Student-Centered Digital Services: Assessing User Experience in Higher Education

Digitalne usluge usmjerene na studenta: vrednovanje korisničkog iskustva u visokom obrazovanju

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Abstract. *In today's digital age, higher education institutions (HEIs) are facing increasing demands to provide a positive user experience (UX) for students with digital services. Institutions seeking to attract and retain students must recognize the importance of students' familiarity with technology in their everyday lives. Delivering digital services that meet their needs and expectations has become essential. Defining and measuring the UX of digital services is a complex task that involves various criteria, including pragmatic and hedonic aspects. The quantitative survey was conducted with students, and two dimensional UX model was confirmed. By understanding the different aspects of UX, HEIs can enhance their digital services to meet students' expectations.*

Keywords. user experience, higher education, digital transformation, student-oriented approach.

Sažetak. *U današnjem digitalnom dobu, institucije visokog obrazovanja suočavaju se sa sve većim zahtjevima za pružanjem pozitivnog korisničkog iskustva (UX) za studente s digitalnim uslugama. Institucije koje žele privući i zadržati studente moraju prepoznati studentsku naviknutost na tehnologije u svakodnevnom životu. Pružanje digitalnih usluga koje ispunjavaju njihove potrebe i očekivanja postalo je ključno. Definiranje i mjerenje UX-a digitalnih usluga složen je zadatak koji uključuje različite kriterije, uključujući pragmatične i hedonističke aspekte. Provedeno je kvantitativno istraživanje sa studentima, te je potvrđen dvodimenzionalni UX model. Razumijevanjem različitih aspekata UX-a, visoka učilišta mogu unaprijediti svoje digitalne usluge kako bi ispunila očekivanja studenata.*

Ključne riječi. Korisničko iskustvo, visoko obrazovanje, digitalna transformacija, studentu orijentiran pristup.

1 Introduction

Digitalization of Higher Education (HE) has been rapidly grooving, and most services are switching from offline to online settings (Pasini et al., 2019). It is no surprise that the digital transformation of HE has been further accelerated by the Covid-19 crisis (Bygstad et al., 2022). In addition, the phenomenon of the internationalization of HE has resulted in intense global competition among higher education institutions (HEIs) for prospective students.

The digital transformation of HEIs involves meeting the expectations and needs of students

1 Uvod

Digitalizacija visokog obrazovanja (VO) brzo napreduje, a većina usluga prelazi s *offline* na *online* okruženje (Pasini et al., 2019). Nije iznenađenje da je digitalna transformacija VO dodatno ubrzana krizom uzrokovanom Covid-19 (Bygstad et al., 2022). Osim toga, fenomen internacionalizacije VOa rezultirao je intenzivnom globalnom konkurencijom među institucijama visokog obrazovanja (IVO) za buduće studente.

(Rodrigues, 2017), and the current generation of students, identified as Generation Z, is characterized by their familiarity and comfort with technology (Martins et al., 2019). For (future) students, digitization in HE should ensure a richer UX and provide more accurate and faster answers to inquiries that are mostly made over the phone or website (Khalid et al., 2018).

These students are accustomed to using different devices and digital services to stay connected to the world, their friends, and their work (Martins et al., 2019). Addressing these needs is critical for HEIs undergoing digital transformation to engage and retain students effectively. The new generation of students has increasingly high expectations regarding the quality of their interaction with the processes of HEIs and the level of student UX. Precisely, students expect a personalized UX, regardless of what type of digital service it is (Obaid, 2019).

For example, some of the factors that contribute to HEIs quality are (Cadena et al., 2018): (1) administrative transparency, (2) student satisfaction, (3) digitization of administrative services, and (4) share of digitized operational processes. Furthermore, providing digital services that deliver a high-quality UX can have several benefits, including increased student satisfaction. It has been confirmed that a higher level of UX leads to higher perceived benefits provided by digital services in HE (Mijač et al., 2023). Consequently, it is imperative to systematically evaluate the concept of UX in delivering digital services in HE (Al-Hunaiyyan et al., 2021).

Users' habits and interests are changing, new trends are emerging, and it should also be borne in mind that UX is highly subjective, dynamic, and contextually dependent (Halvorsrud et al., 2016). UX is crucial for the student population, especially if they are treated as consumers of higher education (Ng & Forbes, 2009).

The importance of providing high-quality UX has been highlighted in the scholarly literature (Díaz et al., 2016; Rodrigues, 2017), particularly in light of its potential to attract and retain students, which is critical in the current competitive landscape.

There have been studies examining the UX in the HE context, such as in the example of the library (Wiles et al., 2013), e-learning (Calle-Jimenez et al., 2021; Slade & Downer, 2020; van Staden et al., 2019), smart glasses (Santana et al., 2022), and Student Information Systems (Al-Hunaiyyan et al., 2021; Langgawan Putra et al., 2021). However, even though most authors consider more aspects when measuring the UX, generally speaking, there is no academic nor practical uniformly accepted model for measuring it (Hornbæk & Hertzum, 2017). This paper aims to verify the dimensions of UX and propose a multidimensional model for UX in an HE setting.

Digitalna transformacija IVO uključuje zadovoljavanje očekivanja te potreba studenata (Rodrigues, 2017), a trenutnu generaciju studenata, identificiranu kao *Generacija Z*, karakterizira njihova upoznatost i udobnost s tehnologijom (Martins et al., 2019). Za (buduće) studente, digitalizacija u VOu trebala bi osigurati bogatije korisničko iskustvo (engl. User eXperience, UX) i pružiti točnije i brže odgovore na upite koji se još uvijek najčešće postavljaju putem telefona ili web stranica (Khalid et al., 2018).

Studenti nove generacije naviknuti su na korištenje različitih uređaja i digitalne usluge, a to rade kako bi bili povezani 24/7 (Martins et al., 2019). Adresiranje njihovih potreba ključno je za institucije koji prolaze kroz digitalnu transformaciju kako bi učinkovito uključili i zadržali studente. Nova generacija studenata ima sve veća očekivanja u vezi s kvalitetom interakcije s procesima institucije, ali i veća očekivanja razine UXa. Točnije, studenti očekuju personalizirano UX iskustvo, bez obzira na vrstu digitalne usluge (Obaid, 2019).

Na primjer, neki od čimbenika koji doprinose kvaliteti institucija VO su (Cadena et al., 2018): (1) transparentnost administrativnih procesa, (2) zadovoljstvo studenata, (3) digitalizacija administrativnih usluga i (4) udio digitaliziranih operativnih procesa. Nadalje, pružanje digitalnih usluga koje pružaju visokokvalitetno UX može osigurati dodatne koristi, kao što je veća razina zadovoljstva studenata. Potvrđeno je da viša razina UXa dovodi do većih percipiranih koristi koje pružaju digitalne usluge u VO (Mijač et al., 2023). Sve navedeno implicira na važnost sustavnog vrednovanja koncepta UXa pri pružanju digitalnih usluga u VO (Al-Hunaiyyan et al., 2021).

Kako se pojavljuju novi trendovi, tako se mijenjaju navike, ali i interesi krajnjih korisnika. Treba imati na umu da je UX jako subjektivan, dinamičan i ovisan o kontekstu (Halvorsrud et al., 2016). UX je ključan za studentsku populaciju, posebno uzimajući u obzir činjenicu da se studenti često smatraju potrošačima visokog obrazovanja (Ng & Forbes, 2009).

Važnost pružanja visokokvalitetnog UXa istaknuta je u znanstvenoj literaturi (Díaz et al., 2016; Rodrigues, 2017), a posebno s obzirom na njegov potencijal da privuče i zadrži studente, što je ključno u trenutnom konkurentnom okruženju.

Provedene su studije koje istražuju UX u kontekstu VO, poput primjera u knjižnici (Wiles et al., 2013), e-učenju (Calle-Jimenez et al., 2021; Slade & Downer, 2020; van Staden et al., 2019), pametnim naočalama (Santana et al., 2022) te informacijskim sustavima studenata (engl. Student Infromation System) (Al-Hunaiyyan et al., 2021; Langgawan Putra et al., 2021). Međutim, iako većina autora uzima u obzir više aspekata pri mjerenju UXa, općenito govoreći, ne postoji jednoglasno prihvaćen model za njegovo mjerenje ni u akademiji ni u industriji (Hornbæk & Hertzum, 2017).

Based on those mentioned above, posed research question is: *How to measure UX construct in HE context?*

The paper is organized as follows: Section 2 discusses the importance of measuring the UX in the context of higher education and digital transformation. Section 3 outlines the research methodology, while Section 4 presents the empirical results of the study. Section 5 highlights the main contributions and findings of the study, along with potential areas for future research. Conclusions are presented in the last section.

2 Literature review

As mentioned in the introductory part, digital transformation in HE is happening, resulting in numerous digital services (Pasini et al., 2019). The role of technology in higher education is aimed at increasing the efficiency and effectiveness of organizational processes and meeting the needs of all stakeholders - students, parents, parents, parents, parents, government, and society (Caushi & Dika, 2018). Digital transformation encompasses all areas of work of HEIs; that is, it equally permeates the areas of research, teaching, and teaching, as well as their administrative processes (Gilch et al., 2019).

It is essential that digital services and information systems offer a positive UX and meet the needs of students simultaneously (Al-Hunaiyyan et al., 2021). All digital services and systems should have a good UX in order to minimize user confusion and get good feedback from the user (Langgawan Putra et al., 2021).

The concept of UX has garnered greater attention in both research and practice due to a recent shift in the domain towards an experiential approach that prioritizes user enjoyment and satisfaction over functionality (Sonderegger et al., 2019). According to the ISO 9241-210:2010 standard, UX encompasses the user's perceptions and response to the use or participation in the use of a particular service, product, or system.

UX is a holistic concept that includes different emotional, cognitive, or physical reactions to use, even to the very thought of using services, and is formed before, during, or after use. UX can be considered as a consequence of presentation, functionality, system performance, interactive behavior, attitudes, skills and personality, and the context of use (Hinderks et al., 2019), and at the same time, represents one of the essential aspects of applying a user-oriented approach (Richter & Fluckiger, 2014).

Researchers have made several proposals for UX models aimed at measuring the UX of different technology products. Author (Hassenzahl Marc, 2003) proposed a model which highlights the pragmatic and hedonic characteristics of a

Cilj ovog rada je istražiti dimenzije UXa te predložiti višedimenzionalni model za mjerenje UXa u kontekstu visokog obrazovanja.

Na temelju navedenog, postavljeno istraživačko pitanje glasi: *Kako mjeriti konstrukt UX-a u kontekstu VOa?*

Ovaj rad je organiziran kako slijedi: U odjeljku 2 raspravlja se o važnosti mjerenja UX-a u kontekstu visokog obrazovanja i digitalne transformacije. Odjeljak 3 prikazuje istraživačku metodologiju, dok odjeljak 4 predstavlja empirijske rezultate istraživanja. Odjeljak 5 ističe glavne doprinose i nalaze istraživanja, zajedno s potencijalnim područjima za buduća istraživanja. Zaključak rada prezentiran je u zadnjem odjeljku.

2 Pregled literature

Kao što je spomenuto u uvodnom dijelu, digitalna transformacija u visokom obrazovanju je pokret koji jako relevantan i aktualan, a rezultira brojnim digitalnim uslugama (Pasini et al., 2019). Uloga tehnologije u visokom obrazovanju ima za cilj povećanje učinkovitosti i učinkovitosti organizacijskih procesa te zadovoljavanje potreba različitih dionika (Caushi & Dika, 2018). Digitalna transformacija obuhvaća sva područja rada visokoškolskih ustanova; odnosno, jednako prožima područje istraživanja, nastave i administrativnih procesa (Gilch et al., 2019).

Važno je da digitalne usluge i informacijski sustavi pružaju pozitivno korisničko iskustvo i istovremeno zadovoljavaju potrebe studenata (Al-Hunaiyyan et al., 2021). Visoka razina UXa je bitna za sve digitalne usluge i sustave kako bi studenti imali manje problema pri korištenju, a i kako bi se ostvarila pozitivna povratna informacija (Langgawan Putra et al., 2021).

Koncept UXa privukao je veliku pažnju, kako u istraživanju, tako i u praksi zbog nedavnog pomaka fokusa prema iskustvenom pristupu koji stavlja naglasak na korisnikovo zadovoljstvo i uživanje više nego na funkcionalnost (Sonderegger et al., 2019). Prema ISO 9241-210:2010 standardu, UX obuhvaća korisnikove percepcije i odgovor na korištenje određene usluge, proizvoda ili sustava.

UX se smatra holističkim konceptom koji uključuje različite emocionalne, kognitivne ili fizičke reakcije na upotrebu, čak i na samu pomisao o korištenju usluga, a formira se prije, za vrijeme ili nakon upotrebe. UX se može smatrati posljedicom prezentacije, funkcionalnosti, performansi sustava, interaktivnog ponašanja, stavova, vještina i osobnosti te konteksta upotrebe (Hinderks et al., 2019). UX istovremeno predstavlja jedan od ključnih aspekata primjene korisniku orijentiranog pristupa (Richter & Fluckiger, 2014).

Autori su iznijeli nekoliko prijedloga za modele s ciljem mjerenja UXa različitih tehnoloških proizvoda. Primjerice, autor (Hassenzahl Marc, 2003) je

technological product that serve as the foundation for determining the resulting consequences in a given situation, including evaluations of appeal, pleasure, and satisfaction. There so, UX can be defined as a set of quality criteria encompassing various dimensions, including classic usability criteria such as efficiency and ease of use, as well as hedonic criteria such as stimulation, fun, novelty, emotions, and aesthetics (Preece et al., 2019; Wani et al., 2017). This approach has the advantage of breaking down the complex concept of UX into a series of simple quality criteria that describe different and relatively well-defined aspects of the UX, which can be measured independently (Hinderks et al., 2019).

Authors (Thüring & Mahlke, 2007) also argue for a breather perspective that regards UX. They proposed components of the user experience (CUE) model as a compound of three elements: Perception of quality and effectiveness of the system, Visual aesthetics, and Emotional response. In the HE setting, authors used three similar dimensions to measure students' UX: ease of use, appeal, and pleasure (Zardari et al., 2021).

Authors (Langgawan Putra et al., 2021) measured UX with UX Honeycomb consisting of 7 aspects: useful, usable, desirable, valuable, findable, accessible, and credible. Another research on UX with Student Information Systems used six dimensions to measure UX (Al-Hunaiyyan et al., 2021): attractiveness, efficiency, perspicuity (ease of use), dependability, stimulation, and novelty.

UX can be viewed as an expansion of the usability construct that takes a more comprehensive approach, considering not only the cognitive aspects but also the user's emotions and overall experience when interacting with an interface (Sonderegger et al., 2019).

Authors (Hornbæk & Hertzum, 2017) conducted a review paper and concluded that all UX models have four things in common:

- The majority of models distinguish between pragmatic and hedonic characteristics.
- Tthe perception of aesthetics and overall assessments of beauty are crucial in UX models.
- UX models demonstrate how perceptions of products and services evolve over time.
- Emotions play a pivotal role in UX models.

Pragmatic aspects are also known as instrumental aspects, while hedonic is known as non-instrumental aspects (Hassenzahl, 2005). The author also suggests that while individuals may have instrumental goals and functional requirements that a product can meet, it's also crucial to consider the presence of additional non-instrumental, hedonic needs.

Research so far revealed that it is not uncommon for students to have negative UX when using digital services in HE (Saplacan et al., 2018; Thoring et al., 2017). Therefore, it is particularly important to

predložio model koji ističe pragmatične i hedoničke karakteristike tehnološkog proizvoda koje služe kao temelj za određivanje posljedica u određenoj situaciji, uključujući procjene privlačnosti, užitka i zadovoljstva. UX se može definirati kao skup kriterija kvalitete koji obuhvaćaju različite dimenzije, uključujući klasične kriterije upotrebljivosti poput učinkovitosti i jednostavnosti korištenja, kao i hedoničke kriterije poput stimulacije, zabave, novosti, emocija i estetike (Preece et al., 2019; Wani et al., 2017). Ovaj pristup ima prednost razbijanja kompleksnog koncepta UXa na niz jednostavnih kriterija kvalitete koji opisuju različite i relativno dobro definirane aspekte UXa, koji se mogu neovisno mjeriti (Hinderks et al., 2019).

Autori (Thüring & Mahlke, 2007) također zagovaraju širi pogled na UX. Tako su predložili komponente modela korisničkog iskustva (CUE) kao kombinaciju tri elementa: percepciju kvalitete i učinkovitosti sustava, vizualnu estetiku i emocionalnu reakciju. U kontekstu visokog obrazovanja, autori su koristili tri slične dimenzije za mjerenje UXa studenata: jednostavnost korištenja, privlačnost i užitak (Zardari et al., 2021).

Dodatno, autori (Langgawan Putra et al., 2021) su mjerili UX s pomoću UX Honeycomb modela koji se sastoji od 7 aspekata: korisno, upotrebljivo, poželjno, vrijedno, lako za pronaći, dostupno i vjerodostojno. Istraživanja koja su se bavila mjerenjem UXa studentskih informacijskih sustava, koristila su šest dimenzija za mjerenje UXa (Al-Hunaiyyan et al., 2021): privlačnost, učinkovitost, jasnoća (jednostavnost korištenja), pouzdanost, stimulacija i novost.

UX se može promatrati kao proširenje konstrukta upotrebljivosti koje ima sveobuhvatan pristup, uzimajući u obzir ne samo kognitivne aspekte već i korisnikove emocije i cjelokupno iskustvo prilikom interakcije s sučeljem (Sonderegger et al., 2019).

Autori (Hornbæk & Hertzum, 2017) u svom preglednom radu su zaključili kako svi modeli UXa imaju četiri zajednička elementa:

- Većina modela razlikuje pragmatične i hedoničke karakteristike.
- Percepcija estetike i opća procjena ljepote ključni su u modelima UX-a.
- Modeli UXa pokazuju kako se percepcije proizvoda i usluga mijenjaju tijekom vremena.
- Emocije imaju ključnu ulogu u modelima UXa.

Pragmatični aspekti također su poznati kao instrumentalni aspekti, dok se hedonički aspekti nazivaju neinstrumentalni aspektima (Hassenzahl, 2005). Autor također sugerira da, iako pojedinci mogu imati instrumentalne ciljeve i funkcionalne zahtjeve koje proizvod može ispuniti, važno je također uzeti u obzir prisutnost dodatnih neinstrumentalnih, hedoničkih potreba.

Dosadašnja istraživanja otkrila su da nije neuobičajeno da studenti imaju negativno korisničko

examine the dimensions of UX depending on the context since context factors may influence the entire UX entirety (Sonderegger et al., 2019).

Despite the growing importance of UX in attracting and retaining students, very few papers cover these phenomena. To illustrate, a search conducted in the Scopus database on March 2023 with the keywords "user experience" or UX and "higher education" or university resulted in 57 documents. Results are illustrated in Figure. 1.

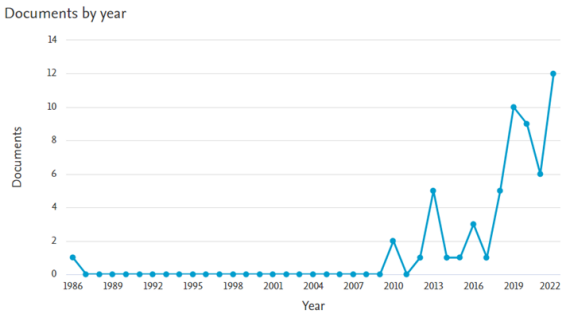


Figure 1. Literature evolution on UX in HE

Due to the fact that recent works in HE still actively investigate which dimensions make up UX and for that purpose, this piece of research tends to address identified research gap by proposing a holistic view defining UX as a multidimensional construct.

3 Methodology

A qualitative survey with student as and-users of digital services in HE was conducted to answer the posed research question. Digital services examined were not related to learning but supportive /administrative digital services. Participants were students from ten institutions of higher education in Croatia. The total number of fully-completed survey questionnaires was n=551.

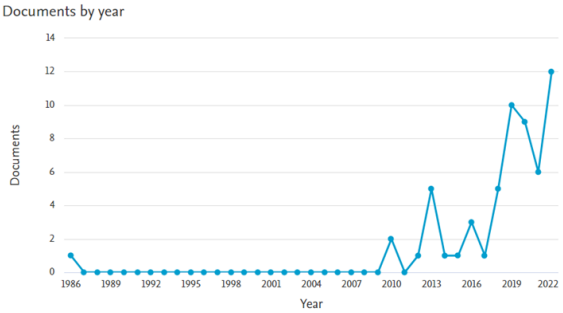
To examine and validate the most commonly used indicators for measuring UX construct, three subdimensions were taken into consideration: *usability*, *appeal*, and *satisfaction*. Items were adapted from previously conducted research.

The prepared survey was composed of 14 items related to measuring UX dimensions. The questionnaire items were rated on a five-point Likert scale, with responses ranging from 1 (strongly agree) to 5 (strongly disagree).

Once the data was gathered, statistical techniques were employed (Hair et al., 2010), specifically confirmatory factor analysis (CFA), to investigate the dimensionality of the UX construct. The data analysis was carried out using IBM SPSS Statistics and IBM SPSS Amos for structural equation modeling (SEM). Since the theory indicates the multidimensionality of UX, the proposed model was

iskustvo prilikom korištenja digitalnih usluga u visokom obrazovanju (Saplacan et al., 2018; Thoring et al., 2017). Stoga je posebno važno ispitati dimenzije UXa ovisno o kontekstu, budući da faktori konteksta mogu utjecati na cjelokupno korisničko iskustvo (Sonderegger et al., 2019).

Unatoč rastućoj važnosti UX-a u privlačenju i zadržavanju studenata, vrlo malo znanstvenih radova se bavim ovim fenomenima. Za ilustraciju, pretraživanje provedeno u bazi Scopus u ožujku 2023. s ključnim riječima "user experience" ili UX i "higher education" ili university rezultiralo je s 57 dokumenata. Rezultati pretrage vizualno su prikazani na slici 1.



Slika 1. Pregled literature o UX u VO

S obzirom da recentni radovi iz područja VO još uvijek aktivno istražuju koje dimenzije sačinjavaju konstrukt UX, ovo istraživanje teži rješavanju identificiranih praznina u istraživanju predlažući holistički pogled te definirajući UX kao višedimenzionalni konstrukt.

3 Metodologija

Da bi se pružio odgovor na postavljeno istraživačko pitanje, provedeno je kvalitativno istraživanje sa studentima kao korisnicima digitalnih usluga u visokom obrazovanju. Digitalne usluge koje su bile predmet istraživanja nisu bile direktno povezane s učenjem, već se radilo o podršci/administrativnim digitalnim uslugama. Sudionici istraživanja bili su studenti na deset institucija visokog obrazovanja u Hrvatskoj. Ukupan broj potpuno popunjenih upitnika bio je 551.

U svrhu istraživanja i potvrđivanja najčešće korištenih indikatora (dimenzija) za mjerenje konstrukta korisničkog iskustva, uzete su u obzir tri dimenzije: upotrebljivost (engl. *usability*), privlačnost (engl. *appeal*) i zadovoljstvo (engl. *satisfaction*). Čestice za svaki od indikatora su razvijene u skladu s prethodno provedenim istraživanjima te prilagođene kontekstu.

Pripremljeni anketni upitnik sastojao se od ukupno 14 čestica koje su mjerile dimenzije korisničkog iskustva. Ispitanici su svaku česticu upitnika ocijenili uz pomoć peto stupanjske Likertove ljestvice, pri

examined as a higher-order construct (HOC) (Awang et al., 2017; Hair et al., 2010).

4 Results

Descriptive statistics have been calculated for all 14 items, and the results are presented in Table 1. The average values of manifest variables are between 3.40 and 4.36. The item regarding a visual appeal has been rated with the lowest grade (*The visual appeal of this digital service keeps my attention*). In contrast, the item *I achieved what I need with a little effort* has been marked with the highest average score. Skewness (SK) and Kurtosis (KU) were calculated, and values for each manifest variable do not exceed the suggested threshold of [-3,+3] (Brown, 2006), so it can be concluded that variables are normally distributed, and further steps can be taken.

Table 1. Descriptive statistics

Items	AVG	SK	KU
U_1 I do not have any problems navigating this digital service.	4.27	-0.990	0.441
U_2 I don't need to click many times to find what I'm looking for.	4.01	-0.644	-0.219
U_3 The layout of the digital service interface elements is appropriate.	4.00	-0.625	0.023
U_4 Digital services are easy to use.	4.18	-0.687	-0.008
U_5 I achieve what I need with a little effort.	4.36	-1.081	0.915
P_1 The visual appeal of this digital service keeps my attention.	3.40	-0.300	-0.253
P_2 The appearance of this digital service is fit for purpose.	4.09	-0.995	1.603
P_3 When I use this digital service, my eyes do not feel tired.	3.69	-0.646	-0.113
P_4 I use all the functionalities of the digital service without stress.	3.88	-0.737	0.114
S_1 I want to use all the functionalities offered to me as part of this digital service.	4.09	-0.797	0.238
S_2 Using this digital service has become part of my routine.	3.93	-0.879	0.305
S_3 Using a digital service does not cause me any frustration.	3.79	-0.718	-0.175
S_4 I am satisfied with this digital service.	4.07	-0.787	0.496

čemu su odgovori varirali od 1 (potpuno se slažem) pa sve do 5 (potpuno se ne slažem).

Nakon završenog prikupljanja podataka, korištene su statističke metode (Hair et al., 2010). Konkretno, korištena je konfirmatorna faktorska analizu (CFA) kako bi se istražila dimenzionalnost konstrukta korisničkog iskustva. Analiza podataka provedena je pomoću programa IBM SPSS Statistics i IBM SPSS Amos za modeliranje strukturnim jednadžbama (SEM). Budući da teorija ukazuje na višedimenzionalnost UXa, predloženi model ispitan je kao konstrukt višeg reda (Higher Order Construct, HOC) (Awang et al., 2017; Hair et al., 2010).

4 Rezultati

Deskriptivna statistika je izračunata za svih 14 predloženih čestica (manifestnih varijabli), a rezultati su prikazani u Tablici 1. Prosječne vrijednosti manifestnih varijabli (AVG) kreću se između 3.40 i 4.36. Čestica koja se odnosi na vizualnu privlačnost dobila je najnižu ocjenu (*Vizualna privlačnost ove digitalne usluge zadržava moju pažnju*). S druge strane, stavka "*Postigao sam ono što trebam s malo napora*" ima najvišu prosječnu ocjenu. Izračunati su koeficijenti asimetrije (SK) i zaobljenosti (KU) te vrijednosti za svaku manifestnu varijablu ne prelaze predloženi prag [-3, +3] (Brown, 2006), pa se može zaključiti da su varijable normalno distribuirane i da se mogu poduzeti daljnji koraci u analizi.

Tablica 1. Deskriptivna statistika

Čestice	AVG	SK	KU
U_1 Nemam problema sa snalaženjem unutar ove digitalne usluge.	4.27	-0.990	0.441
U_2 Ne trebam puno puta kliknuti da pronađem što tražim.	4.01	-0.644	-0.219
U_3 Raspored elemenata sučelja digitalne usluge je prikladan.	4.00	-0.625	0.023
U_4 Digitalna usluga jednostavna je za korištenje.	4.18	-0.687	-0.008
U_5 Uz malo truda ostvarim ono što trebam kroz ovu digitalnu uslugu.	4.36	-1.081	0.915
P_1 Izgled ove digitalne usluge zadržava mi pažnju.	3.40	-0.300	-0.253
P_2 Izgled ove digitalne usluge primjeren je svrsi.	4.09	-0.995	1.603
P_3 Kada koristim ovu digitalnu uslugu ne osjećam zamor u očima.	3.69	-0.646	-0.113
P_4 Koristim sve funkcionalnosti digitalne usluge bez stresa.	3.88	-0.737	0.114

S_5 The satisfaction with use is in line with my expectations.	4.00	-0.743	0.413

The proposed model included three dimensions: appeal, satisfaction, and usability.

Further, CFA was conducted in IBM AMOS, and the results are shown in the Figure. 2.

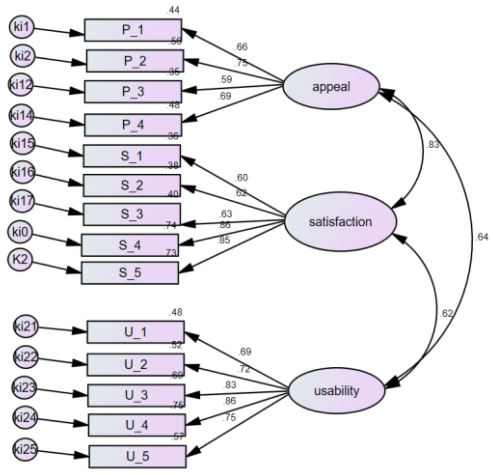


Figure 2. CFA results

To evaluate reliability and validity, factor loading (FL), average variance extracted (AVE), and composite reliability (CR) have been calculated and shown in Table 2. According to the results presented in Table 2, the scale demonstrates strong reliability as evidenced by the fact that the CR for each dimension (usability, appeal, and satisfaction) exceeds 0.70 and the AVE exceeds 0.50 (Hair et al., 2017).

Additionally, FLs have been calculated and presented to assess the reliability of individual items. It is worth noting that the smallest acceptable FL value is 0.4, but only if the AVE is greater than or equal to 0.5 (Hair et al., 2017). Based on these findings, it can be concluded that there is no need for further item deletion.

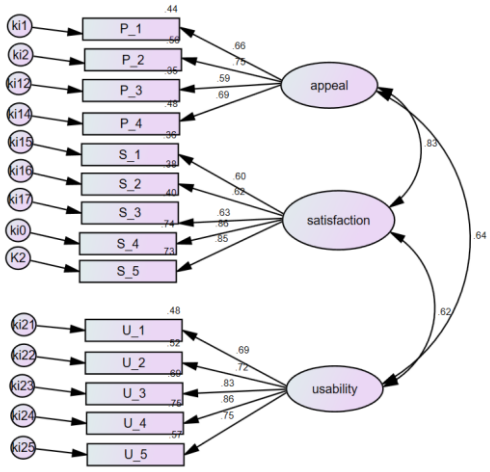
Table 2. Reliability and validity results

Model 1				
Dimension	**Items**	**FL**	**AVE**	**CR**
Usability	U_1	0.69	0.6	0.78
	U_2	0.72		
	U_3	0.83		
	U_4	0.86		
	U_5	0.75		
Appeal	P_1	0.75	0.5	0.72
	P_2	0.59		
	P_3	0.69		
	P_4	0.66		
Satisfaction	S_1	0.60	0.5	0.72
	S_2	0.62		

S_1 Želim koristit sve funkcionalnosti koje mi se nude u sklopu ove digitalne usluge.	4.09	-0.797	0.238
S_2 Korištenje ove digitalne usluge postalo mi je dio rutine.	3.93	-0.879	0.305
S_3 Korištenje digitalne usluge ne izaziva mi frustraciju.	3.79	-0.718	-0.175
S_4 Zadovoljan/a sam što sam koristim ovu uslugu.	4.07	-0.787	0.496
S_5 Zadovoljstvo korištenja u skladu je s mojim očekivanjima.	4.00	-0.743	0.413

Predloženi model sadrži tri dimenzije: privlačnost, zadovoljstvo i upotrebljivost.

Nadalje, CFA je napravljena uz pomoć IBM AMOS alata, a rezultati su prikazani na slici u nastavku (Slika 2).



Slika 2. Rezultati CFA

U svrhu procijene pouzdanost i valjanost, izračunato je faktorsko opterećenje (engl. *Factor loading*, FL), prosječna ekstrahirana varijanca (AVE) te kompozitna pouzdanost (CR). Navedeno je prikazano u Tablici 2. Prema rezultatima, instrument pokazuje snažnu pouzdanost, što potvrđuje činjenica da je CR za svaku dimenziju (upotrebljivost, privlačnost i zadovoljstvo) veći od 0,70, a AVE je za sve veći od 0,50 (Hair et al., 2017).

Dodatno, izračunata su i prikazana faktorska opterećenja (FL) kako bi se procijenila pouzdanost pojedinačnih čestica. Važno je napomenuti da najmanja prihvatljiva vrijednost FLa iznosi 0.4, ali samo ako je AVE veći ili jednak 0.5 (Hair et al., 2017). Na temelju rezultata može se zaključiti da nema potrebe za daljnjim izbacivanjem čestica.

	S_3	0.63		
	S_4	0.86		
	S_5	0.85		

The next step was to calculate discriminate validity, and for that purpose, Fornell & Larcker criterion was applied (Afthanorhan et al., 2021). Calculated results do not meet the criterion since the correlation between appeal and satisfaction exceeds square root AVE.

Table 3. Discriminant validity results

	Usability	Appeal	Satisfaction
Usability	0.78	0.64	0.62
Appeal	0.64	0.68	*0.83*
Satisfaction	0.62	*0.83*	0.72

As suggested by (Hair et al., 2010), model re-specification has to be done by eliminating manifest variables with the lowest factor loading. Two manifest variables were excluded, and the number of proposed dimensions was reduced to two (satisfaction and usability). CFA results are shown in Fig. 3.

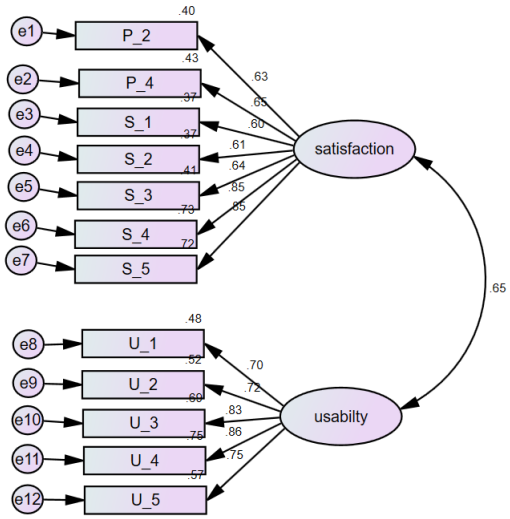


Figure 3. CFA results for the second model

Calculated FL, AVE, and CR are shown in Table 4. All values meet the suggested reference values.

Table 4. Reliability and validity results for the second model.

Model 2				
Dimension	**Items**	**FL**	**AVE**	**CR**
Usability	U_1	0.70	0.6	0.88
	U_2	0.72		
	U_3	0.83		
	U_4	0.86		
	U_5	0.75		

Tablica 2. Rezultati pouzdanosti i valjanosti

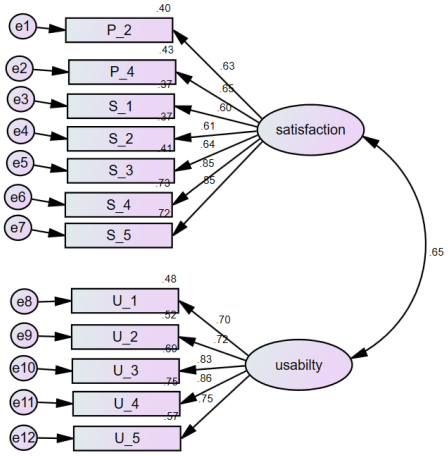
Model 1				
Dimenzija	**Čestica**	**FL**	**AVE**	**CR**
Upotrebljivost	U_1	0.69	0.6	0.78
	U_2	0.72		
	U_3	0.83		
	U_4	0.86		
	U_5	0.75		
Privlačnost	P_1	0.75	0.5	0.72
	P_2	0.59		
	P_3	0.69		
	P_4	0.66		
Zadovoljstvo	S_1	0.60	0.5	0.72
	S_2	0.62		
	S_3	0.63		
	S_4	0.86		
	S_5	0.85		

Sljedeći korak bio je izračun diskriminantne valjanosti, a u tu svrhu primijenjen je Fornell i Larckerov kriterij (Afthanorhan et al., 2021). Izračunati rezultati ne zadovoljavaju kriterij jer korelacija između privlačnosti i zadovoljstva premašuje korijen kvadrata AVEa.

Tablica 3. Rezultati diskriminantne valjanosti

	Upotrebljivost	Privlačnost	Zadovoljstvo
Upotrebljivost	**0.78**	0.64	0.62
Privlačnost	0.64	**0.68**	*0.83*
Zadovoljstvo	0.62	*0.83*	**0.72**

Kao što je sugerirano od strane autora (Hair et al., 2010), re-specifikacija modela mora biti izvedena eliminacijom čestica s najnižim faktorskim opterećenjem. Dvije čestice su isključene, te je broj predloženih dimenzija smanjen na dvije (zadovoljstvo i upotrebljivost). Rezultati CFA-a prikazani su na Slici 3.



Slika 3. Rezultati CFA za drugi model

Appeal	P_2	0.63	0.5	0.86
	P_4	0.65		
	S_1	0.60		
	S_2	0.61		
	S_3	0.64		
	S_4	0.85		
	S_5	0.85		

After checking the validity and reliability of the two proposed dimensions, Fornell & Larcker criterion was again applied, and the criterion was met. Discriminant validity was achieved, and the results are shown in Table 5.

Table 5. Discriminant validity results for the second model.

	Usability	Satisfaction
Usability	0.78	0.65
Satisfaction	0.65	0.70

According to (Hair et al., 2010), the following step was to estimate model fit measures. To evaluate the model fit, ratio of chi-square and degrees of freedom (CMIN/df), root mean square error of approximation (RMSEA), and Goodness-of-fit (GFI) have been calculated (Browne & Cudeck, 1992; Hair et al., 2010; Marsh & Hocevar, 1985). Results are shown in Table 6. And all calculated values are within the acceptable range.

Table 6. Model fit results.

	Results	**Acceptable range**
CMIN/df	3.258	[2, 5]
RMSEA	0.064	<= 0.08
GFI	0.950	>=0.9

The final results of the UX construct as HOC consisting of two dimensions are shown in the Figure. 4.

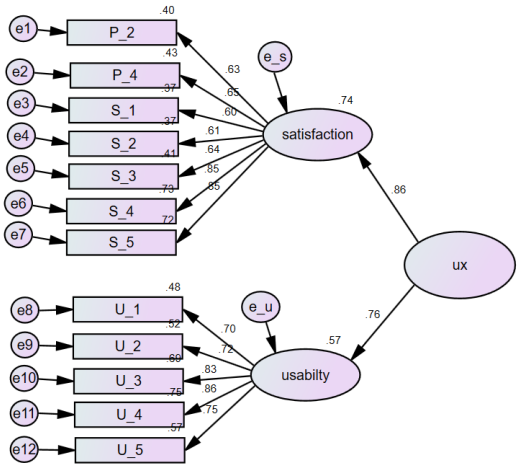


Figure 4. UX as HOC

Izračunati su FL, AVE te CR, a rezultati su prikazani u tablici 4. Svi pokazatelji zadovoljavaju predložene referentne vrijednosti.

Tablica 4. Rezultati pouzdanosti i valjanosti za drugi model

Model 2				
Dimenzija	**Čestica**	**FL**	**AVE**	**CR**
Upotrebljivost	U_1	0.70	0.6	0.88
	U_2	0.72		
	U_3	0.83		
	U_4	0.86		
	U_5	0.75		
Zadovoljstvo	P_2	0.63	0.5	0.86
	P_4	0.65		
	S_1	0.60		
	S_2	0.61		
	S_3	0.64		
	S_4	0.85		
	S_5	0.85		

Nakon provjere valjanosti i pouzdanosti dviju predloženih dimenzija, ponovno je primijenjen Fornell & Larcker kriterij, te je kriterij zadovoljen. Diskriminantna valjanost je postignuta, a rezultati su prikazani u tablici 5.

Table 5. Rezultati diskriminantne valjanosti za drugi model.

	Upotrebljivost	Zadovoljstvo
Upotrebljivost	0.78	0.65
Zadovoljstvo	0.65	0.70

Prema (Hair et al., 2010.), sljedeći korak bio je procijeniti mjere adekvatnosti modela (engl. *Model fit*). Za procjenu adekvatnosti modela izračunati su omjer hi kvadrata i stupnjeva slobode (CMIN/df), korijen srednje kvadratne pogreške aproksimacije (RMSEA) i GFI (engl. *Goodnes of fit*) (Browne & Cudeck, 1992.; Hair i sur., 2010.; Marsh i Hočevar, 1985.). Rezultati su prikazani u tablici 6. te su sve izračunate vrijednosti unutar prihvatljivog raspona.

Tablica 6. Rezultat prikladnosti modela

	Rezultati	**Raspon prihvaćanja**
CMIN/df	3.258	[2, 5]
RMSEA	0.064	<= 0.08
GFI	0.950	>=0.9

Končani rezultati za konstruktu UX, promatran kao HOC prikazan je u nastavku. Potvrđene su dvije dimenzije (Slika 4).

5 Discussion

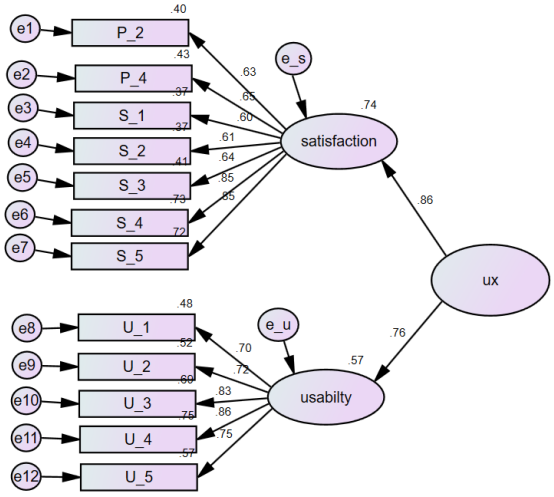
This paper aimed to examine and validate the UX model as a multidimensional construct in the HE setting. Results of a conducted survey among students confirmed the multidimensionality of UX. However, from the initially proposed three dimensions (*usability*, *appeal,* and *satisfaction*), only two dimensions were confirmed. Precisely, *usability* as one of the subdimension was confirmed in the first and the second model, but due to a strong correlation between *satisfaction* and *appeal*, the first model had to be re-specified and reduced to two dimensions. These results are inconsistent with the assumption that there is no mutual influence of the two UX aspects, made by authors who proposed measuring UX as a composite of three elements (Thüring & Mahlke, 2007).

Two items removed when the second model was proposed are *The visual appeal of this digital service keeps my attention*, and *I do not feel tired after using this digital service*. Both items (manifest variables) are related to dimension appeal. This could be explained by the fact that digital services that were the subject of this study are something that students need to use.

Precisely, those services do not provide any pleasure or additional benefits but are fully related to the process of studying (such as applying for the exam, requesting different proofs, accessing the schedule, etc.). After the model was re-specified, two remaining items related to *appeal* were assigned to dimension *satisfaction*. These results align with previous research that argued for two aspects of UX: **pragmatic** and **hedonic**. The pragmatic aspect refers to *usability*, while the hedonic dimension refers to *emotions* and *aesthetics* (Preece et al., 2019; Wani et al., 2017).

While there are studies related to satisfaction and quality of e-learning systems in Croatia (eg., Bušljeta Kardum, Jurić Vukelić, 2021; Klasnić et al, 2008), up to the author s knowledge, this is the first paper applying the HOC approach for validating comprehensive UX construct in an HE setting. The findings validate the significance of taking into account all aspects while assessing the UX. Findings are also in line with previous definitions considering the UX as an extension of usability (but not limited to), however, including also personal subjective perceptions and emotions (Sonderegger et al., 2019).

As for the results, students in Croatian HEIs rated the visual appeal of digital services with the lowest rate (average score was 3.4); however, they do agree that the visual of digital services observed fits the purpose. Similarly, Croatian students, in a previous study, evaluated satisfaction with the visual appearance of the e-learning system also with the similar average grade (3.42) (Klasnic et al, 2008). As for the usability dimension, the average score is



Slika 4. UX kao HOC

5 Diskusija

Cilj ovog rada je bio istražiti i potvrditi model korisničkog iskustva kao višedimenzionalni konstrukt u kontekstu VO. Rezultati provedene ankete među studentima potvrdili su višedimenzionalnost UX-a. Međutim, od inicijalno predložene tri dimenzije (*upotrebljivost*, *privlačnost* i *zadovoljstvo*), potvrđene su samo dvije dimenzije. Konkretno, upotrebljivost kao jedna od dimenzija potvrđena je u prvom i drugom modelu, ali zbog snažne korelacije između *zadovoljstva* i *privlačnosti*, prvi model je morao biti ponovno definiran te je sveden na dvije dimenzije. Dobiveni rezultati nisu u skladu s pretpostavkom autora koji su predložili mjerenje UXa kao kombinaciju triju elementa (Thüring & Mahlke, 2007)

Dvije čestice su uklonjene prilikom formiranja drugog modela: *Vizualna privlačnost ove digitalne usluge zadržava moju pažnju* i *Ne osjećam umor nakon korištenja ove digitalne usluge*. Obje čestice (manifestne varijable) odnose se na dimenziju privlačnosti. To bi se moglo objasniti činjenicom da su digitalne usluge koje su bile predmet ovog istraživanja nešto što studenti moraju koristiti.

Konkretno, te usluge ne pružaju nikakvo zadovoljstvo ili dodatne pogodnosti, već su potpuno povezane s procesom studiranja (kao što su prijava za ispit, traženje različitih dokaza, pristup rasporedu itd.). Nakon ponovne specifikacije modela, dvije preostale čestice povezane s *privlačnošću* dodijeljene su dimenziji *zadovoljstva*. Ovi rezultati u skladu su s prethodnim istraživanjima koja zagovaraju dva aspekta UX-a: **pragmatični** i **hedonički**. Pragmatični aspekt odnosi se na *upotrebljivost*, dok se hedonička dimenzija odnosi na *emocije* i *estetiku* (Preece et al., 2019; Wani et al., 2017).

Iako postoje istraživanja o zadovoljstvu i kvaliteti sustava e-učenja u Hrvatskoj (npr. Bušljeta Kardum, Jukić Vukelić, 2021; Klasnić i sur., 2008), prema

above 4, implying that students do not report usability issues.

There are a few limitations that should be addressed in further research. The first limitation is regarding the type of digital services in HE. As mentioned, observed digital services are the ones related to support/administrative activities. It would be interesting to measure UX with digital services that provide additional content for students (extracurricular activity, not content closely related to the studying process).

Even though participants of this study evaluated their UX higher than students in a similar study (Al-Hunaiyyan et al., 2021), there are few practical implications for HEIs that could be derived. Even though the usability dimension is important, the hedonic dimension should not be neglected. HEIs need to invest effort in designing those digital services, so they provide students with higher UX.

Providing better UX of those digital services could help improve students' satisfaction in general, which is proved to be one of the factors when measuring the quality of HEIs (Cadena et al., 2018). Results confirm the importance of measuring students' UX, especially since the number of these services will keep increasing.

Another limitation is geographical since all participants are Croatian students. It would be interesting to conduct similar research in another EU country to see whether there are any differences.

Future research should also focus on examining the impact of UX on constructs related to student satisfaction with HEIs in general.

6 Conclusion

The multidimensionality of UX in HE has been confirmed, and both hedonic and pragmatic aspects reviled as important when measuring the UX. To conclude, meaning UX in HE is particularly important for several reasons. First, the new generation of students expects high UX. Second, the number of services is increasing, and these services need to be properly designed to enable effective and good experiences. Providing optimal UX benefits not only students but also faculty and staff by streamlining their work processes and improving their efficiency. Institutions that understand the significance of employing modern technology and offering a seamless UX can potentially gain a competitive advantage. Therefore, HEIs must prioritize measuring and enhancing their UX to meet students' increasing expectations and remain competitive in the global market. Results of quantitative survey conducted on over 500 Croatian students reviled that visual appeal is graded with the lowest grade (3.4), while usability aspect regarding effort needed received the highest grade (4.36).

dosadašnjim saznanjima autora, ovo je prvi rad koji istražuje mjerenje sveobuhvatnog UXa kao višedimenzionalnog konstrukta i to u kontekstu visokog obrazovanja. Rezultati potvrđuju važnost mjerenja svih dimenzija prilikom vrednovanja UXa. Rezultati su također u skladu s prethodnim definicijama koje smatraju da je UX proširenje *upotrebljivosti* (ali ne ograničeno na to), uključujući i osobne subjektivne percepcije i emocije (Sonderegger et al., 2019).

Što se tiče rezultata, studenti na hrvatskim institucijama VO najniže su ocijenili vizualnu privlačnost digitalnih usluga (prosječna ocjena je bila 3.4); međutim, slažu se da vizualni aspekt digitalnih usluga odgovara svrsi. Slično tome, hrvatski su studenti, u prethodnom provedenom istraživanju, vrednovali zadovoljstvo vizualnim izgledom sustava za e-učenje i ocijenili ga slično (3,42) (Klasnic i sur., 2008.). Što se tiče dimenzije upotrebljivosti, prosječna ocjena je iznad 4, što implicira da studenti ne prijavljuju probleme s upotrebljivošću.

Postoji nekoliko ograničenja koja bi trebala biti adresirana u budućim istraživanjima. Prvo ograničenje odnosi se na vrstu digitalnih usluga u VOKao što je spomenuto, promatrane digitalne usluge odnose se na podršku/administrativne aktivnosti. Bilo bi zanimljivo izmjeriti UX digitalnih usluga koje pružaju dodatne sadržaje za studente (izvannastavne aktivnosti, sadržaje koji nisu usko povezani s procesom studiranja).

Iako su sudionici ovog istraživanja ocijenili UX višom ocijenom nego studenti u sličnom istraživanju (Al-Hunaiyyan et al., 2021), postoje neke praktične implikacije za institucije VO koje se mogu derivirati. Iako je dimenzija upotrebljivosti važna, hedonički aspekt ne smije biti zanemaren. Institucije trebaju uložiti napore u dizajniranje tih digitalnih usluga kako bi studentima pružile bolji UX. Osiguravanje visokre razine UXa promatranih digitalnih usluga može pomoći poboljšanju zadovoljstva studenata općenito, što se pokazalo kao jedan od čimbenika pri mjerenju kvalitete visokoškolskih ustanova (Cadena et al., 2018). dodatno, rezultati potvrđuju važnost mjerenja UXa studenata, pogotovo jer će se broj tih usluga nastaviti povećavati.

Drugo ograničenje ovog rada je geografsko, budući da su svi sudionici hrvatski studenti. Bilo bi zanimljivo provesti slično istraživanje u drugoj zemlji Europske unije kako bi se vidjele eventualne razlike.

Buduća istraživanja također bi trebala usmjeriti pažnju na ispitivanje utjecaja UXa na konstrukte koji su povezani sa zadovoljstvom studenata u visokom obrazovanju općenito.

6 Zaključak

Potvrđena je višedimenzionalnost UX-a u kontekstu visokog obrazovanja, pri čemu su i hedonički i pragmatički aspekti istaknuti kao važni pri mjerenju

The UX methodology gives priority to the needs and preferences of students (users) when creating a service experience that is easy to use and meets their goals. This approach requires a deep understanding of user behavior and careful execution to make it simple for users to accomplish what they want. Despite the growing importance of UX in attracting and retaining students, HEIs still lack to prioritize this area. The ongoing pandemic, declining revenues, rapidly evolving demographics, and a surge in the number of students accessing HE through digital devices still pose significant challenges for HEIs.

Acknowledgment

The research is supported by the Croatian Science Foundation [grant number IRP-2017-05-7625].

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UXa. Zaključno, značaj UXa u HE-u posebno je važan iz nekoliko razloga. Prvo, nova generacija studenata očekuje visok UX. Drugo, broj usluga se povećava, a te usluge treba adekvatno dizajnirati kako bi omogućile učinkovita i dobra iskustva. Pružanje optimalnog UXa koristi ne samo studentima, već i nastavnom osoblju i osoblju podrške putem pojednostavljenja njihovih radnih procesa i poboljšanja njihove učinkovitosti. Institucije koje shvaćaju važnost korištenja modernih tehnologija i pružanja besprijekornog UXa mogu potencijalno ostvariti konkurentske prednosti. Stoga visokoškolske ustanove moraju dati prioritet mjerenju i poboljšanju svojeg UX-a kako bi zadovoljile sve veća očekivanja studenata i ostale konkurentne na globalnom tržištu. Rezultati kvantitativnog istraživanja, provedenog na više od 500 hrvatskih studenata, pokazali su da je vizualna privlačnost ocijenjena najnižom ocjenom (3,4), dok je aspekt upotrebljivosti u pogledu potrebnog truda dobio najvišu ocjenu (4,36).

Metodologija UXa daje prednost potrebama i preferencijama studenata (korisnika) prilikom stvaranja iskustva usluge koje je jednostavno za korištenje i koje zadovoljava njihove ciljeve. Ovaj pristup zahtijeva duboko razumijevanje ponašanja korisnika i pažljivu izvedbu kako bi korisnicima bilo jednostavno postići ono što žele. Unatoč sve većem značaju UX-a u privlačenju i zadržavanju studenata, institucije VO još uvijek nedovoljno tretiraju ovu područje. Nastavak pandemije, pad prihoda, brza demografska promjena i porast broja studenata koji pristupaju VO putem digitalnih uređaja i dalje predstavljaju značajne izazove za institucije.

Zahvale

Ovaj je rad financirala Hrvatska zaklada za znanost projektom UIP-2017-05-7625.

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