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Behavioural Intentions for Health by the Z Generation: A Fuzzy Cognitive Maps Analysis

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Abstract:

Purpose: *The purpose of the research was to examine behavioural intentions (acceptance attitudes) regarding the use of health information available on the Internet by representatives of the generation Z. We adapt the UTAUT model and Fuzzy Cognitive Maps for evaluating the acceptance attitudes and reasoning about young Internet users preferences.*

Design/Methodology/Approach: *We present the results of research conducted in a group of 200 IT specialization students in 2019. A purposive sampling was used. The survey was conducted in a group of students of the Lublin University of Technology in June 2019. The group of respondents was a group of 200 students of Computer Science in full-time studies. The questionnaire was used as a research tool. The survey was conducted in the CAWI (Computer Assisted Web Interview) technique.*

Findings: *Obtained results indicate that selected variables conditioning behavioural intentions and shaping mental attitudes are significant and internally consistent. Very strong correlations exist between the following constructs: effort expectancy, social influence and facilitating conditions. Conducted and presented studies have shown the possibility of identifying factors affecting acceptance attitudes using the UTAUT model and Fuzzy Cognitive Maps.*

Practical Implications: *As more and more human activities are carried out with the use of the Internet, it becomes necessary to develop theories and models that will allow us to understand, explain and predict the behaviour of entities in the specific environment of the Internet. Therefore, further work on the use of acceptance models such as UTAUT is recommended.*

Originality/Value: *The presented results of the pilot studies showed the possibility of identifying the factors influencing the intention of generation Z to use health information contained in the Internet using the UTAUT model. They allowed to identify the main determinants of the use of health information by young Internet users.*

Keywords: *Generation Z, knowledge management, UTAUT, Fuzzy Cognitive Maps.*

JEL codes: *I12, C31, O32.*

Paper Type: *Research article.*

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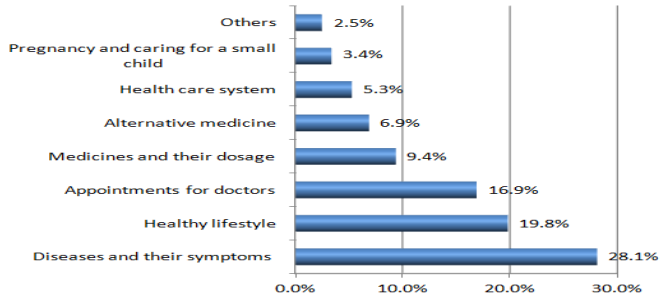
1. Introduction

The end of the 20th century and the beginning of the 21st century is a period of rapid development of the Internet and the widespread use of it in various areas of human activity. According to the annual report We Are Social company, called "Digital 2021", which covers the use of the Internet, mobile devices and social media, we currently have 4.66 billion Internet users in the world, 5.22 billion mobile device users and 4.20 billion active social media users (as of January 2021). The most dynamically developing group are social media users - their number has grown over the year (from January 2020) by 13.2% (or by 490 million people). Even more growth was recorded in the group of mobile social media users. Percentage of total social media users accessing via mobile is 98.8%. These growth trends are present for several years. In line with these global trends, the number of Internet users has also systematically increased in Poland. In 2020 in Poland, 81.4% of people aged 16-74 regularly used the Internet (at least once a week) (compared to 78.3% in the previous year). About 55% of people aged 16-74, or 65.9% of all Internet users, used social networking sites (CSO, 2020).

Figure 1. *Types of health information sought on the Internet*



Source: *Own study based on CSO data*.

The Internet is increasingly used in the area of health as well (Czerwinska, 2013; Dalimunte *at al.*, 2019). Among persons searching for health information on the Internet, the largest number of persons searched for information on diseases and their symptoms - 28.1% (Figure 1). Compared to 2012, this indicator increased by 2.9 percentage points (CSO, 2015).

The literature on social and civilization development describes generations X (born 1965-80), Y (born 1981-96), Z (born 1997-2012) (Anderson and Jiang, 2018; Dimock, 2019). Representatives of these generations have different characteristics and display different social attitudes. Their response to technological, economic and social changes is different. Generations Z, X, Y differ when it comes to everyday use of the Internet and tools for using it. Representatives of the generation Z are much more likely to use the Internet via telephone than older generations (Czerwinska, 2017).

We now notice that the dominant group of Internet users today are representatives of Generation Z. For this reason, the considerations in this article focus on the analysis of the attitudes and behaviour of this particular group. The aim of the research was to investigate the behavioural intentions (acceptance attitudes) regarding the use of health information available on the Internet by the representatives of the Z generation. The UTAUT and Fuzzy Cognitive Maps models were adapted to assess the acceptance attitudes and reason about the preferences of young Internet users.

2. Model UTAUT

To investigate the attitudes of generation Z representatives regarding the acquisition and use of health information on the Internet, the Unified Theory of Acceptance and Use of Technology (UTAUT) was chosen from numerous behavioural theories regarding IT adoption. This theory is used by many researchers to understand user behaviour towards technology.

Examples include the use of the UTAUT model to study the acceptance of student websites (Van Schaik, 2011), online banking (Khan *at al.*, 2021), adoption of a social learning system (Khechine *at al.*, 2020), understanding the behavioural intentions of patients and clinicians to use telemedical equipment (Kohnke *at al.*, 2014), acceptance for e-Government services (Mutaqin and Sutoyo, 2020). Therefore, this model is quite suitable to assess the behaviour of Generation Z in relation to the use of health information available on the Internet. Unified Theory of Acceptance and Use of Technology (UTAUT) is one of the models for the acceptance of information technology. Its purpose is to explain and forecast various online behaviours of Internet users - for example, searching for information on the Internet, ordering online purchases, activity in social media.

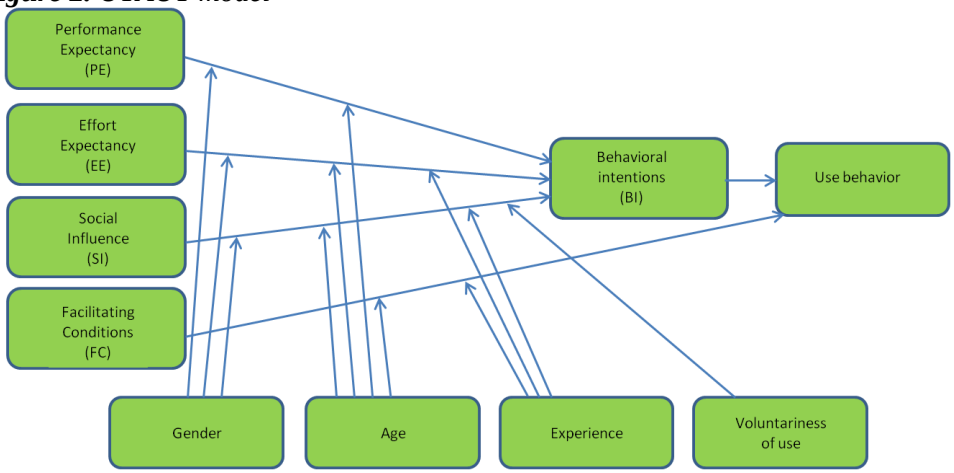
The UTAUT model introduces four constructs, which are the main direct determinants of the use of information technologies. They are: Expected Performance (PE), Expected Effort (EE), Social Impact (SI) and Facilitating Conditions (FC) (Venkatesh *at al.*, 2003). This model also introduces four variables that play the role of key moderators and influence the above constructs (independent variables). These moderators are gender, age, experience and voluntariness of use. (Figure 2).

For the purposes of the conducted research, the constructs were defined as follows:

1. Performance Expectancy (PE) is how generation Z perceive the usefulness of health information available on the Internet.
2. Effort Expectancy (EE) is how generation Z feels the ease use of accessing and using health information available on the Internet.
3. Social Influence (SI) has been described as how the generation Z senses the influences of someone important to them suggesting and encouraging the use of health information available on the Internet.

4. Facilitating Conditions (FC) is the way how the generation Z perceives infrastructure and its ability to support the use of health information available on the Internet.

Figure 2. *UTAUT model*



Source: *Venkatesh at al., 2003.*

The research proposed the following hypotheses:

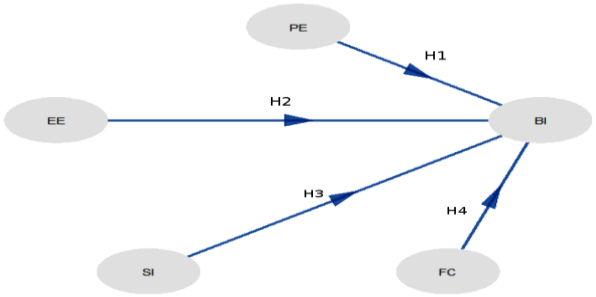
- *H1: Performance Expectancy (PE) positively influence generation Z's intention to use online health information.*
- *H2: Effort Expectancy (EE) has a positive effect on the intention to keep generation Z regarding the use of online health information.*
- *H3: Social Influence (SI) positively influences generation Z's behavioural intentions regarding the use of online health information.*
- *H4: Facilitating Conditions (FC) have a positive effect on the intention to preserve generation Z to use online health information.*

3. Model Specification

The main idea of the model is, that results from questionnaire are put into four main constructs, which will play the significant role as direct determinants on behavioural intention (BI). Connections of the constructs to the BI are made through the hypotheses, which is shown in Figure 3. The following methods can be used to solve the model and provide hypothesis values:

- maximum likelihood method,
- analysis of variance (ANOVA),
- multivariate analysis of variance (MANOVA),
- adaptive neuro-fuzzy inference system (ANFIS),
- structural equation modelling (SEM),
- partial least square structural equation modelling (PLS-PM).

Figure 3. *The UTAUT model constructs connections idea*



Source: *Own creation.*

In this article we used PLS Path modelling (PLS-PM) at final stage for UTAUT model solution. In PLS-PM each variable X is connected through the path to the latent variable LV (i.e., main construct). The outer model relationships are considered to be linear and mathematically we can write:

$$LV_j = ld_{0j} + ld_{jk} \cdot X_{jk} + res_j \tag{1}$$

where: LV is latent variable for concept, ld_{jk} is loading factor, ld_{0j} is an intercept term, res_j is residual.

Additionally the regression specification can be written as formula below:

$$E\left(LV_j \middle| X_{jk}\right) = ld_{oj} + ld_{jk} \cdot X_{jk} \tag{2}$$

In PLS-PM model, latent variables are calculated as a linear combination of their input variables:

$$\hat{LV}_j = S_j = \sum_k w_{jk} \cdot X_{jk} \tag{3}$$

where: S_j is a score, w_{jk} is a weight.

To solve the task with the use of PLS Path Model the three main steps are needed:

1. calculate the weights to compute latent variable scores,
2. estimate the path coefficients - inner model,
3. obtain the loadings - outer model.

In the second step of PLS-PM solution the path coefficients PC_{ji} are obtained. They are estimated by ordinary least squares in the multiple regression of Y_j on the Y_i:

$$PC_{ji} = \left(S_i' \cdot S_i\right)^{-1} \cdot S_i' \cdot S_j \tag{4}$$

where S_j is given by formula:

$$S_j = \sum_{i \to j} PC_{ji} \cdot S_i \tag{5}$$

To get the other point of view during the analysis we used Fuzzy Cognitive Maps (FCM) which are very effective tool for modelling complex structures. A Fuzzy Cognitive Map is a directed graph where: nodes are factors and branches reflect causal relationships. In FCM the interconnection between each two concepts C_i and C_j is implemented with the directed edge w_{ij}, which indicates the strength of relationships between concepts. There are three possible cases for the weight value:

- $w_{ij} > 0$ indicates a positive causality between two concepts,
- $w_{ij} < 0$ indicates a negative causality between concept two concepts,
- $w_{ij} = 0$ indicates no relationship between concepts.

A concept in a Fuzzy Cognitive Map has the value A_i which express its strength. Each subsequent value of the causal state is calculated by Kosko (Kosko, 1986) using previous state and weight matrix. The relationship is given by the formula:

$$A_i(m+1) = f\left(\sum_{j=1, j\neq 1}^{N} \left(w_{ji} \cdot A_j(m) \right) \right) \tag{6}$$

The value of the particular concept strength is calculated during each step of simulation taking into consideration the influence of all other concepts in weight matrix. In this formula f is the threshold function which can be: bivalent, trivalent, sigmoid and hyperbolic tangent (Nápoles *at al.*, 2017; Sharma and Singh, 2018). In our case the threshold function was sigmoid and expressed below. Parameter λ was set to 1.

$$f(x) = \frac{1}{1 + e^{-\lambda \cdot x}} \tag{7}$$

4. Research Methodology

In this study the established UTAUT model was used to confirm the impact of specific factors on the intention to maintain generation Z in the use of health information available on the Internet. The questionnaire was used as a research tool. The questionnaire consisted of two parts: a basic one containing questions about the studied issues related to 5 measured forecast variables (PE, EE, SI, FC and BI) together with 13 indicators presented in the questions presented in Table 1 and 9 metric questions.

The answers were expressed on a 7-point Likert scale (definitely no, no, rather not, I have no opinion, rather yes, yes, definitely yes). A purposive sampling was used.

The survey was conducted in a group of students of the Lublin University of Technology in June 2019. The group of respondents was a group of 200 students of Computer Science in full-time studies. The survey was conducted in the CAWI (Computer Assisted Web Interview) technique.

Table 1. *List of questions and variables projected*

Statement in questionnaire	Variable	Question indicator
I think websites devoted to health are very useful in the process of taking care of health	PE1	v6_7
Internet access to information / advice on health, disease prevention, proper nutrition, etc. allows me to take better care of my health	PE2	v7_1
It is easy to find health information on the Internet	EE1	v10_1
I have the ability to navigate in a hypertext online environment	EE2	v10_4
When I use the computer and the Internet to get health advice, I usually get what I am looking for	EE3	v10_9
I have the necessary skills to effectively use the computer and the Internet	EE4	v10_10
Using health information available on the Internet fits my lifestyle well	SI1	v12_3
I use electronic services also in other spheres of life (e-taxes, e-banking) and I have positive experience in this area	SI2	v12_5
I have the necessary measures (electricity, computer, laptop, WiFi, software, family support) to use health information available on the Internet	FC1	v13_1
I have the necessary knowledge (e.g. basic computer skills, navigating the Internet) to use health information available on the Internet	FC2	v13_2
I already use health information available on the Internet and will use it in the future	BI1	v18_1
I plan to inform my friends and relatives about the use of health information available on the Internet	BI2	v18_4
I would like to use of health information available on the Internet to a greater extent	BI3	v18_5

Source: *Own creation.*

5. Analysis and Results

5.1 Descriptive Statistics

The dominant group in the survey were men (73.5%), representatives of the generation Z. The most numerous group of respondents (32%) were Lublin

residents. Table 2 contains information on the use of computers and the Internet by the respondents. Respondents use the Internet primarily through computers (95%) and smartphones (95%), every third uses a tablet (35%) and a television (35%) for this purpose. About 86% of respondents say they have been using the computer for over 10 years, while for 14% the use of computers stretched 5-10 years. No one admitted to using a computer for less than five years. They were also experienced Internet users - 65% had over 10 years of Internet experience, 33% had used the Internet for over 5 years, only 2% had used the Internet for 2-5 years. The respondents were also active in social media - 56% of them used them for 5-10 years, every 5th student (18.5%) had been using social media for over 10 years, only 9% of respondents did not use them. The respondents were active Internet users. 48% of them used it for over 6 hours a day. As many as 95% of respondents spent over 3 hours online. Nobody spent less than 0.5 hour during the day on network activity.

Table 2*. Information on the use of computers and the Internet by the respondents*

Variable	Number (%)
The device used for Internet activity	
Computer	190 (95%)
Tablet	35 (17.5%)
Smartfon	190 (95%)
TV	35 (17.5%)
Duration of computer use	
2-5 years	0 (0%)
5-10 years	28 (14%)
More than 10 years	172 (86%)
Duration of Internet use	
2-5 years	4 (2%)
5-10 years	66 (33%)
More than 10 years	130 (65%)
Activity on social media	
I do not engage in such activity	18 (9%)
A month or less	0 (0%)
Several months (up to 1 year)	1 (0.5%)
1-2 years	5 (2.5%)
2-5 years	25 (12.5%)
5-10 years	114 (57%)
More than 10 years	37 (18.5%)

Source: *Own study on the basis of conducted research.*

5.2 Data Analysis

First, the reliability of the measurement of individual constructs was analyzed. The results are shown in Table 3.

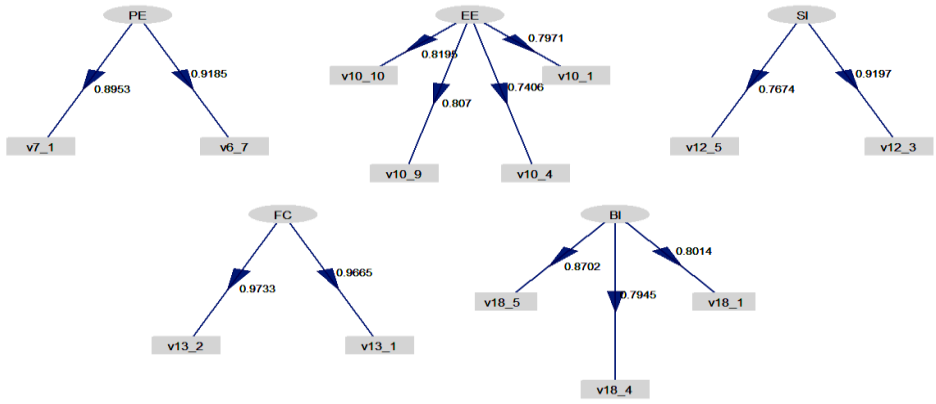
***Table 3**. Reliability and validity of the constructs of the research model*

Factor	Item	Factor loadings	Cronbach α	Rho Dillona-Goldsteina
Performance Expectancy	PE1	0.92	0.76	0.89
	PE2	0.90		
Effort Expectancy	EE1	0.80	0.80	0.87
	EE2	0.74		
	EE3	0.81		
	EE4	0.82		
Social Influence	SI1	0.92	0.65	0.85
	SI2	0.77		
Facilitating Conditions	FC1	0.97	0.92	0.96
	FC2	0.97		
Behavioural Intentions	BI1	0.80	0.75	0.86
	BI2	0.79		
	BI3	0.87		

***Source:** Own study on the basis of conducted research.*

All items in Table 3 have the value of factor loadings higher than 0.5, which confirms convergent validity. According to Hair *et al.* (2010) factor loading estimates should have higher value than 0.5, and excellently the value 0.7 or higher. The data presented in Table 3 show that all constructs are characterized by adequate measurement reliability. The generally accepted Cronbach's value of 0.6 for each variable as a credible limit was met as shown in the table. This proves that the developed research tool in the form of a survey is internally consistent. The Dillon-Goldstein rho index reaches values greater than 0.7, which proves the unidimensional nature of the constructs (Tenenhaus *et al.*, 2005). To verify unidimensionality of reflective blocks the loadings (correlations of variables with latent variables) with questionnaire statements were calculated and shown in Figure 4.

***Figure 4.** Loadings of the reflective blocks of UTAUT model*



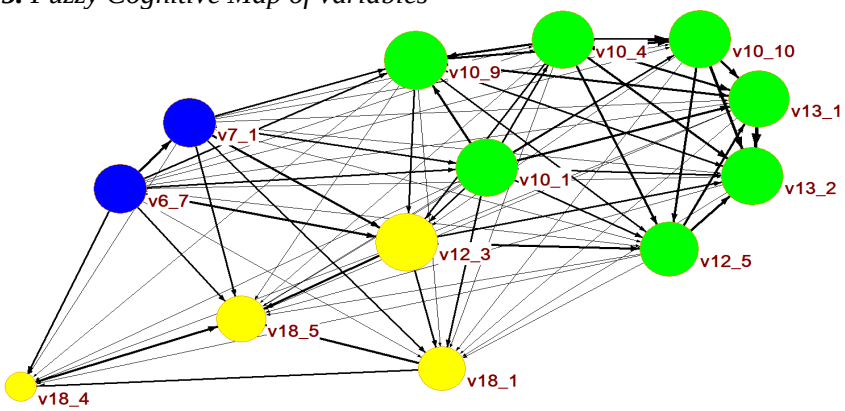
***Source:** Own creation.*

It can be noticed that all loadings have positive sign and value greater than 0.7. This allows us to use PLS-PM method for evaluation of UTAUT model. As the result of calculations we obtain the path coefficient values which gives us the assigned values to the hypotheses H1-H4. The highest values were obtained in case of connections PE→BI=0.2442 and SI→BI=0.4454. Due to the fact, that PLS-PM does not rely on any distributional assumptions, it is useful to obtain information about the variability of the parameter estimates with the use of bootstrap validation. We performed the bootstrap resampling with the value of 200 resamples.

The results of calculations were as follows: PE→BI=0.1125 (perc. 0.025), 0.3895 (perc. 0.975), EE→BI=-0.0810 (perc. 0.025), 0.2687 (perc. 0.975), SI→BI=0.2577 (perc. 0.025), 0.5981 (perc. 0.975), FC→BI=-0.2123 (perc. 0.025), 0.0940 (perc. 0.975). Bootstrap validation is especially important for the path coefficients. For each of the connection the bootstrap confidence interval (95%) provided by the percentiles 0.025 and 0.975 was examined. Path coefficients of Effort Expectancy and Facilitating Conditions on the Behavioural Intention contain the zero in range. Thus we may say that these coefficients are not significant at a 5% confidence level.

We also analyse the data which was input for PLS-PM model with the use of Fuzzy Cognitive Maps. The input for a Fuzzy Cognitive Map is the weight matrix, which represents the relation between the elements (concepts or variables). We calculated the weight matrix as a modified matrix of correlation coefficients between a set of 13 variables. We use the algorithm implemented in the *rcorr* function of the **R** language. After this we used made by us code to modify the matrix values in the following way: diagonal of the matrix set to 0 to remove the self loops in the Fuzzy Cognitive Maps, only the values of correlation coefficients for which P-values smaller than 0.05 were taken into consideration. Next the strength of the elements was calculated. The number of iterations was set to 25 and the activation vector for each variable was set to 1. The results of calculations were presented in the form of energy Fruchterman Reingold graph shown in Figure 5.

Figure 5. *Fuzzy Cognitive Map of variables*



Source: *Own creation.*

In this graph the energy of the whole system is minimised. The nodes are moving until the system reaches its equilibrium state. The circles diameters are proportional to the concept strength and the thickness of the lines is proportional to the relation between elements. Black lines show positive relations between the graph elements. What is interesting FCM gives us additional information comparing to the UTAUT model. We can notice that variables EE2-4 has strong influence on FC1-2 and SI2, as also as PE1-2 on SI1. Taking the look how the variables influence on behavioural intension BI we can see that the strongest impact have PE1-2, EE1 and SI1.

Additionally we checked how the correlation values between the variables interact with Fuzzy Cognitive Maps. There are three groups of variables which are strongly correlated, one marked with green, second marked with yellow and third with blue (Figure 5). It can be noticed that correlations differ from Fuzzy Cognitive Map analysis. For example variables *v*10_1 and *v*12_3 which are not strongly correlated are in the centre of graph close to each other.

6. Conclusions

Two of the four hypotheses were confirmed in the study (H1 and H3) with the use of PLS-PM method. Social influence has proved to be the strongest determinant of the intention to use health information available on the Internet. This result should be interpreted as meaning that persons important to the user (friends, family, teachers or other persons, in any way associated with it, have a direct impact on decisions regarding the use of health network information). It turns out that the decisions taken by the generation Z are strongly influenced by the position of people who are authorities for young people in a given field. Positive experience of using electronic services in other areas of life (e-taxes, e-banking) is also important for respondents. Because they are successful in these areas and are satisfied with them, it encourages them to a similar form of activity when seeking health information.

Research has also shown that other constructs which cannot be proved with the use of PLS-PM method (i.e. expected effort) behave differently when we analyse them with FCM-s. It occurs that the EE1 has an influence on BI. In both analyses the FC (facilitating conditions) does not have strong influence on BI. This demonstrates that students are unlikely to notice problems in accessing and using health information available on the Internet. For the generation Z, navigating the online environment is something very natural and not hassle in everyday life. Facilitating conditions are treated the same. By answering the questions assigned to the variable, facilitating conditions confirm that the necessary knowledge and infrastructure measures to search for health information on the Internet is not something unique and commonly accompanies representatives of the generation Z.

The conducted and presented research showed the possibility of identifying factors influencing the intention of the generation Z to use health information contained on the Internet using the UTAUT model and Fuzzy Cognitive Maps. In further research

we will try to analyse the Z generation behaviour in the time of COVID-19 pandemic. We will try to improve the Fuzzy Cognitive Map classification efficiency with the use of sub maps from other aspects, such as social activities of young people in the area of health information.

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