Fenerbahçe Üniversitesi
Sağlık Bilimleri Dergisi
Cilt 3, Sayı 3, 372-385, 2023

Fenerbahce University
Journal of Health Sciences
Volume 3, Issue 3, 372-385, 2023

FBU-JOHS

# Investigation of the Relationship Between Tiger-Based Nursing Informatics Competencies and Digital Literacy Levels in Nurses: Analysis with Machine Learning Approach

## Hemşirelerde Tiger Temelli Hemşirelik Bilişimi Yetkinlikleri ile Dijital Okuryazarlık Düzeyleri Arasındaki İlişkinin İncelenmesi: Makine Öğrenmesi Yaklaşımı ile Analizi

**Metin YILDIZ[1], Mehmet YILDIZ[2*], Mehmet Salih YILDIRIM[3], Yakup SARPDAĞI[4], Tuğçe KABAK SOLAK[5], Ebubekir KAPLAN[4], Mehmet Emin ATAY[3]**

[1] Sakarya University, Faculty of Health Sciences, Department of Nursing, Sakarya, Türkiye.
[2] Sakarya University of Applied Sciences, Faculty of Technology Health Sciences, Department of Nursing, Sakarya, Türkiye.
[3] Agri Ibrahim Cecen University School of Health, Vocational School of Health Services, Agri, Türkiye.
[4] Van Yuzuncu Yil University, Department of Nursing, Van, Türkiye.
[5] Agri Ibrahim Cecen University, Department of Nursing, Agri, Türkiye.

### Abstract

This study aimed to examine the relationship between nurses' TIGER-based nursing informatics competencies and digital literacy levels. This descriptive and correlational study was conducted at a hospital in eastern Turkey between October 2021 and October 2022. R programming language 4.1.3, G*Power 3.1, and SPSS-22 program were used in the analysis of the study. There was a positive and significant relationship between the mean total score on the TIGER-based assessment of nursing informatics competencies (TANIC) and the mean total score on the Digital Literacy Scale (DLS) ($p<0.05$). The regression model developed to determine the effect of DLS on TANIC level was found to be $F(1,167)=355.786$, $p=0.001$, and 68.1% ($R^2=.681$) of the variance in the dependent variable was explained by the independent variable. The independent variable predicts the dependent variable significantly. Accordingly, DLS has a positive and significant effect on the level of TANIC ($\beta=0.825$; $t(167)=18.862$, $p=0.001$). There is a positive relationship between individuals' TIGER-based nursing informatics competencies and digital literacy levels. Longitudinal studies on nursing informatics are recommended.

**Keywords:** Computer literacy, nursing, technology

### Özet

Bu çalışmanın amacı, hemşirelerin TIGER temelli hemşirelik bilişimi yetkinlikleri ile dijital okuryazarlık düzeyleri arasındaki ilişkiyi incelemektir. Tanımlayıcı ve korelasyonel tipteki bu çalışma Ekim 2021-Ekim 2022 tarihleri arasında Türkiye'nin doğusundaki bir hastanede yürütülmüştür. Çalışmanın analizinde R programlama dili 4.1.3, G*Power 3.1 ve SPSS-22 programı kullanılmıştır. TIGER temelli hemşirelik bilişim yetkinlikleri (TTHBY) toplam puan ortalaması ile Dijital Okuryazarlık Ölçeği (DOÖ) toplam puan ortalaması arasında pozitif ve anlamlı bir ilişki bulunmuştur ($p<0,05$). DOÖ'nün TTHBY düzeyi üzerindeki etkisini belirlemek üzere geliştirilen regresyon modeli $F(1,167)=355,786$, $p=0,001$ olarak bulunmuş ve bağımlı değişkendeki varyansın %68,1'inin ($R^2=,681$) bağımsız değişken tarafından açıklandığı görülmüştür. Bağımsız değişken bağımlı değişkeni anlamlı bir şekilde yordamaktadır. Buna göre, DOÖ'nün TTHBY düzeyi üzerinde pozitif ve anlamlı bir etkisi vardır ($\beta=0,825$; $t(167)=18,862$, $p=0,001$). Bireylerin TIGER temelli hemşirelik bilişimi yetkinlikleri ile dijital okuryazarlık düzeyleri arasında pozitif bir ilişki vardır. Hemşirelik bilişimi konusunda longitudinal çalışmalar yapılması önerilmektedir.

**Anahtar Kelimeler:** Bilgisayar okur yazarlığı, hemşirelik, teknoloji

*Corresponding author: yildizz.metin@gmail.com



DOI: 10.56061/fbujohs.1252026
ORIGINAL ARTICLE

**How to cite (atıf için)**: Yıldız, M., Yıldız M., Yıldırım, M. S., Sarpdağı, Y., Kabak Solak, T., Kaplan, E., & Atay, M. E. (2023). Investigation of the relationship between tiger-based nursing informatics competencies and digital literacy levels in nurses: Analysis with machine learning approach. Fenerbahce University Journal of Health Sciences, 3(3), 372-385. DOI: 10.56061/fbujohs.1252026

*Submission Date: 16.02.2023, Acceptance Date: 23.05.2023, Publication Date: 29.12.2023*

## 1. Introduction

Health informatics is the design, development, adaptation and implementation of innovations based on information communication technologies in the delivery, management and planning of health care (United States National Library of Medicine, 2016). Today, health information systems are used intensively in health institutions for easy, high quality and secure management of health data. Therefore, it is very important for healthcare professionals to have the knowledge and skills to manage health information electronically. The effective and efficient use of information technology in the health field is becoming increasingly important. In this direction, nurses, who are one of the biggest shareholders of the health workforce, should also closely follow technological developments (Bilgiç & Şendir, 2014). There are many definitions of the concept of informatics. The Turkish Language Association defines informatics as: “The regular and rational processing of information, which is used by human beings in communication in technical, economic, and social fields and is the basis of science, especially through electronic tools” (Kabadayı, 2016). According to the American Medical Informatics Association, informatics is the use of data, information, and science for the delivery of health care services and the improvement of human health (McDonald & Levine-Clark, 2017). Nursing informatics has emerged as a result of the use of information technologies in unique nursing knowledge and practices. In 1989, Graves defined nursing informatics as "The use of information science and nursing science together in all areas from planning to evaluation of nursing care" (Bilgiç & Şendir, 2014; Hübner et al., 2018).

Today, nursing is influenced by new information technologies and medical innovations designed to improve patient care. It pushes nurses to practice in an environment that requires competence in human interactions, clinical skills, and information technologies (Hebda & Calderone, 2010).

TIGER (Technology Informatics Guiding Education Reform) provides a technological framework to reorganize the education and professional improvement of 21st century nurses. In response to the initial establishment of the United States of America Office of the National Coordinator for Health Information Technology (ONC) in 2004, the TIGER initiative was officially launched in 2006, when key nursing stakeholders came together for health informatics, education, and practice to empower nursing. TIGER aims to create a nursing future that uses information technologies to improve the safety and quality of nursing care. In this direction, it aims to create an environment that will allow nurses to use information technologies seamlessly to provide safer and higher-quality care (Hebda & Calderone, 2010; Hunter et al., 2013; Hübner et al., 2018).

Digital literacy is the awareness and ability of individuals to appropriately use digital tools and facilities to identify, analyze and synthesize digital resources, create new knowledge, and communicate with others. Digital literacy requires the correct use of different technologies, the ability to reach, produce,

*Corresponding author: yildizz.metin@gmail.com

DOI: 10.56061/fbujohs.1252026
**ORIGINAL ARTICLE**

and share the correct information, and the skills to use technology in learning and teaching processes (Ng, 2012; Üstündağ et al., 2017). Technology is becoming more and more widespread in our daily lives. Technology has affected individuals' reading, writing, listening, and communication/speaking skills. For this reason, individuals must improve their digital literacy skills in order to take advantage of the opportunities offered by technology in modern life. In light of all this information, it is important to investigate TIGER-based nursing informatics and digital literacy among nurses. Starting from this point of view, the study titled "TIGER-Based Nursing Informatics and Digital Literacy in Nurses", aimed to fill a missing gap in the literature and contribute to the enrichment of future relevant studies.

This study was conducted to examine the relationship between TIGER-based nursing informatics competencies and digital literacy levels in nurses.

## 2. Method

### *2.1. Design*

This descriptive and correlational study was conducted with volunteers among nurses working in a public training and research hospital between October 2021 and October 2022. The STROBE guideline (Vandenbroucke et al., 2007) was used in the reporting of this research article.

### *2.2. Dependent and Independent variables*

Dependent variable: TIGER-based assessment of nursing informatics competencies.

Independent Variable: Digital Literacy and demographic characteristics.

### *2.3. Sample*

The population of the research consisted of all nurses working in a public training and research hospital. The sample of the study included nurses (n:169) who had been working in this hospital and agreed to participate in the study. No sampling method was used in the study, and all nurses were tried to be reached. Nurses who agreed to participate in the study were included. In the power analysis performed in line with the results obtained from 169 participants, the power of our study was calculated as 99% at a confidence level of 95% and a medium effect size (Cohen, 1988). Nurses who voluntarily agreed to participate in the study were included in the research. Volunteer individuals working as nurses in the hospital were included in the study. Those who left the questionnaire unfinished were not included in the study.

### *2.4. Data Collection*

Introductory Information Form: The form was created by the researchers and consists of questions regarding the introductory characteristics of individuals.

TIGER-based Assessment of Nursing Informatics Competencies (TANIC): TANIC was developed by Hunter, McGonigle, and Hebda in 2013 to evaluate the nursing informatics competencies of nurses and nurse students and has a 4-point Likert-type response option (1=Novice, 2=Competent, 3=Proficient, 4=Expert) (Hunter et al., 2013). The Turkish validity and reliability study of the tool was performed by Kaynar and Secginli in 2021 (Kaynar & Secginli, 2021). TANIC consists of 85 items and

*Corresponding author: yildizz.metin@gmail.com

DOI: 10.56061/fbujohs.1252026
ORIGINAL ARTICLE

three subscales: “Basic Computer Skills (51 items)”, “Clinical Information Management (9 items)” and “Information Literacy (25 items)”. The Cronbach alpha coefficients of the tool were reported as .94, .95, and .98 for the subscales (Hunter et al., 2013). In our study, the Cronbach alpha value was found to be 0.98.

Digital Literacy Scale (DLS): DLS, developed by Ng (Ng, 2012), is a scale consisting of 17 items and 4 subdimensions: attitude, technical, cognitive, and social. The scale has no reverse-scored item. All items are scored on a 5-point Likert-type scale that is scored from “Strongly Agree” (5), to “Strongly Disagree” (1). The minimum-maximum scores obtainable from the scale are 17 and 85. It was adapted to Turkish by Hamutoğlu et al. (Hamutoğlu et al., 2017). The scale items are answered by the participants on a 5-point Likert structure. All scale items have a positive structure, and there is no reverse-scored item. The standard deviation of the original scale was 0.89, and the internal consistency coefficients determined for its subdimensions ranged from 0.79 to 0.98 (Ng, 2012). Low scores on the subdimensions and the overall DLS indicate insufficient/low digital literacy, and higher scores indicate high digital literacy. In our study, the Cronbach alpha value was found to be 0.97.

This study was collected using a Google online form created by the researchers. Data were collected from those who voluntarily agreed to participate in the study after receiving consent at the beginning of the survey.

### *2.5. Ethical Considerations*

Ethics committee permission was obtained for the study (Date: 19.10.2021; Number: 253). The determination of the individuals to participate in the research was on a voluntary basis. The following ethical principles were fulfilled: “Informed Consent” by explaining the purpose of the research to the individuals, “Confidentiality and Protection of Confidentiality” by stating that the obtained information will be kept confidential, “Respect for Autonomy” by including those who want to participate voluntarily, and “No Harm/Benefit” in general. Permission was obtained from the institution where the research was conducted. Since individual rights should be protected in the research, the Declaration of Helsinki on Human Rights was followed throughout the study.

### *2.6. Limitations*

There may be many factors affecting the informatics competences of nurses. The limitation of the study is that mediator or moderator variables were not included in it.

### *2.7. Data Analysis*

The analysis of the data was made using the SPSS-22 statistical package program. For normal distribution, kurtosis and skewness (-1.5 / +1.5) values were examined (Tabachnick et al., 2007). Independent samples t-test, One-Way Variance (ANOVA), Games-Howell, Pearson correlation test, and Simple Linear Regression Analysis were used to evaluate the data. A p-value of $<0.05$ was considered statistically significant.

Analyses for the estimation of the TANIC variable were performed with the R programming language version 4.1.3. While performing the analyses, ggplot2, hrbrthemes, hexbin, and GGally packages were

used for graphics, SHAPforxgboost and xgboost packages were used for shap graphics. In order to apply and compare machine learning methods, 10-fold cross validation method was applied with caret package. In the caret package used for the cross validation method, knn for K nearest neighbor regression (KNN), svmRadial for Support vector machine regression (SVM), nnet for Artificial neural network regression (ANN), rf for Random forest (RF), xgbLinear for XGBoost, rpart for Decision Tree regression (CART), and glmnet for Regression (REG) functions were used to determine the best performance of the methods.

## 3. Results

Of the nurses participating in the study, 51.5% were male; 55% were single; 73.4% had a bachelor's degree; 74% had an income equal to their expenses; and 56.8% had participated in a program on nursing informatics such as training, course, meeting, conference. The mean age was 28.99±5.41 (years) (Table 1).

**Table 1.** Introductory characteristics of nurses (n=169)

| **Demographic Characteristics** | | **n** | **%** |
|---|---|---|---|
| Gender | Female | 82 | 48.5 |
| | Male | 87 | 51.5 |
| Marital Status | Single | 93 | 55.0 |
| | Married | 76 | 45.0 |
| Education | High school | 15 | 8.9 |
| | Associate degree | 18 | 10.7 |
| | Bachelor's degree | 124 | 73.4 |
| | Postgraduate degree | 12 | 7.1 |
| Monthly income | Income < expenses | 30 | 17.8 |
| | Income = expenses | 125 | 74.0 |
| | Income > expenses | 14 | 8.3 |
| Participation in any program on nursing informatics such as training, course, meeting, conference | Yes | 96 | 56.8 |
| | No | 73 | 43.2 |
| | $\overline{X}$ **±SD (Min-Max)** | | |
| Age (Year) | 28.99±5.41 (18-49) | | |

The mean total score on TANIC was 237.36±58.19. The mean scores on the subscales were 146.49±36.74 for Basic Computer Skills, 24.89±6.65 for Clinical Information Management, and 65.97±18.07 for Information Literacy. The mean total DLS score was 62.30±14.77 (Table 2).

**Table 2.** Nurses' mean scores on tanic, dls, and subscales (n=169)

| **Scales** | $\overline{X}$ **±SD** | **Min** | **Max** |
|---|---|---|---|
| Mean Total TANIC Score | 237.36±58.19 | 87 | 340 |
| Basic Computer Skills | 146.49±36.74 | 52 | 204 |
| Clinical Information Management | 24.89±6.65 | 9 | 36 |
| Information Literacy | 65.97±18.07 | 25 | 100 |
| Mean Total DLS Score | 62.30±14.77 | 17 | 85 |

There was a significant difference between the mean total score of individuals on TANIC and their educational status, monthly income, and status of participation in a program on nursing informatics such as training, course, meeting, or conference ($p<0.05$) (Table 3).

In the post-hoc (Bonferroni) analysis performed to determine which group caused the difference between the mean total TANIC score and educational status, it was determined that the mean score of high school graduates was lower than the mean score of all groups.

There was a significant difference between the mean total score of individuals on the DLS and their educational status and status of participation in a program on nursing informatics such as training, course, meeting, or conference ($p<0.05$) (Table 3).

In the post-hoc (Bonferroni) analysis performed to determine which group caused the difference between the mean total DLS score and educational status, it was determined that the mean score of high school graduates was lower than the mean scores of those who had a bachelor's or postgraduate degree (Table 3).

**Table 3.** Comparison of demographic characteristics of nurses with their mean scores on TANIC and DLS (n=169)

| Demographic Characteristics | | TANIC | | | DLS | |
|---|---|---|---|---|---|---|
| | | n | $\overline{X}$ ±SD | Test and Significance | $\overline{X}$ ±SD | Test and Significance |
| Gender | Female | 82 | 226.54±59.58 | t=-2.377 p=0.019 | 61.52±14.99 | t=-0.668 p=0.505 |
| | Male | 87 | 247.55±55.27 | | 63.04±14.60 | |
| Marital Status | Single | 93 | 232.75±60.74 | | 62.20±14.49 | |
| | Married | 76 | 243.01±54.78 | t=-1.140 p=0.256 | 62.43±15.20 | t=-0.100 p=0.920 |
| Education | High school (1) | 15 | 165.80±74.37 | F=13.458 p=0.001 1<2,3,4 | 47.93±18.54 | F=7.302 p=0.001 1<3,4 |
| | Associate's degree (2) | 18 | 223.33±61.43 | | 59.44±15.65 | |
| | Bachelor's degree (3) | 124 | 243.47±47.82 | | 63.66±13.17 | |
| | Postgraduate degree (4) | 12 | 284.66±55.73 | | 70.58±13.55 | |
| Monthly income | Income < expenses (1) | 30 | 222.30±69.42 | F=3.798 p=0.024 1<3 | 62.03±14.60 | F=1.622 p=0.201 |
| | Income = expenses (2) | 125 | 236.95±54.69 | | 61.61±14.90 | |
| | Income > expenses (3) | 14 | 273.28±50.63 | | 69.07±13.07 | |
| Participation in any program on nursing informatics such as training, course | Yes | 96 | 257.04±50.88 | t=5.456 p=0.001 | 67.15±11.88 | t=5.269 p=0.001 |
| | No | 73 | 211.47±57.36 | | 55.93±15.81 | |

There was a positive and significant relationship between the mean total TANIC score and the mean total DLS score ($p<0.05$) (Table 4).

**Table 4.** Correlation between the mean scores on TANIC and DLS (n=169)

| | | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|---|
| (1) TANIC | r | - | | | | |
| | p | - | | | | |
| (2) Basic Computer Skills | r | .974 | | | | |
| | p | .001 | | | | |
| (3) Clinical Information Management | r | .859 | .773 | | | |
| | p | .001 | .001 | | | |
| (4) Information Literacy | r | .922 | .820 | .825 | | |
| | p | .001 | .001 | .001 | | |
| (5) DLS | r | .825 | .794 | .699 | .784 | |
| | p | .001 | .001 | .001 | .001 | |

The regression model developed to determine the effect of DLS on TANIC level was found to be F (1,167)=355.786, p=0.001, and 68.1% (R2=.681) of the variance in the dependent variable was explained by the independent variable. The independent variable predicts the dependent variable significantly. Accordingly, DLS has a positive and significant effect on the level of TANIC (β=0.825; t (167) =18.862, p=0.001) (Table 5).

**Table 5.** The Results of Simple Linear Regression Analysis Performed to Determine the Effect of DLS on TANIC

| Independent variable | B | SD | β | t | p* |
|---|---|---|---|---|---|
| (Constant) | 34.848 | 11.032 | | 3.159 | 0.002 |
| DLS | 3.250 | 0.172 | 0.825 | 18.862 | 0.001 |
| | | | R=0.825 R2=0.681 | F=355.786 | p=0.001 |

*Simple Linear Regression Analysis**

K nearest neighbor regression (KNN), Support vector machine regression (SVM), Artificial neural network regression (ANN), Random Forest (RF), xgboost regression (xgboost), Decision Tree regression (CART) and Regression (REG) algorithms were used for the prediction of the TANIC variable. Education, Participation in any Program, Income, Gender, Marital and Digital Literacy Scale (DLS) variables were used for TIGER-based Assessment of Nursing Informatics Competencies (TANIC) estimation. In the prediction model, the most accurate parameter value was determined for 7 algorithms by applying 10-fold Cross Validation. In order to find the most accurate parameter value, the data set was divided into 70% train and 30% test data, and the methods were compared. There are 121 observations in train data and 48 observations in test data. In order to determine the most accurate parameter value for the algorithms, the train data is estimated and shown in Figure 1 (Figure 1).

*Corresponding author: yildizz.metin@gmail.com

DOI: 10.56061/fbujohs.1252026
ORIGINAL ARTICLE

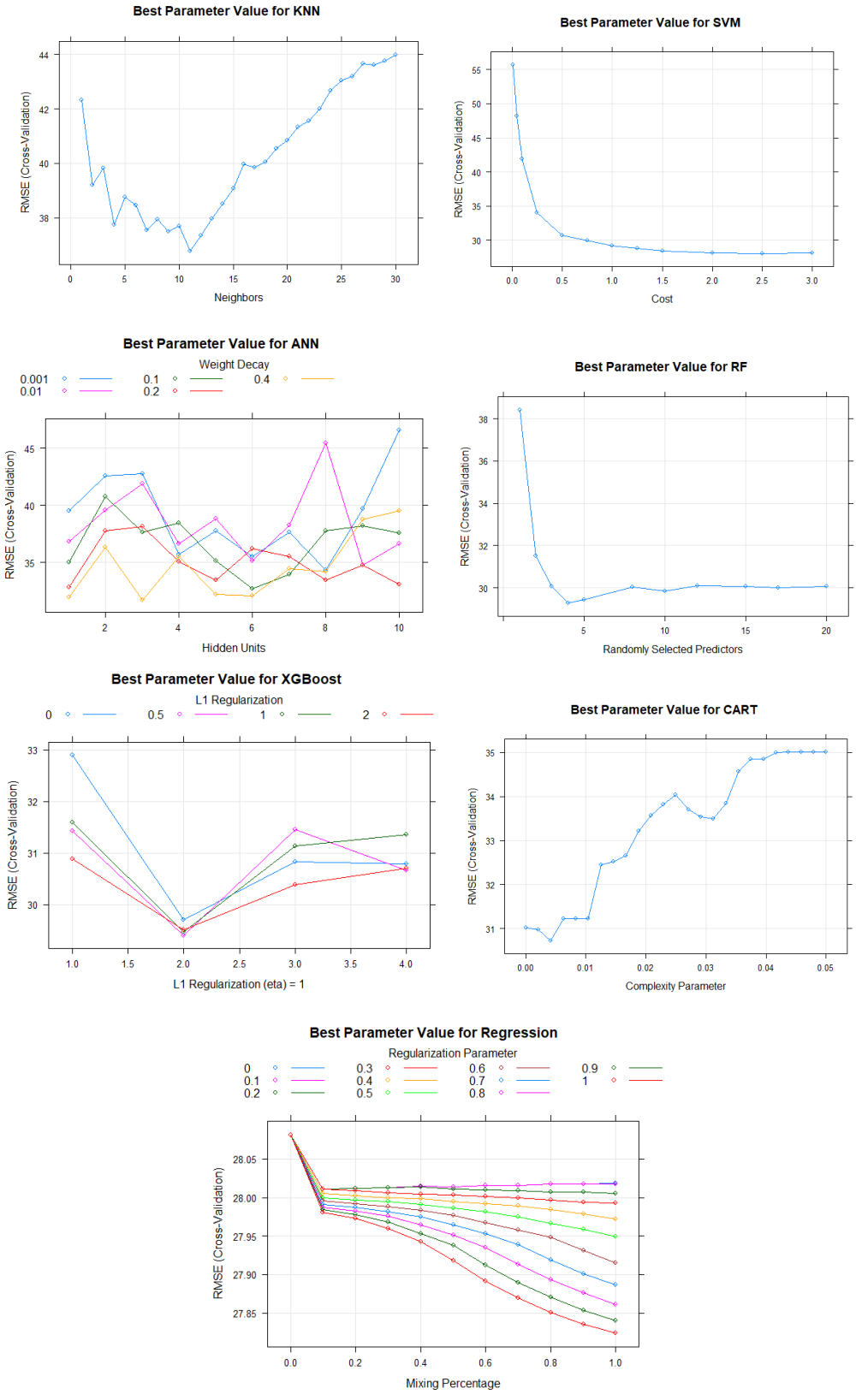


**Figure 1.** KNN, SVM, ANN, RF) XGBoost regression, CART and Lasso Regression algorithms Models used for the estimation of TANIC variable and determining the best parameter value according to the train data

Figure 2 shows the comparison metrics (RMSE, MAE) for the best parameter values. Figure 2 shows the RMSE and MAE values obtained as a result of estimating the most accurate metric values obtained with the train data with the test data. When the metric values are analyzed, although all models except the Lasso REG model produce close and successful predictions, the Lasso REG model gives the most accurate result (Figure 2). R2 values of the methods: ANN 0.4573014, CART 0.5414468, KNN 0.4446882, RF 0.5971887, SVM 0.5522704, XGBoost 0.4081743 and REG 0.6051447. Lasso Regression produces the best result in terms of explanatory probability.

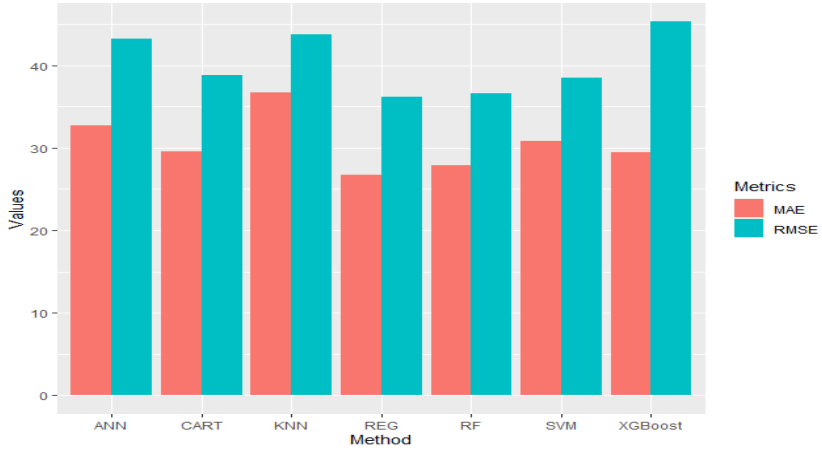


**Figure 2.** The metric values of the methods according to the estimation of the test data

A prediction table can be created for the Lasso REG method. In Figure 3, we can see the test data predicted by the REG model with red lines. The blue lines are the actual test data. Visually, the closer the red lines are to the blue lines, the more successful the prediction model is (Figure 3).

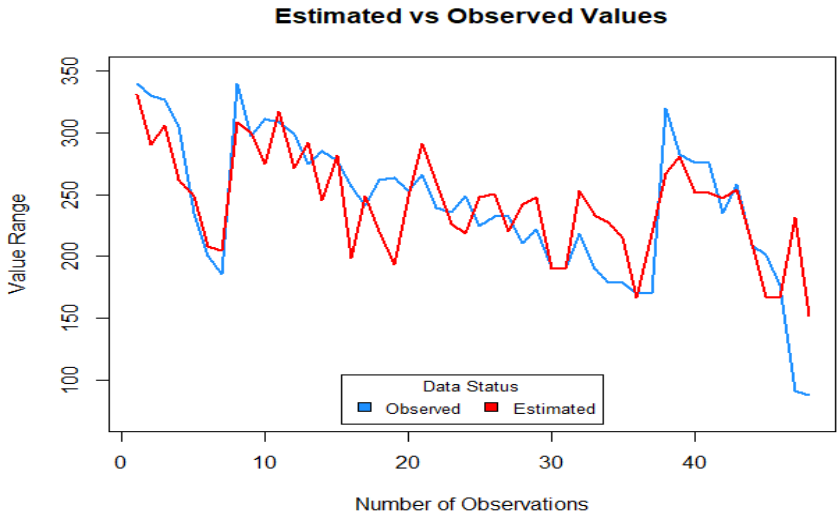


**Figure 3.** TANIC prediction with Lasso Regression method

All variables for the prediction model were compared with the performance of machine learning algorithms. It was then found that the best performing algorithm was Lasso (REG) regression. The contributions of these variables to the model were calculated with Shapley values (Shapley Additive

Explanations (SHAP). The SHAP values of the variables in the best performing model were examined to avoid bias in terms of comparison in the performance criterion. SHAP values (Shapley Additive Explanations) show the contribution or importance of each variable in the estimation of the model. As can be seen in the graph, the most important variable that should be in the model to predict the TANIC variable is the DLS variable (Figure 4).

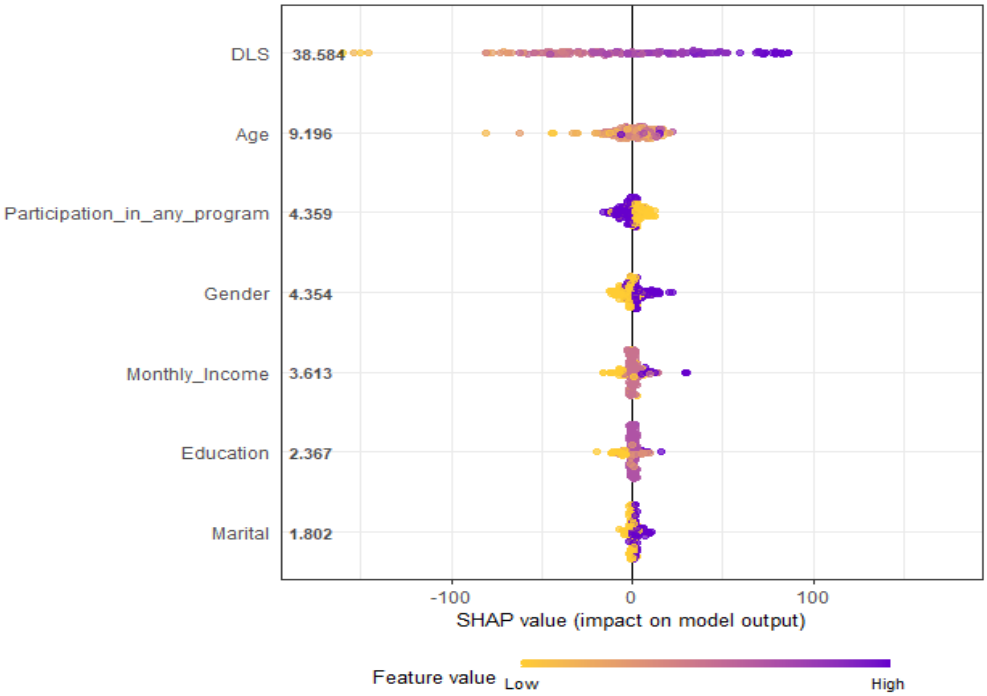


**Figure 4.** Determining the contributions of variables to the model for TANIC estimation with Shapley values

The distribution of TANIC and DLS variables according to education level is given in Figure 5.

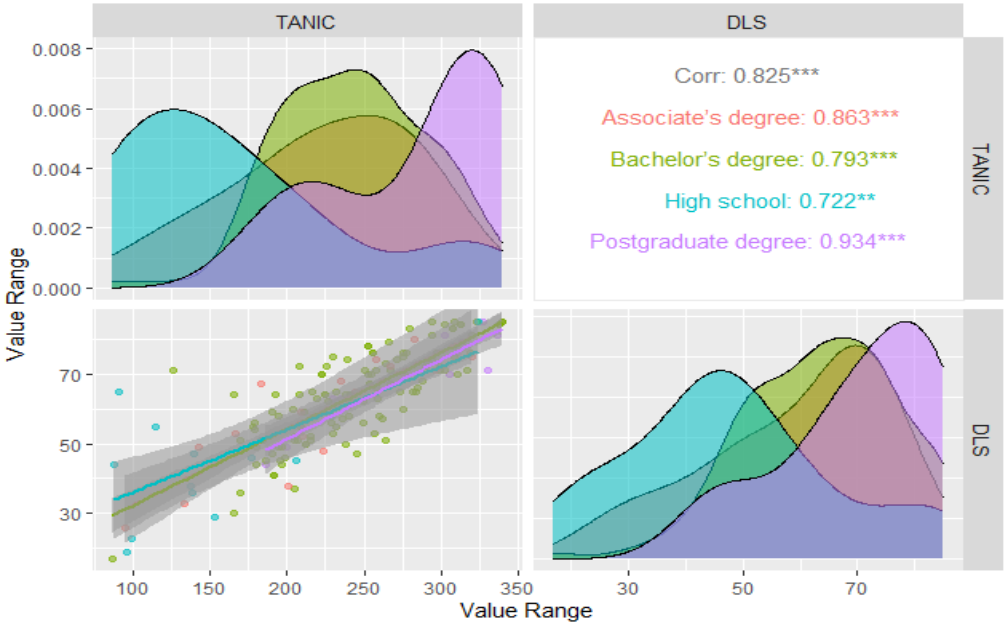


**Figure 5**. Distribution of TANIC and DLS variables depending on education status

*Corresponding author: yildizz.metin@gmail.com

DOI: 10.56061/fbujohs.1252026
ORIGINAL ARTICLE

The pie chart and correlation graph of the variables are given in Figure 6.

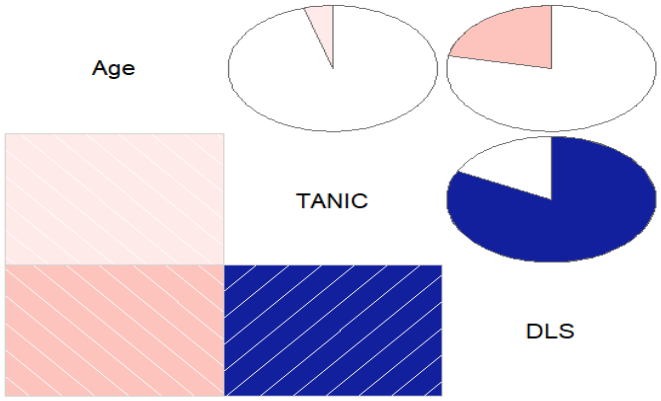


**Figure 6.** Pie chart and correlation graph of variables

## 4. Discussion

Today's rapid technological developments necessitate an improvement in health professionals in the field of informatics and technology for quality health care services. In this direction, the key point for nurses is to increase the quality of patient care by using information systems and technologies (Hebda & Calderone, 2010). It is important for nurses to have digital literacy skills that are defined as the ability to use technology, interpret and understand the content, and conduct research in order to follow developments (Sharma et al., 2019). In this section, the findings are discussed in light of the literature.

The mean scores of the nurses participating in the research showed that the nurses evaluated themselves as "experts" in the basic computer skills subscale and as "proficient and competent" in the clinical information management and information literacy subscales. In the research conducted by Hunter et al., it was determined that individuals expressed themselves as experts in general TIGER competency items whereas their scores in the information literacy subscale were at the novice level (Hunter et al., 2013). According to the study conducted by Kleib and Nagle, although the perception of competence in basic information and communication technology skills is at the highest level, the level of use of information and communication technologies in competencies related to professional practices is low in information management competencies (Kleib & Nagle, 2018). This difference may be due to the fact that the methods used in professional practices, the population participating in the research, the education curricula, and the levels of development are different.

The result showed that the nurses had a moderate level of digital literacy. In the study of Sharma et al., it was found that nursing students had a moderate level of digital health (e-health) literacy (Sharma et al., 2019). Karadas et al. reported that the information and technology literacy of nursing and midwifery students was at a high level (Karadaş et al., 2021). Accordingly, it is important to support nurses in terms of digital literacy during the education period. In order to increase the quality of patient care, the opportunity to use up-to-date, evidence-based technologies and technical support should be provided both in the education process and in in-service training (Staggers et al., 2018). Increasing the level of digital literacy enables nurses to work more comfortably and flexibly in the digital age.

In the research, a significant difference was determined between the mean total score of nurses on TANIC and their educational status, monthly income, and status of participation in a program on nursing informatics such as training, course, meeting, or conference . It was found that nurses who were high school graduates had lower informatics competencies compared to all groups. In their study, Selvili stated that individuals with postgraduate education had a higher level of informatics competencies (Selvili, 2018). It can be said that the courses given on information technologies and informatics in undergraduate education create awareness in the individual about knowing, using technological tools, and integrating them into the clinic (Tatlı et al., 2018). In this study, it was found that nurses whose income was less than their expenses had lower informatics competencies than those whose income was more than their expenses. In the literature, no research has examined monthly income levels and informatics competencies. This result may be attributed to the fact that individuals with high economic levels have a greater opportunity to access and use information and technological tools. According to study results, the level of information of nurses who had participated in a program on nursing informatics such as training, course, meeting, or conference was high. As a result of the programs that nurses attend, they gain the ability to use search engines and databases to access information electronically, put them into practice, and have informatics competency.

In the research, a significant difference was found between the mean total DLS score of the nurses and their educational status and status of participation in a program on nursing informatics such as training, course, meeting, or conference. In the study, it was found that the digital literacy levels of nurses who were high school graduates were lower than those with a bachelor's or postgraduate degree. This result is consistent with some other research results reported in the literature (Aksoy et al., 2021; Erbir, 2021; Yeşildal & Kaya, 2021). Digitalization is increasing with digital and technological tools at every level of the education process. For this reason, it can be said that digital literacy levels increase in parallel with education. In the research, it was found that the level of digital literacy was high among nurses who had participated in a program on nursing informatics, such as training, course, meeting, or conference.

In the research, a positive and significant relationship was determined between the mean total TANIC score and the mean total DLS score. These results show that informatics competencies increase with the increase in the digital literacy level. In line with these results, it is important for nurses to understand the importance of digital literacy in the education process and in-service training, make sense of it, and use it actively in daily life in terms of nursing informatics competencies. In order to increase nursing informatics competencies, nurses should know and read about the types of health information systems and improve clinical integration and decision-making skills. Moreover, informatics applications should be included in the supporting infrastructure of nursing education (Devran & Elitaş, 2017). The lack of relevant studies makes it difficult to evaluate the results of the research. However, the gap in the field addresses the necessity of this research and its originality. Digital literacy and informatics competence in nursing will enablenurses to be more sensitive both in the field and within the scope of lifelong learning and to act faster in making practices evidence-based.

## 5. Conclusion

There is a positive relationship between individuals' TIGER-based nursing informatics competencies and digital literacy levels. In our study, it was found that digital literacy level and TIGER-based nursing informatics competencies affect each other. In the developing and changing world of technology, it is necessary to increase the digital literacy of nurses both as students and in the field, and integrated subjects should be included in the curriculum due to their relationship with nursing informatics. As digital literacy levels increase, TIGER-based nursing informatics competencies increase. Longitudinal studies on nursing informatics are recommended.

## Authors Contributions

Subject selection: MY; Design: MY, MY; Planning: MY, MSY; Data collection and analysis: All authors; Manuscript writing: All authors; Critical revision: MY.


## Aknowledgement

We would like to express our sincere thanks to those who contributed to the relevant literature. We have established our work, the institutions where the work is carried out and all person who chose to participate in the study voluntarily.


## Conflict of Interest

No potential conflict of interest was reported by the authors.

## References


Aksoy, N. C., Karabay, E., & Aksoy, E. (2021). Sınıf öğretmenlerinin dijital okuryazarlık düzeylerinin incelenmesi. Selçuk İletişim, 14(2), 859-894. https://doi.org/10.18094/josc.871290

Bilgiç, Ş., & Şendir, M. (2014). Hemşirelik bilişimi. Cumhuriyet Hemşirelik Dergisi, 3(1), 24-28.

Cohen, J. (1988). The concepts of power analysis. Statistical Power Analysis for the Behavioral Sciences, 2, 1-17.

Devran, Y., & Elitaş, T. (2017). Uzaktan eğitim: Fırsatlar ve tehditler. AJIT-e: Bilişim Teknolojileri Online Dergisi, 8(27), 31-40. https://doi.org/10.5824/1309-1581.2017.2.003.x

Erbir, M. (2021). Hemşirelik mesleğinde dijital okuryazarlık: Kayseri ili örneği. Ekonomi İşletme Siyaset ve Uluslararası İlişkiler Dergisi, 7(2), 336-352.

Hamutoğlu, N. B., Güngören, Ö. C., Uyanık, G. K., & Erdoğan, D. G. (2017). Dijital okuryazarlık ölçeği: Türkçe'ye uyarlama çalışması. Ege Eğitim Dergisi, 18(1), 408-429. https://doi.org/10.12984/egeefd.295306

Hebda, T., & Calderone, T. L. (2010). What nurse educators need to know about the TIGER initiative. Nurse Educator, 35(2), 56-60. https://doi.org/10.1097/NNE.0b013e3181ced83d

Hunter, K. M., McGonigle, D. M., & Hebda, T. L. (2013). TIGER-based measurement of nursing informatics competencies: The development and implementation of an online tool for self-assessment. Journal of Nursing Education and Practice, 3(12), 70. http://dx.doi.org/10.5430/jnep.v3n12p70

Hübner, U., Shaw, T., Thye, J., Egbert, N., de Fatima Marin, H., Chang, P., O'Connor, S., Day, K., Honey, M., & Blake, R. (2018). Technology informatics guiding education reform–TIGER. Methods of Information in Medicine, 57(S 01), e30-e42. http://doi.org/10.3414/ME17-01-0155

Kabadayı, O. (2016). Bilişim dünyasının dili: Sanal ortam Türkçesi. https://turkoloji.cu.edu.tr/pdf/bilisim_dunyasinin_dili.pdf

Karadaş, A., Kaynak, S., Ergün, S., & Karaca, P. P. (2021). Hemşirelik ve ebelik öğrencilerinin 21. yüzyıl becerilerinin bazı değişkenlere göre incelenmesi. Ordu Üniversitesi Hemşirelik Çalışmaları Dergisi, 4(2), 232-239. https://doi.org/10.38108/ouhcd.906190

Kaynar, N. S., & Secginli, S. (2021). Nursing informatics competencies and assessment tools in 21st century. Journal of Education and Research in Nursing, 18(1), 72-77. https://link.gale.com/apps/doc/A681790920/AONE?

Kleib, M., & Nagle, L. (2018). Development of the Canadian nurse informatics competency assessment scale and evaluation of Alberta's registered Nurses' self-perceived informatics competencies. CIN: Computers, Informatics, Nursing, 36(7), 350-358. https://doi.org/10.1097/CIN.0000000000000435

McDonald, J. D., & Levine-Clark, M. (2017). Encyclopedia of library and information sciences. CRC Press.

Ng, W. (2012). Can we teach digital natives digital literacy? Computers & Education, 59(3), 1065-1078. https://doi.org/10.1016/j.compedu.2012.04.016

Selvili, F. N. (2018). Pediatri hemşirelerinin hemşirelik bilişimi yeterliliklerinin belirlenmesi [Yüksek Lisans Tezi]. İstanbul Medipol Üniversitesi. https://acikerisim.medipol.edu.tr/xmlui/handle/20.500.12511/7359

Sharma, S., Oli, N., & Thapa, B. (2019). Electronic health–literacy skills among nursing students. Advances in Medical Education and Practice, 527-532. https://doi.org/10.2147/AMEP.S207353

Staggers, N., Elias, B. L., Makar, E., & Alexander, G. L. (2018). The imperative of solving nurses' usability problems with health information technology. JONA: The Journal of Nursing Administration, 48(4), 191-196. https://doi.org/10.1097/NNA.0000000000000598

Tabachnick, B. G., Fidell, L. S., & Ullman, J. B. (2007). Using multivariate statistics (5th ed.). Pearson Boston, MA.

Tatlı, Z., Aydın, A., Şimşek, P., Özdemir, M., Gölbaşı, S., Karacan, S., Gürsoy, A., & Gündüz, A. (2018). Hemşirelerin ve hemşirelik öğrencilerinin bilişim teknolojilerini kullanma durumları. Ordu Üniversitesi Hemşirelik Çalışmaları Dergisi, 1(1), 18-27.

United States National Library of Medicine. (2016). Health Informatics. https://www.nlm.nih.gov/hsrinfo/informatics.html.

Üstündağ, M. T., Güneş, E., & Bahçivan, E. (2017). Dijital okuryazarlık ölçeğinin Türkçeye uyarlanması ve fen bilgisi öğretmen adaylarının dijital okuryazarlık durumları. Journal of Education and Future, (12), 19-29.

Vandenbroucke, J. P., Elm, E. von, Altman, D. G., Gotzsche, P. C., Mulrow, C. D., Pocock, S. J., Poole, C., Schlesselman, J. J., & Egger, M. (2007). Strengthening the reporting of observational studies in epidemiology (STROBE): Explanation and elaboration. Epidemiology, 18(6), 805–835. https://doi.org/10.1097/EDE.0b013e3181577511

Yeşildal, M., & Kaya, Ş. D. (2021). Yetişkin bireylerde dijital okuryazarlık ve sağlık okuryazarlığı arasındaki ilişki: Konya örneği. Sağlık Bilimleri Dergisi, 30(2), 174-181. https://doi.org/10.34108/eujhs.774808