanosti, didaktički scenariji u nastavi i školi će se u idućim godinama bitno mijenjati. Rezultati istraživanja koji su prezentirani u ovoj monografiji mogu koristiti stručnjacima pri uvažavanju kriterija za izbor i didaktičko dizajniranje nastavnih scenarija za nove generacije učenika.

SUMMARY

Constructivist teaching: Theory and empirical research

Constructivism cannot be defined or explained in a single, unique way: it is, at the same time, a theory of learning and a theory of knowledge. Constructivism and constructivist learning theories are based in ontology and epistemology. Theses and hypotheses inscribed in the constructivist view on the genesis of reality, knowledge and learning are neither new nor original. What is new, however, is the way they perceive and interpret that same reality, knowledge, and learning. When it comes to the history of constructivist thought, some authors claim it was first formed in the 20th century (Watzlawick, 1984; 2003; Ernst 1998; 2005; Piaget, 2002; 2005; Vygotsky, 1977). In contrast, some authors (Palekčić, Vollstädt, Terhart i Katzenbach, 1999; Pritchard & Woollard, 2010; Von Glasersfeld 2003) describe the long history of the development of constructivism, a history they trace back to the B.C.E period, while others believe constructivist thought has been around for a little over one hundred years (Schweizer, 2007).

Depending on their approach to constructivism, Null (2004) has divided constructivists into three groups, based on the specific level they focus on. The first of Null's groups encompasses epistemological constructivists, i.e. theoreticians who study knowledge on the epistemological level, examining *how, why, when, and where* knowledge is created (constructed) within society. These theoreticians often deal with the social, political, and economic context. The second group consists of instructional constructivists, whose main focus of interest is research on local and individual constructions of knowledge which take place within individual classrooms, and are performed by individual students. These theoreticians and researchers therefore examine the processes of learning and instruction. They frequently point out that learning is not linear, and that it is rooted in students' abilities to attribute meaning. Simply put, the third of Null's groups includes researchers – prescriptive constructivists – who study constructivism by prescribing certain actions. They distil the entirety of theoretical and scientific discussions into a certain number of techniques and advice teachers should implement in their classrooms. There are some indications of attempting to prescribe what the teacher

“must” do in order to organise classes in accordance with the theoretical findings of constructivism (Null, 2004, pp. 181–182).

However, there are different types of theoretical approaches and different types of constructivism, which can be viewed through three theoretical lenses: philosophy (ontology and epistemology); the psychological theory of learning; and didactics (the theory of education) (Kanselaar, de Jong, Andriessen & Goodyear, 2002).

The philosophical approach focuses on ontology and epistemology, with the former examining the issue and nature of reality, and the means of its comprehension. This raises the question about whether all people perceive reality and the world around them in the same way and in terms of the same content. Developed in the 20th century, the second theoretical approach views constructivism as a psychological theory of learning. The basic premise of this learning theory is the notion that the learning process is facilitated by human activity, handling objects, and interaction with one’s physical and social environment. The psychological constructivist theory has undergone significant development in the last three decades, primarily thanks to the implications its findings have had in the context of education. Older than the psychological approach, the third approach to constructivism is rooted in didactics and focuses on the characteristics and means of organising education, i.e. instruction and learning. In contrast to some other didactic approaches, the constructivist approach to education places emphasis on student activity. The constructivist approach in didactics stands in direct contrast to the dominant paradigm of the class-subject-lesson system and instruction from the front, which requires students to be silent, remain seated, listen, and observe.

There are several constructivist learning theories. Phillips (1995) lists three aspects of thinking about constructivist learning: individually or socially constructed knowledge; creation or discovery; and intellectual or physical knowledge construction. It should therefore come as no surprise that there are many classifications of constructivism, and that the concept is often understood as a synthesis of existing approaches: cognitive constructivism, personal constructivism, social constructivism, critical constructivism, and radical constructivism. Approaches that have had the most influence on the organisation of student-oriented education include the cognitive constructivist theory of learning and the social theo-

ry of learning (social constructivism). Constructivist learning is defined as a self-regulatory, interpretative, and non-linear process of knowledge building, supported by active interaction with one's surroundings – both physical and social (Fosnot & Perry, 2005, p. 34). Within the constructivist paradigm, learning is seen as a constructive and situational process, with classroom education functioning as a source of support, stimulation and advice for students participating in the learning process (Palekčić, 2002; Babić, 2007). The role of the teacher is to organise learning activities, experiences and an environment in which learning will take place. Constructivist didactics ensures the conditions and circumstances which support independent learning (knowledge construction). Terhart (2003) explains that the principles of constructivist didactics have already been recognised and were founded at the beginning of the 20th century, within the framework of reform pedagogy.

To be sure, these theories of learning have not been immune to criticism. Kirchner, Sweller and Clark (2006) point to several weak points of constructivist education: namely, they consider constructivist education – especially research and problem-solving learning – to be based on the processes of scientific knowledge and scientific methodologies of a given discipline (mostly in the field of natural sciences). Kirchner (1992) explains that the way in which a (scientific) expert reaches scientific conclusions is not the same as classroom education and the didactic formation of the processes of instruction and learning. Mayer (2004), Kirchner, Sweller and Clark (2006), Rosenshine (2009) and others believe there is not enough empirical data to support the notion of the superiority of constructivist learning over learning through direct instruction.

However, it is important to recognise that constructivist learning is future-oriented. It is an anticipatory type of learning which lays the groundwork for competences necessary for studying. Regardless of the different approaches to what we call learning theories, the constructivist approach can be recognised in all previously mentioned ideas formed within reform pedagogy and didactics. The idea of the so-called new school was formed under the influence of art education and the working school movement. It is believed that constructivism first appeared within the field of arts at the beginning of the 20th century: first in Russia, from where it gradually spread through the rest of Europe. As an artistic style

and approach, constructivism first affected painting, and later developed into an approach to architectural design. All this could not have been excluded from the art classroom, where it was manifested as freedom of expression, encouragement of aesthetic perception and experience, and stimulation of creativity and divergent ways of thinking. Creative artistic expression, students' individuality and creativity in artistic fields earned their place on the lists of content and activities in the curricula of general and trade schools, which presented a significant and necessary departure from highly didactic 19th-century intellectualism (Croatian Encyclopaedia, <http://www.enciklopedija.hr/>).

In didactics and pedagogy, constructivism implies the activity of all the participants involved, primarily the students. Representatives of one of the original pedagogical reform movements (the working school movement) which appeared at the turn of the 20th century, support active and independent student work. Proponents of the working school movement call for more active learning, with special focus on students' manual labour. The working school movement developed during the Second Industrial Revolution, in the period of intensive search for new didactic strategies that would satisfy the needs and expectations connected to school results; this was a time when Maria Montessori, Dewey, Freinet, Feriere, Petersen, Parkhurst, Claparede, Decroly, Cousinet and others intensively examined didactic scenarios and strategies that highlight the different (individual, group) student activities connected to independent research, discovery, and problem-solving.

They provide changes in ways of thinking about the curriculum, as well as the processes of learning, instruction, and evaluation. Their approach to curriculum development presents a departure from the standardised curriculum and is based on students' previous experiences. Learning and instruction are organised as processes of meaningful activities during which students gain new knowledge based on their previous experiences and abilities, which they increase and improve with the help of others and in cooperation with them. Education strategies promote questioning, research, reflection, and practical activities, while avoiding memorising facts. Naturally, this approach also affects evaluation methods and principles, which become part of the learning process. Standardised student evaluation and marking become pointless. Another

common feature of the previously presented projects and pedagogues is the search for balance between independent individual activities on the one hand, and students' independent group and collaborative work on the other. All forms described here require teachers who are not lecturers, but organisers, moderators, and collaborators. However, despite these long-standing observations and solutions that have been tested in practice, many institutions of teacher education still insist on training future teacher-lecturers, who will rely primarily on lecture-demonstrations, ignoring constructivist principles.

A new wave of changes in education was prompted by computer technologies and new media. Initial research on the role and effect of computer technology was dominated by euphoria and the notion that in and of themselves, media would raise the quality of education and learning (Tamim et al., 2011; Timmermann & Kruepke, 2006). These results suggest that media-based instruction is at least as efficient as or even more efficient than instruction that does not rely on the use of media (Schmidt et al. 2009; Torgerson & Elbourne, 2002; Zhao, 2003). The development and intensification of research which took place during the 1980s and lasted until around the middle of the 1990s resulted in a lowering of this estimate; in other words, research began to indicate that (digital) media-based instruction was as efficient as instruction that did not rely on media. Research conducted in the 1990s pointed out, and that from the 2000s confirmed that (digital) media are simply one of many factors whose interconnectedness (interaction, multivariate) can improve the quality and raise the level of reaching certain learning goals (e.g. Tamim, 2009; Tamim et al., 2011).

The importance of (socio)constructivist learning, self-regulated, contextualised, and cooperative learning supported by digital technologies (primarily the internet and Web 2.0 technologies) and contextualised within the relativisation of formal and emphasis on informal learning (anywhere, anytime) triggered the emergence of special discourse on what has been termed "worlds of digital learning" (Ger. *Digitale Lernwelten*) (Hugger & Walberg, 2010). Generally speaking, worlds of digital learning signify the possibility of self-regulatory, independent, but also collaborative learning supported by digital technologies.

It is not possible to fully examine the characteristics of contemporary education based on constructivist theories of learning and multimedia

education without studying the computer self-efficacy of teachers and students, and the motivation for implementing digital media. Research has confirmed that attitudes toward digital technology and the perception of one's ability to use it play an important role in determining one's success in performing tasks by employing that same technology. Computer self-efficacy is defined as the self-perception of one's abilities to perform certain tasks and activities with the help of digital (computer) technology. Computer self-efficacy has developed from the theoretical concept of self-efficacy, proposed by Albert Bandura (1977, 1982, 1993, 1997). It is important to note that self-efficacy – be it a general or specific type of self-efficacy (Pintrich, 2004; Pintrich & De Groot, 1990; Schunk, 2005; Torrano Montali & Tores, 2004; Usher & Pajares, 2008) – is an important factor in motivation and self-regulated study.

When discussing the possibility of implementing digital technology into a specific phenomenon and process, i.e. education, learning, instruction, and schooling, the theory of values and expectations has proved highly useful (e.g. Eccles, 2005; Eccles & Harold, 1991; Wigfield & Eccles, 2000). In other words, this theory has proved to be the optimal theoretical and practical framework which can be used to explain a series of implementations of innovations in the educational context (e.g. Marušić, Jugović & Pavin Ivanec, 2011; Pavlin-Bernardić, Rovanić & Marušić, 2017; Wozney, Venkatesh, & Abrami, 2006).

The aim of the present research was to examine the characteristics of digital media use and constructivist education, from the point of view of students and teachers in primary and secondary schools in the Republic of Croatia. Specifically, our goal was to examine the degree to which teachers and students possess individual digital media; the degree to which schools are equipped with digital media and encourage their use; the frequency of using individual digital media in the classroom; the level of computer self-efficiency; reasons for using digital media in the classroom (motivation for their use); and students' and teachers' views of constructivist learning. To collect data on computer self-efficacy, the Computer Self-Efficacy Scale developed by Teo and Ling Koh (2010) was used. To examine the elements of constructivist education, Taylor, Fraser and Fischer's (1997) Constructivist Learning Environment Scale was used. To determine the motivation for using digital media in the class-

room, Wozney, Venkatesh and Abrami's (2006) Technology Implementation Questionnaire was employed to examine the reasons, i.e. motivation, for using both digital technology and digital media in the classroom. The instruments were constructed based on the theory of values and expectations, and on the theory of motivation (e.g. Eccles, 2005; Eccles & Harold, 1991; Wigfield & Eccles, 2000). Further, our aim was to examine the characteristics of each previously listed variable with regards to the individual demographic characteristics of students and teachers. Finally, we wanted to determine whether or not differences in the examined variables exist between students and teachers.

Data were collected among participants ($N = 880$) from the whole of the Republic of Croatia. The aim was to encompass schools from all regions in Croatia in order to obtain the most representative sample possible. The sample included primary and secondary school students ($n = 512$) and teachers ($n = 368$). Data were gathered in January and February 2016 using the paper-and-pencil method. The research was conducted in accordance with the Code of Ethical Research Involving Children and Young Adults, and was entirely anonymous and voluntary. The research itself was quite extensive, and the following paragraphs present only some of the results of the detailed analyses, with regards to the independent variables.

A descriptive analysis shows that almost every student owns a computer and has internet access, a mobile phone, smart phone, and a social media profile. To a lesser, but still large, extent, students own multimedia software; an even smaller number of students owns tablets. These results correspond to those obtained by OECD (2015), which suggest that the digital divide with regards to socio-demographic factors no longer poses a real problem in education. A significant difference when it comes to ownership of digital media was determined with regards to student gender: compared to their male colleagues, more female students own mobile phones ($\chi^2 = -0,141$; $df = 1$; $p = 0,001$) and have social media profiles ($\chi^2 = -0,103$; $df = 1$; $p = 0,019$). A significant difference in digital media ownership with regards to the level of education was determined only for tablets: primary school students own tablets more often than secondary school students ($\chi^2 = 0,181$; $df = 1$; $p = 0,000$). When it comes to their results at school, students who finished the previous class with a passing grade are

less likely to have a computer ($\chi^2 = 0,526$; $df = 3$; $p = 0,022$) and internet access ($\chi^2 = 1,930$; $df = 3$; $p = 0,039$) than other students. Analyses of differences based on individual school programmes indicate that gimnazija (grammar) school students are slightly more likely to own some kind of multimedia software ($\chi^2 = 0,143$; $df = 1$; $p = 0,019$) than vocational school students. When it comes to the schools' level of digital media equipment, it was determined that, on average, schools are somewhat equipped with computers, internet access, special computer programs, and projectors; they are equipped with SMART Boards to a lesser degree, and completely unequipped with tablets. Student assessments indicate that secondary schools are somewhat better equipped when it comes to internet access ($U = 27607,0$; $z = -3,346$; $p = 0,001$) and SMART Boards ($U = 29279,0$; $z = -2,276$; $p = 0,023$), while primary schools are better equipped with tablets ($U = 29649,5$; $z = -2,292$; $p = 0,022$). According to student assessments, classes very often include activities that require them to use the internet (63,7%), look up information online (56,6%), and use social media (60%). On the other hand, a large number of students believe classroom activities are organised so that they never get a chance to show video (54,3%) or audio recordings (73,8%), use online learning platforms (66,8%), or do any programming (63,5%). Based on the analysis of pedagogical practices in 174 case studies, Kozma (2003) established that in the majority of cases, students use various design tools in the classroom, such as presentations (78%), web resources (71%), and multimedia software (52%). When it comes to the degree in which the use of digital media in education and learning is encouraged, students assess that teachers usually do not encourage them to use digital media in the classroom or for studying purposes ($M = 2,33$; $SD = 0,89$); rather, it is their parents who mostly encourage the use of digital media ($M = 2,85$; $SD = 0,92$).

It was established that almost all the teachers included in the research own personal computers (99,7%), have internet access, and own mobile phones. To a lesser degree, they also have smart phones, multimedia software (64%) and social media profiles (65%); the smallest percentage of teachers own tablets (56%). Asked to comment on how well their schools are equipped with digital media, teachers on average consider the schools in which they work to be somewhat equipped with computers, appropriate computer programmes, projectors, SMART Boards, and tablets. 50% of the 605 teachers consider their schools to be fully equipped with

projectors, internet access, and computers. A little over 50% find their schools to be somewhat equipped with SMART Boards, although more than 40% claim their schools are completely unequipped with SMART Boards. More than 60% of teachers consider their schools completely unequipped with tablets.

It was established that 30–60% of teachers claim their principals encourage them to use digital media, while 30–45% claim they receive this type of encouragement from experts. On the other hand, around 30% of teachers state they were trained to use digital media in education during their professional development, while 1/5 of teachers point out they have not participated in this type of training.

With regards to assessments of media ownership among students and teachers, the Mann-Whitney U test established considerable differences in the ownership of computers ($U = 91704,0$; $z = -2,909$; $p = 0,004$), internet access ($U = 91264,0$; $z = -3,420$; $p = 0,001$), multimedia software (CD, DVD) ($U = 69688,0$; $z = -9,436,432$; $p = 0,000$), smart phones ($U = 78728,0$; $z = -7,572$; $p = 0,000$), and social media profiles ($U = 65632,0$; $z = -11,925$; $p = 0,000$); however, no significant differences were determined with regards to mobile phones ($U = 93504,0$; $z = -0,984$; $p = 0,325$) or tablets ($U = 90456,0$; $z = -1,181$; $p = 0,238$). A significantly higher number of teachers claimed to have computers and internet access at home, while more students claimed to have multimedia software, smart phones, and social media profiles.

Evaluating the constructivist learning environment at their school on a 4-grade scale (with 1 meaning “does not describe to me at all”, and 4 meaning “fully describes me”), students assessed that classroom education provides them with learning activities that, for the most part, enable them to maintain interest in learning and recognise its importance ($M = 2,99$), and promote critical thinking ($M = 3,07$) and collaborative learning (student negotiation) ($M = 2,73$). However, students also believe they are not given control of their own learning process (individualisation and self-regulated learning) ($M = 2,43$). Teachers also generally believe the learning environment they create for their students has constructivist elements. Specifically, they believe the learning environment enables students to develop a personal sense of the importance of learning (connecting the contents of learning with real-life situations) ($M = 3,36$), critical

thinking ($M = 3,44$), learning control ($M = 2,96$), and student negotiation (collaborative learning) ($M = 3,8$).

An analysis of the results determined no significant difference in evaluating constructivist learning with regards to teachers' gender. Teachers who obtained their degree from faculties other than the Faculty of Teacher Education (University of Zagreb) have a significantly more negative perception of students' learning control and negotiation abilities. Furthermore, significant differences were noted in evaluations of students' abilities to recognise the personal importance of learning, students' critical thinking, and students' ability to negotiate when it comes to the learning process. Primary school teachers gave higher assessments of these elements than their secondary school colleagues. Considering the type of secondary school, significant differences were also established when it comes to the control factor. Grammar school teachers gave much lower assessments of students' abilities to control learning than primary school and secondary vocational school teachers. Years of working experience did not prove to be a source of statistically significant differences in evaluating constructivist learning.

When analysing differences with the help of the Mann-Whitney U test in student and teacher assessments of opportunities for creating a constructivist learning environment, significant differences were determined with regards to each factor. Student assessment of the levels of the personal importance of learning ($U = 56914,0$; $z = -10,026$; $p = 0,000$), critical thinking ($U = 56060,0$; $z = -10,293$; $p = 0,000$), the ability to control learning ($U = 49094,5$; $z = -12,155$; $p = 0,000$), and their negotiation abilities with regards to the learning process ($U = 59788,0$; $z = -9,292$; $p = 0,000$) are much lower than the teachers' assessment.

The research findings indicate that students gave a positive assessment of the value of using digital media in the classroom ($M = 2,89$), have similar expectations when it comes to achieving learning goals with the help of digital media ($M = 2,83$), and believe the use of digital media in learning activities does not require additional effort on their part ($M = 2,83$). It was found that teachers have a relatively high degree of motivation for using digital media in the classroom. In other words, teachers ascribe more value to digital media ($M = 3,03$) and their ability to successfully organise classes by using it (among other tools) ($M = 3$). Furthermore, they believe

that organising classroom activities with the help of digital media does not require additional effort on their part ($M = 2,97$). No significant differences were determined in teacher assessment with regards to gender. Assessments of the implementation of digital media and the investment of effort required to use them differ significantly depending on the teachers' initial education: teachers who were trained at faculties other than the Faculty of Teacher Education gave a more negative assessment. There are no significant differences when it comes to teachers' assessments of the implementation of digital media in terms of the education level of the school in which the teachers are employed, the education programme, or years of working experience.

The Mann-Whitney U test was used to examine the differences in student and teacher assessments of the motivation for implementing digital technology. Significant differences were found: students' assessment of the values and benefits of classroom use of digital media ($U = 86060,0$; $z = -2,193$; $p = 0,028$), their expectations regarding the success of digital media use ($U = 79907,0$; $z = -3,855$; $p = 0,000$), and assessment of the effort required to use digital media ($U = 84942,0$; $z = -2,497$; $p = 0,013$) are considerably more negative.

The research findings confirm that students believe that they have an above-average level of computer self-efficacy in all aspects, i.e. in terms of basic computer skills ($M = 3,63$), the use of individual computer programs ($M = 2,74$), and internet skills ($M = 3$). Teachers assess their own levels of computer self-efficacy as being partially high. Namely, they consider their basic computer ($M = 3,69$) and internet skills ($M = 3,03$) to be above average, but find their ability to use computer programs to be below average ($M = 2,01$). Male teachers provided considerably more positive assessments of their computer self-efficacy than their female colleagues. It is interesting to note that teachers who graduated from the Faculty of Teacher Education consider their basic computer skills to be considerably lower than teachers who received pedagogical training from a different faculty, or who graduated from a different faculty and received pedagogical training only subsequently. Significant differences in evaluating computer self-efficacy were established among primary school and secondary school teachers. In both cases, secondary school teachers provided much higher evaluations of their computer self-efficacy. When it comes

to evaluating computer self-efficacy with regards to years of teaching experience, significant differences were found in the self-assessment of basic computer skills and computer program skills. Teachers with the most years of teaching experience gave the most negative assessment of these factors. There are no significant differences in assessing internet skills.

When analysing data with the Mann-Whitney U-test, partially significant differences were established in student self-assessment of computer self-efficacy, and teacher assessment of their computer program skills ($U = 55863,5$; $z = -19,364$; $p = 0,000$), as well the self-assessment of their internet skills ($U = 53416,0$; $z = -11,045$; $p = 0,000$). Students provided considerably more positive assessments of their computer program and internet skills. These findings indicate that students, and younger generations in general, consider the level of their own computer-efficacy to be much higher than that of their teachers, and older generations in general, which further supports previous findings on this issue (European Commission, 2013; Topolovčan & Matijević, 2014; Topolovčan, Matijević & Dumančić, 2016; Whitley, 1997).

The previously presented conclusions and results of some other research point to a need for more radical changes in pedagogical scenarios which contemporary schools offer members of the Net generation (Matijević, 2015; Topolovčan, Matijević & Dumančić, 2016; Matijević, 2017). Rooted in movements and orientations of reform pedagogy launched some hundred years ago, constructivist education provides positive options and stimuli for change in the pedagogical outlook which is meant to dominate the present-day classroom. This new outlook provides ample room for the implementation of digital media in both curricular and extra-curricular activities. While acknowledging the findings of multimedia pedagogy and curriculum theory, multiple intelligence theories, and the findings of educational neuroscience, pedagogical scenarios in education and in the classroom will continue to undergo significant changes in the coming years. The research findings presented in this monograph may be of use to experts faced with selecting criteria for choosing and pedagogically designing educational scenarios for new generations of students.

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