# Information Quality of Digital Services in Higher Education: Higher Order Construct Analysis

**Tea Mijač, Mario Jadrić, Maja Ćukušić**

Faculty of Economics, Business and Tourism

University of Split

Cvite Fiskovića 5, Split, Croatia

{tea.mijac, mario.jadric, maja.cukusic}@efst.hr

**Abstract**. *Digital transformation in higher education leads to new digital services for stakeholders, particularly students. The importance of service quality and quality assurance is particularly emphasised in the shift to the "digital-first" or "digital-only" mode. In that context, the paper focuses on the multidimensionality of digital services in higher education and the subdimension of information quality based on the feedback from over 561 students in Croatia.*

**Keywords.** Information quality, higher education, digital transformation, higher-order-construct.

## 1 Introduction

Digital transformation (DT) represents the most significant paradigm shift in Higher Education (HE) (Biedermann, Kalbfell, Schneider, & Drachsles, 2019). It manifests in novel concepts and solutions, not only as a technology-driven approach but also resulting in new digital business models, digital user engagement, and so on (Moreira, Ferreira, & Seruca, 2017). Consequently, an increase in the number of digital services in HE has been notable (Julião & Gaspar, 2021; Pasini, Estevez, & Pesado, 2019). DT in HE enables modular growth, development, and access to resources, ensuring that institutions become more efficient in teaching and non-teaching activities (Fisher, 2006; Xiao, 2019).

DT is not only about *moving* to digital, but due to the *marketisation* of HE, those digital services must also be aligned with end-users needs (Díaz-Méndez, Paredes, & Saren, 2019; Elsharnouby, 2015; Ng & Forbes, 2009). Higher Education Institutions (HEIs) strive to foster relationships with stakeholders by delivering timely, accurate information and, most importantly, aligning with the stakeholders' interests (Pinho, Franco, & Mendes, 2022). Even though there are numerous stakeholders in HE (Kettunen, 2015), due to increased competition among HEIs, students' needs are particularly highlighted (Nguyen, Shirahada, & Kosaka, 2012).

In the DT projects, HEIs should place a particular emphasis on evaluating and measuring issues linked to service quality (Annamdevula & Bellamkonda, 2016). It is well argued that *service quality* (primarily focusing on information) is a crucial aspect of *student satisfaction* (Annamdevula & Bellamkonda, 2016; Sultan & Wong, 2019) which has a mediator role between service quality and student loyalty (Annamdevula & Bellamkonda, 2016).

Reliable, accurate, and up-to-date information is cogitated as *information quality*. In the public sector, the information quality of digital services proved significant for citizen satisfaction (Rasool & Warraich, 2018). Similarly, information quality in HE has been emphasised (Sultan & Wong, 2019). Because of DT, consuming information online has become commonplace in HE (Chen & Chengalur-Smith, 2015), and as the information is now consumed online, its quality needs to be assured both online and offline.

Although HEIs began their digital transformation (Grajek, 2020), *there is still a lack of empirical studies* in this area (Khalid, Ram, & Khalee, 2018). Even though information quality has a significant role in HE and is considered a complex multidimensional phenomenon, it has not been fully understood (Ge, Helfert, & Jannach, 2011). Also, for evaluating digital services' characteristics, studies have generally modelled information quality as first-order constructs (Forsgren, Clay, Wang, & Durcikova, 2016). It has been implied that future studies should inspect it as the second-order construct and explore it in a different context (Rasool & Warraich, 2018).

In line with this, the study presented herein aimed to *model the construct of information quality of digital services in HE and determine preferred characteristics (subdimensions) of those digital services from students' perspective, i.e. from the end-users side.*

The paper is structured as follows. Section 2 presents the role of information quality in the DT of HE. Section 3 describes the research methodology, while section 4 presents the study's empirical results. Highlights and the main contributions of the study are

presented in section 5, together with future research directions.

# 2 Theoretical Background

Technology development is changing the operations in the public sector and contributing significantly to DT in HEIs (Sandkuhl & Lehmann, 2017; Santos, Batista, & Marques, 2019). DT presupposes the transition from the traditional value creation and delivery to the mass application of different technologies (Sandkuhl & Lehmann, 2017; Verina, Titko, & Shina, 2019). In that regard, it is expected that HEIs will focus even more on developing and implementing ICTs that represent appropriate channels for communication with their stakeholders (Santos et al., 2019). HEIs are using these technologies both to improve their performance and adapt to changes in a society that is increasingly driven by technology (Rodrigues, 2017) since the structures and processes in HE are just as susceptible to far-reaching changes as the ones in the business environment (Gilch et al., 2019). A recent survey revealed that 13% of HEIs are engaged in DT projects, 32% are developing DT strategies, and 38% of HEIs are still discovering DT as a concept (Grajek, 2020). At the same time, 17% of institutions do not invest time in DT.

Another transformation impetus is a competitive market where HE institutions compete for students and staff nationally and internationally (Díaz-Méndez et al., 2019; Sutjarittham, Gharakheili, Kanhere, & Sivaraman, 2019). Embracing *marketisation* in HE leads to adopting concepts and practices such as advertising, branding, monitoring and managing customer satisfaction in a customer-oriented approach (Díaz-Méndez et al., 2019; Elsharnouby, 2015; Ng & Forbes, 2009). Customer-oriented, i.e. the student-oriented approach, has become particularly important (Elsharnouby, 2015; Fader, 2012). It aims to look at the product or service from students' perspectives to understand their needs (Levaniemi, 2015). Ensuring the student-oriented approach by using the technology is becoming a norm (Balyer & Oz, 2018; Bond, Marín, Dolch, Bedenlier, & Zawacki-Richter, 2018; Seres, Pavlicevic, & Tumbas, 2018) and a key factor in creating a successful HE environment (Arkhipova, Belova, Gavrikova, Pleskanyuk, & Arkhipov, 2020). To maintain their role in the development of society, HEIs must respond in a timely and adequate manner to these challenges.

Providing sufficient and reliable *information* to students can impact their perception of HEIs' service quality (Sultan & Wong, 2019). The findings show that information is more statistically significant than experience as the antecedents of service quality.

There are four types of digital services in HE, and for each, information quality is of utmost importance (Pasini et al., 2019):

1. Informational digital services – delivering useful information to the HE community; for example, notifying students of important dates.
2. Digital certification services – verification and confirmation of different student statuses; for example, proof that a student has obtained a diploma.
3. Digital records services – these are digital services that generally control the presence/attendance. For example, checking the presence of students, teaching or administrative staff working hours.
4. Digital authorisation services – refers to authorisation and digital signatures.

Despite the inevitable importance, numerous business initiatives have been postponed or cancelled in various industries, citing poor information quality as the main reason (Ge et al., 2011). Subdimensions often used to measure information quality in HE are (1) understandability (Aldholay, Abdullah, Isaac, & Mutahar, 2019; Efiloğlu Kurt, 2019; Xu & Du, 2018), (2) reliability (Cidral, Oliveira, Di Felice, & Aparicio, 2018; Daghan & Akkoyunlu, 2016), (3) accuracy (Aldholay et al., 2019; Çelik & Ayaz, 2021; Fadelelmoula, 2018), (4) up-to-dateness (Çelik & Ayaz, 2021; Efiloğlu Kurt, 2019), (5) timeliness (Daghan & Akkoyunlu, 2016; Lwoga, 2013), (6) relevancy (Çelik & Ayaz, 2021; Efiloğlu Kurt, 2019; Hasan et al., 2018; Xu & Du, 2018) and (7) completeness (Al-Azawei, 2019; Aldholay et al., 2019; Efiloğlu Kurt, 2019; Hagos, Garfield, & Anteneh, 2016).

# 3 Methodology

Based on the literature review, an instrument was prepared. An online survey tool (Lime Survey) was used for data collection with the participants, students from Croatia.

Higher-Order Constructs (HOC) analysis using Covariance-Based Structural Equation Modelling (CB-SEM) has been applied. It contributes to each dimension, as opposed to connecting all manifest variables with a single first-order construct when it can be said that the explanation of the construct is incomplete (Mohammadi & Mahmoodi, 2019). A minimal sample size is achieved ( Hair, Black, Babin, & Anderson, 2010), and the HOCs have been evaluated the same way first-order constructs are (ibid). HOC analysis has been done using the IBM Amos software.

The sample was stratified and made of students from ten HEIs in Croatia in the field of social sciences (economics) who use any digital services for non-teaching-related activities. The survey began in May 2021 and lasted until June 2021. Nine responses (outliers) are removed from the total number of completed survey questionnaires (N=551).

# 4 Results

Information quality has been modelled as a second-order construct. The initial list of proposed subdimensions has been changed. *Completeness* has been removed, as discriminant validity was not achieved. Therefore, a second model analysis was performed with six subdimensions. Confirmatory Factor Analysis (CFA) was used to check validity and reliability, and the results are presented in Figure 1. In Table 1, Factor Loadings (FL), Average Variance Extracted (AVE), and Composite Reliability (CR) are presented (Hair, Babin, & Krey, 2017). Calculated FLs range from 0.723 to 0.917 (each above the referent value of 0.60). Calculated AVE indicators exceed the value of 0.50, as suggested. Finally, CRs for each first-order construct are over 0.70. Therefore, convergent validity is confirmed. Discriminant validity is also confirmed as all calculated correlations are lower than 0.85 (Brown, 2006). Additionally, the square root of AVE surpasses calculated correlations (Afthanorhan, Ghazali, & Rashid, 2021).
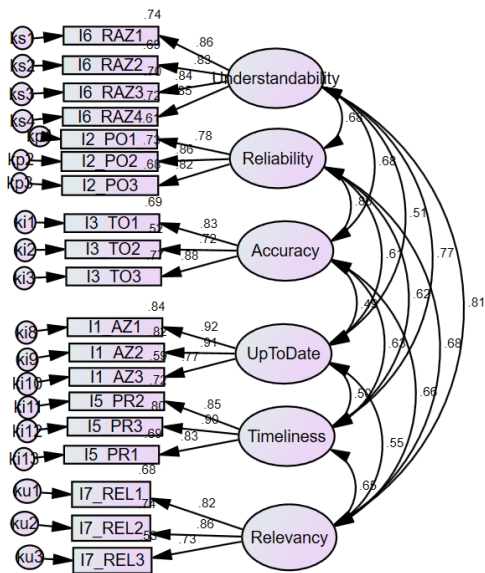


**Figure 1.** CFA model

**Table 1.** FL, AVE and CR

| Item | First-order construct | FL | AVE | CR |
|---|---|---|---|---|
| I3_SQ001 | Accuracy | 0.83 | | |
| I3_SQ002 | Accuracy | 0.723 | 0.662 | 0.854 |
| I3_SQ003 | Accuracy | 0.88 | | |
| I7_SQ001 | Relevancy | 0.824 | | |
| I7_SQ002 | Relevancy | 0.859 | 0.648 | 0.846 |
| I7_SQ003 | Relevancy | 0.727 | | |
| I2_SQ003 | Reliability | 0.824 | | |
| I2_SQ002 | Reliability | 0.856 | 0.672 | 0.860 |
| I2_SQ001 | Reliability | 0.778 | | |

| | | | | |
|---|---|---|---|---|
| I5_SQ002 | Timeliness | 0.849 | | |
| I5_SQ003 | Timeliness | 0.895 | 0.739 | 0.894 |
| I5_SQ001 | Timeliness | 0.833 | | |
| I6_SQ001 | Understandability | 0.862 | | |
| I6_SQ002 | Understandability | 0.829 | 0.713 | 0.909 |
| I6_SQ003 | Understandability | 0.838 | | |
| I6_SQ004 | Understandability | 0.848 | | |
| I1_SQ001 | Up-to-date | 0.917 | | |
| I1_SQ002 | Up-to-date | 0.908 | 0.753 | 0.901 |
| I1_SQ003 | Up-to-date | 0.77 | | |

Results of calculated discriminant validly are in Table 2.

**Table 2.** Discriminant validity

| | Understan. | Reliability | Accuracy | UpToDate | Timeliness | Relevancy |
|---|---|---|---|---|---|---|
| Understandability | **0.84** | | | | | |
| Reliability | 0,68 | **0,82** | | | | |
| Accuracy | 0,68 | 0,80 | **0,81** | | | |
| UpToDate | 0,51 | 0,61 | 0,49 | **0,87** | | |
| Timeliness | 0,77 | 0,62 | 0,63 | 0,50 | **0,86** | |
| Relevancy | 0,81 | 0,68 | 0,66 | 0,55 | 0,65 | **0,81** |

After validity and reliability are confirmed, path coefficients are calculated. Figure 2 shows standardised path weights, and all weights are significant.
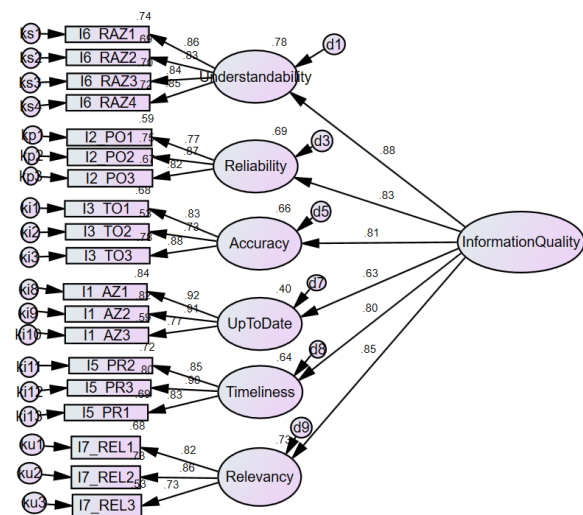


**Figure 2.** Path model with standardised estimations

Several relevant fit indices have been calculated to determine if the model fits the data (Hair et al., 2010; Marsh & Hocevar, 1985). Chi-square and freedom degrees ratio (CMIN/DF) is 3.67, Comparative Fit Index (CFI) is 0.953, Goodness-of-fit (GFI) is 0.903, and Root mean square error of approximation (RMSEA) 0.070. All calculated indices are within proposed referent values.

# 5 Discussion and conclusion

First-order constructs, i.e., subdimensions of information quality for digital services in HE, have been identified and confirmed as foreseen based on the theoretical foundations of the study.

By modelling information quality as a second-order construct, the multidimensional nature of the observed construct is confirmed. Hence, it would be more appropriate for future research to avoid using the *overall information quality* and instead measure it as a second-order construct. For that matter, this study provides a better understanding of the characteristics of digital services regarding information quality in the context of HE. Namely, the research study conducted with end-users confirmed that *accuracy, relevancy, up-to-dateness, timeliness, reliability,* and *understandability* are essential information quality subdimensions. Initially, *completeness* has been tested as a subdimension of information quality. However, although convergent validity was confirmed and the model fit indicators met the threshold, *discriminant validity was not confirmed.* The proposed model with six subdimensions, however, meets all the thresholds.

Further to confirming the six subdimensions, the findings have other implications relevant to the user-oriented design of digital services in HE. As some authors point out – the information for end-users in the information systems of HEIs is often not aligned with their needs (Husain, Syafar, Sabara, & Syafar, 2019). Therefore the results of the study could be used as guidelines for HEIs regarding specific aspects of information system (re)design in the process of DT.

However, the study has notable limitations. Participants are students from Croatia, so it would be interesting to conduct the same research in other countries and compare the results. Also, since the study focuses on the end-users perspective, it would be helpful to inspect and compare the results from the perspective of service providers and identify possible differences. This study focused on digital services unrelated to learning and teaching; however, since DT represents a much bigger perspective, future research should take a more comprehensive approach.

# Acknowledgements

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