How to Measure Co-Creation in the Digital Environment of Higher Education?

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Abstract - **Co-creation, as a form of collaborative innovation, has been a topic of growing interest in Higher Education (HE). Regardless of the industry, engaging end-users in the design of products and services has been assessed as important for the success of the initiatives and is often considered a means to increase competitive advantage. As all markets face digital transformation impetus that permanently alters product and service delivery, the physical aspect of the delivery becomes secondary in many cases. Namely, most services nowadays are delivered exclusively online, and the area of (higher) education is no exception. New generations of learners belonging to Gen Z are connected 24/7, their digital experiences and expectations have evolved, and are prepared to engage with the product or service providers. In that regard, previously developed research instruments focusing on general services (as opposed to digital ones) comprising of two dimensions (customer participation and citizenship behaviour), need validation in the new context. This study aimed to test it in the digital service environment of HE with more than 550 students (as end-users) from different HE institutions in Croatia. To that end, confirmatory analysis using structural equation modelling confirmed that not all subdimensions are relevant in the digital context.**

Keywords - co-creation, higher education, digital services, digital tranformation

I. INTRODUCTION

Digital transformation has experienced a rapid increase in today's society, resulting in the widespread adoption of digital technologies as the new normal. This digital transformation is significantly impacting the field of higher education (HE), which is undergoing a fundamental change in its operational processes and business models and the integration of technology platforms being increasingly employed [1], [2], [3]. As a result, all aspects of HE are undergoing transformation, with significant changes in how institutions carry out their daily processes [4].

In today's society, institutions of HE are facing a multitude of challenges, including the globalization of the market and the subsequent internationalization of education. This trend has led to increased competition among higher education institutions (HEI) in attracting prospective students, as well as a rise in the demands and expectations of future students, particularly with respect to the level of user experience provided by HEIs and the expected high standards of quality [5], [6]. To remain competitive, institutions must be able to provide a superior student experience that meets or exceeds the expectations of their students. This involves optimizing the interaction between students and the institution [7]. Institutions are also developing strategies to enhance efficiency, quality, and student experience, as well as to foster loyalty through co-creation, which involves creating collaborative, customer-specific value that is closely aligned with the concept of value-in-use [8], [6]. Value co-creation is a concept that has been defined as the process of creating value through collaborative activities between users and organizations during the consumption and use of a product or service [9]. In other words, it occurs when interactions between the organization and the customer take place, leading to the co-creation of value.

Accompanied by mentioned digital transformation, the web environment became increasingly important for offering digital services that support interactivity, thereby enhancing the student experience [10]. However, due to evident relevancy, empirical research on the operationalization of co-creation in higher education is scarce [11], and there is a need for further research on the topic, especially in the context of technology support for co-creation [12].

In line with this, the study presented herein aimed to *examine how to measure co-creation in this (new) digital environment of HE.*

The paper is structured as follows. Section 2 presents the role of co-creation in higher education and digital transformation. Section 3 describes the research methodology, while section 4 shows the study's empirical results. Highlights and the main contributions of the study are presented in section 5, together with future research directions.

II. LITERATURE REVIEW

A. Co-creation in Higher Education (HE)

Over the past 15 years, the service-centered approach known as service-dominant (S-D) logic has evolved into a meta-theoretical framework that fosters a systemic understanding of value co-creation [13]. Co-creation can be defined as joint innovation, that is, joint development and improvement of a product or service with all stakeholders [14]. Even though co-creation originally comes from marketing it has become a popular topic in HE research [15]. Higher education institutions (HEI) tend to increase loyalty through cooperation and collaboration with students [6].

Co-creation represents an alternative with the help of which it is possible to improve the study experience [6]. In the context of HEIs, co-creation refers to the integration of institutional resources with student opinions, responses, personalities, and academic abilities in such a way as to realize shared value for all stakeholders [16], [17]. Co-creation is based on voluntary participation, which represents an additional challenge for institutions considering that users can withdraw at any time [18]. Authors [11] define co-creation as the creation of value that is common to all stakeholders (organization and users) and enables everyone to build experiences, define problems and solve problems together [11]. Authors [18] and [19] investigated the co-creation construct on the example of HE teaching processes and confirmed that co-creation could be used as a tool for bridging cultural differences.

The authors [20] operationalized the construct of co-creation in the corporate environment and confirmed its multidimensionality. Precisely, they confirmed two dimensions: (1) customer participation behavior (CPB) and (2) customer citizenship behavior (CCB). The authors [12] adopted the instrument [20] for the HE context and confirmed that student satisfaction positively affects co-creation. In addition, authors [21] also examined how to enhance the university's brand image and reputation through customer value co-creation behavior. They confirmed that the university's website positively impacts co-creation behavior in general. Authors who examined co-creation in HE are listed in Table I.

TABLE I.   Co-CREATION IN HE

Dimensions	Subdimension	Authors
Customer participation behavior	Information seeking	[6], [12], [22]
	Information sharing	[12], [22]
	Responsible behaviour	[6], [12], [22]
	Personal interaction	[12], [21], [23]
Customer citizenship behavior	Feedback	[12], [21], [22]
	Advocacy	[12], [21]
	Helping	[21]
	Tolerance	[21]

Eight subdimensions commonly used in previous research regarding co-creation construct are:

- **Information seeking**: Customers seek information for several reasons. Firstly, information helps consumers to comprehend better and manage their co-creation settings. Secondly, acquiring knowledge allows customers to become integrated into the value co-creation process and understand their role as value co-creators. There are various ways in which customers can request information from businesses [20]. Additionally, apart from seeking out alternative sources of information, such as other customers or informal and personal means

of information, customers also prefer these sources over official ones [12].

- **Information sharing**: To ensure successful value co-creation, it is necessary for customers to contribute resources, including information, to be utilized in the co-creation process, as noted by Lengnick-Hall (1996). If customers are unable to provide precise and relevant information, the quality of value co-creation may be negatively impacted. Therefore, effective information sharing is essential to promote high-quality value co-creation [20]. For instance, it is expected that students will give university staff the information they need and respond to their inquiries about customer service to enable staff to provide the best possible service [12].

- **Responsible behavior**: It is often required for consumers to adhere to employee instructions and be physically present for value co-creation to be successful. In the service interaction, little value is co-created without customers' responsible behaviour [20]. The consumer (student) must cooperate, follow the rules and policies, behave politely, and take instructions from service provider staff [12].

- **Personal interaction**: The process of creating value in a service environment typically takes place in a social setting. Customers are more likely to take part in value co-creation if the social setting is fun, welcoming, and upbeat [20]. Owing to the social context, interpersonal skills, including politeness, friendliness, and respect, are crucial [12].

- **Feedback**: The behavior of organization affects the experience of students, who are essentially the customers, and thus organization can gain significant benefits by considering suggestions from these customers for improving their services [20]. However, although feedback is valuable, it should be noted that it is not a mandatory but voluntary act [20] where students (customers) engage in making constructive suggestions for improvements [12]. For example, feedback can be obtained via higher education websites [21].

- **Advocacy:** When customers recommend a company to others in a positive manner, it is a sign of their loyalty to that company. This kind of advocacy is highly beneficial for the company in many ways, including improving its reputation, promoting its products and services, receiving higher evaluations for service quality, and growing the customer base [20]. This behavior involves endorsing, supporting, and defending the organization by recommending it to people outside the organization, such as friends and family, and spreading goodwill about it [21],[12].

- **Helping**: When customers (students) are involved in co-creating a service, they tend to offer help and support to other customers (students) [20]. Customers remember their own challenging experiences and feel a sense of obligation to assist others [20]. Helping may include students' willingness to help other students with difficulties

[12], or it could be just considered as helping refers to students' behavior aimed at assisting other students [21].

- **Tolerance**: Tolerance is the degree to which a user is willing to be patient when the service they receive falls short of their expectations for acceptable service [20]. In the HE offline context, it can refer to accepting inconvenient study conditions, accepting alternative class meeting times, etc. [12], or if any HE service is not delivered as expected [21].

B. Digital transformation

Information and communication technologies (ICT) have changed the way in which services are defined and realized in HEIs [10], [24]. Co-creation presupposes connections and interactions with all stakeholders [25], and it is almost impossible to achieve it without using technology (which has become a key element in the functioning of HEIs). Not only is technology necessary for the execution of all processes, but it also provides the basis for joint work and cooperation among all stakeholders [26].

Technology supports and helps students co-create [27]. For most organizations, even websites alone represent a key tool that serves them to strengthen relationships with customers/users [28]. The results of the author's research [21] indicated that the university's website positively impacts co-creation behavior in general. Thus, even the website, which represents the lowest level of maturity of digital services in HE because it is an asynchronous way of communication [29], has a positive impact on co-creation. Precisely, the author [15] listed several examples in which the use of technology influenced co-creation, and it is about students who, with the help of digital resources, stated their ideas about improvement.

Several authors confirmed that social networks could also be used to encourage co-creation thanks to functionalities such as enabling active dialogue/interaction between (future) students and employees of the institution [18], [30]. Different system functionalities encourage the interactivity and creativity of end users and, thus, co-creation [10]. For example, online discussions are also considered a form of co-creation realization [23].

Online platforms have proven to be a good tool for encouraging and conducting co-creation, but the results indicate that the level of student engagement in practice is still low [18].

III. METHODOLOGY

To answer the proposed research question, quantitative research was conducted on students who have experience in using digital service for supporting activities (such as applying for exams, gaining proofs, etc.).

Items were adopted and prepared based on the literature review. The instrument consisted of 29 items and Liker scale was used from 1 (totally disagree) to 5 (totally agree).

This study was conducted with students from ten HEIs in Croatia who use digital services for supporting activities. Total number of fully-completed survey questionnaires was N=551. As for year of studying, majority had 3 years' experience of studying (27%), 22.1% had two-year experience, 18.5% were freshman's, and 17.8% had 4-year experience, while the least had 5 years (14.5%). Also, 70.8% were female which is comparable publicly available gender structure data at Croatian HEIs.

After data had been collected, multivariate statistic methods were applied [31]. Precisely, to examine the dimensionality, confirmatory factor analysis (CFA) was used. Software tools used for data analysis were IBM SPSS Statistics and IBM SPSS Amos for structural equation modelling.

IV. RESULTS

As variables' normality is required for conducting a CFA, skewness and kurtosis have been calculated. Items measuring *personal interaction* subdimension have been excluded from further analysis since values have not met the referent value of +/-3 [32]. Also, three out of four items from the subdimension *responsible behavior* have been removed due to not meeting the referent value for normality.

After excluding the two subdimensions (*personal interactions* and *responsible behaviour*), six subdimensions were retained for further analysis (*information seeking, information sharing, feedback, advocacy, helping* and *tolerance*). CFA was conducted in AMOS, and the results are shown below in Figure 1.
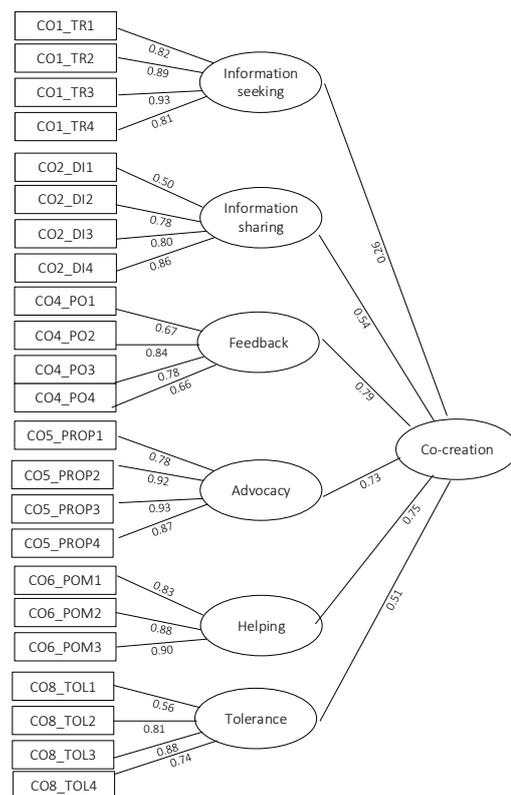

Figure 1.   CFA results

TABLE II. VALIDITY AND RELIABILITY RESULTS

	FL	CR	AVE
Information seeking (I_SE)			
I have asked others about this digital service.	0.82		
I have asked others how to access this digital service.	0.89	0.92	0.74
I have asked others what is contained within this digital service.	0.93		
I have paid attention to how others use this digital service.	0.81		
Information sharing (I_SH)			
I clearly explain to employees/IT department what I want if I need something.	0.50		
I share necessary information via this digital service.	0.78	0.83	0.56
I share true information via this digital service.	0.80		
I share all the needed information so digital service can be realized.	0.86		
Feedback (FE)			
If I have idea for improving this digital service, I would be happy to share it.	0.67		
If I am satisfied with this digital service, I will share it with others.	0.84	0.83	0.55
I will comment with others on my experience with this digital service.	0.78		
If I experience problem with this digital service, I will be happy to report it.	0.66		
Advocacy (AD)			
I share my positive experience about institution with others.	0.78		
I recommend the institution to other potential students.	0.92	0.93	0.77
I encourage other students to apply for the institution.	0.94		
I encourage other students to attend the institution.	0.87		
Helping (HE)			
I assist other students if they need my help with using this digital service.	0.84		
I teach other students how to use this digital service if needed.	0.88	0.90	0.76
I happy give advice on how to use this digital service.	0.90		
Tolerance (TO)			
If problem with this digital service occurs, I will not stop using it immediately.	0.56		
If problem with this digital service occurs, I am ready to wait and not to use alternative way (ex., F2F visit to institution).	0.82	0.84	0.58
If it takes longer than usually while using the digital services, I am ready to wait.	0.88		
If this digital service does not meet my expectations, I will tolerate it.	0.74		

To evaluate reliability and validity, composite reliability (CR) and average variance extracted (AVE) have been calculated. The results show that the scale possesses good reliability, as the CR for each construct is greater than 0.70, and the AVE is greater than 0.50 [33] (see Table II). For accessing the reliability of items, factor loading (FL) has also been calculated and presented in the Table II. The smallest FL value can be 0.4, but only if the condition that the AVE is greater than or equal to 0.5 is met [33]. All results suggest that no further deletion of items is necessary.

Results for calculating reliability and validity are shown in Table II.

To assess discriminant validity, we used Fornell & Larcker criteria [34], and the results are shown in Table III.

The Fornell & Larcker criterion assumes that the second root of the AVE value of each observed construct should be greater than all correlations to other constructs - when this criterion is met, discriminant validity is achieved. Results point out that criteria has been met.

TABLE III. DISCRIMINANT VALIDITY RESULTS

	I_SE	I_SH	TO	FE	AD	HE
I_SE	**0.86**					
I_SH	0.28	**0.75**				
TO	0.07	0.29	**0.76**			
FE	0.28	0.40	0.46	**0.74**		
AD	0.07	0.32	0.32	0.62	**0.88**	
HE	0.22	0.47	0.38	0.54	0.59	**0.87**

To estimate model fit, several measures have been calculated. The value of the chi-square ratio and degrees of freedom (CMIN/df) must not be less than 2 and greater than 5 according to [35] and the calculated CMIN/df is 3.427. The comparative fit index (CFI) has been calculated and equals 0.94. The root mean square error of approximation (RMSEA) should not be above 0.08, according to [31], and it scores 0.66. Therefore, all calculated values are within the acceptable range.

The results confirm the dimensionality of the 29-item, six-dimension scale. However, since two subdimensions (*responsible behavior* and *personal interaction*), which belong to the dimension *Customer participation behavior,* were removed, the third level construct is not present in this study. However, all subdimensions of *Customer citizenship behavior* were retained.

Descriptive statistics have been conducted to calculate the average value for each of the six validated co-creation subdimensions. The results are graphically presented in Figure 2 in continuation.

The subdimension with the highest average value was *helping*, which had an average score of 4.06. This suggests that participants in the study placed a high value on their ability to help other students. The next two subdimensions with the highest average scores were *tolerance* and *advocacy*, both with an average score of 3.97.

The fourth subdimension, *information sharing*, had an average score of 3.91. This is followed by the fifth subdimension, *feedback*, with an average score of 3.71.

The lowest average score was for the subdimension *information seeking*, with an average score of 2.80. This suggests that students were less likely to actively seek information from digital services.

V. DISCUSSION AND CONCLUSION
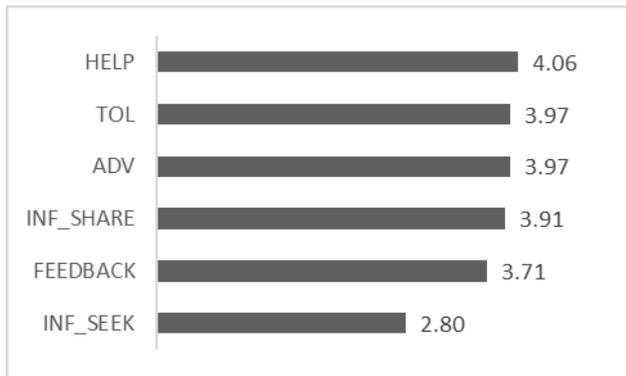
Co-creation is a marketing concept that assumes

Figure 2. Average values for co-creation dimensions

collaborative value creation, where the customer receives higher value if they participate in the whole process. Co-creation has been examined in HE, but primarily regarding the face-to-face context. For example, authors have confirmed how co-creation can be used to bridge cultural differences [18] or how co-creating the teaching process enriches the overall process and provides higher value for students.

However, due to digital transformation that is changing the whole setting of HE, circumstances have also changed. The majority of services are now being consumed online [29], including the delivery of support services, such as applying for exams, obtaining different proofs, payments, and scheduling. Taking into consideration that the new generation of students has a different mindset [36], it is essential to provide value co-creation in an online setting as well.

The goal of our paper was to examine how to measure co-creation in this new digital environment of HE. To provide an answer to our research question, a quantitative survey was conducted on more than 500 students in Croatia. The results of this study confirmed that measuring co-creation in the digital environment differs from offline co-creation. The multidimensionality of the construct was confirmed; however, some subdimensions were omitted. Precisely, the dimensions *personal interaction* and *responsible behavior* did not confirm as relevant to measure co-creation in the digital environment.

As indicated in the literature review, personal behavior is essential since the service encounter occurs in a social setting [12]. However, if we take into consideration that the majority of services nowadays are being delivered online, it is questionable how this dimension remains important, even in other settings and not just in HE. The results of our study did not confirm the importance of subdimension *responsible behavior*. This can be explained by the fact that from the first day of enrolling in an HEI, it is expected that students follow the rules and procedures. This is something that students take for granted, given the HE context. Due to this, it can be expected that this subdimension may remain relevant in other digital settings as well.

There are a few limitations that need to be addressed in future research. Even though this study included participants from ten different HEIs, it would be interesting to conduct a similar study in another country to check whether these findings can be considered for all Z Generation.

Future research should be oriented toward examining antecedents of co-creation. Also, to use this instrument in the business digital environment, dimensions need further to be validated.

To summarize, the results of this study address a few research gaps and therefore make several scientific contributions. First, literature regarding co-creation in HE is relatively scarce. Thus, the empirical results of this study contribute to enriching the literature. Second, even though there are studies examining co-creation in HE, they haven't been examined in the digital environment. As mentioned, due to rapid digital transformation in HE, it is particularly important to measure and manage co-creation in digital settings. Through empirical research, this study validated the student value co-creation behavior scale.

In conclusion, this study provides valuable insights into the measurement of co-creation in the digital environment of HE. It suggests that while the multidimensionality of the construct is confirmed, some dimensions may not be as relevant in online settings as they are in face-to-face settings. The results of this study can be used to guide the development of co-creation strategies in the digital environment of HE and provide a foundation for future research in this area.

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