Predicting undergraduate students' perspectives on the E-learning obstacles with artificial neural networks

The problem and the aim of the study. Educational institutions aim to provide an electronic learning environment that attracts students' interest and encourages them to exchange information, which considers eLearning a convenient way and means to develop. The rapid expansion in using eLearning might lead to obstacles during the teaching process. The present study aimed to investigate the eLearning obstacles from the undergraduate student's perspective at Al-Balqa Applied University through Artificial Neural Networks (ANN).

Research methods. The researchers adopted two types of curricula, the descriptive and analytical approaches. The illustrative method is the definition of e-learning, neural networks and their fields of use and construction, and the application of a questionnaire to identify e-learning obstacles. The analytical approach applies the artificial neural network model to identify e-learning obstacles.

Results. The result of the analyses indicated that there were different level degrees of four obstacle areas from the student's perspective: the most obstacle was faculty member obstacles (100%), followed by the infrastructure and technical support obstacles (95.4%), then university administration obstacles (81.1%), and the last one was the student's obstacles (80.3%). Also, the results showed differences in students' perspectives concerning their majors.

Conclusion. The present study aimed to investigate the eLearning obstacles from the undergraduate student's perspective at Al-Balqa Applied University through Artificial Neural Networks, based on data collected from answers students on a questionnaire. The literature review indicated that neural networks outperform all other classifiers in prediction accuracy. A multi-layer neural network has been trained through a backpropagation algorithm to predict e-learning obstacles. The accuracy rate of the classification was very high. The results show the differences in students' expected predictions for e-learning obstacles according to the student major. The order of the student predictions for eLearning obstacles from most important to least important was as follows: faculty member obstacles, faculty member obstacles, infrastructure and technical support, university administration and the student's barriers. The reality of the application of e-learning showed that undergraduate students of Princess Alia University College had a negative perspective on eLearning. The study recommended improving the capability of the students' academic advisors in employing e-learning through training to improve their proficiency in using e-learning.

Keywords: students' perspectives, eLearning, undergraduate students, artificial neural networks, multilayer perception model, Al-Balqa Applied University, predicting, obstacles

For Reference:
Modern technology is considered one of the most important means of learning and teaching. It has been used effectively in scholarly communication since communication depends on computer devices, including local information sources and global sources, photos, drawings and films and other services. Computer and communication technology devices remove the obstacles of time and location for the student. It's undeniable that eLearning allows a broader range of people in society, especially college students, to gain access to education and training, remove barriers of distance and time, and lower the overall cost of that education over time [1].

The development of information and communication technology has led to the use of eLearning in teaching more than before. Notably, after the COVID-19 pandemic, whether learning is synchronous or asynchronous learning, one of the advantages of using communication technology tools in eLearning is direct communication between learners, immediate response from the teacher to learners' questions, low transportation costs, and consideration of time, especially for learners [1]. Many studies have dealt with eLearning. Numerous challenges accompany this approach, and lack of skills is the main obstacle to eLearning. Participants were not satisfied with eLearning as the sole method for undergraduate teaching. The absence of students' electronic literacy is compatible with the study of Özncar, Dericioğlu [2], the poor administration, the lack of material resources and equipment, the educational training, and students speaking in a professional context [3]. In contrast, Alqudah, Jamal, Saleh, Khader, Obeidat [4] investigated the eLearning experience of academic ophthalmologist students in Jordan during (COVID-19). The results showed that the flexibility of time and place was a significant advantage of eLearning.

The present study aimed to investigate the eLearning obstacles from the undergraduate student's perspective at Al-Balqa Applied University through Artificial Neural Networks (ANN). The importance of this study is to improve the teaching methods among undergraduate students in different majors, treat the opposing sides and overcome obstacles of eLearning and provide information to decision-makers about the eLearning obstacles to find solutions in the future. To the researchers' knowledge, this study is considered the first to address the prediction of eLearning obstacles from the undergraduate student's perspective at Al-Balqa Applied University through Artificial Neural Networks (ANN).

The study problem stems from the influence of the obstacles from the undergraduate student's perspective at Al-Balqa Applied university / Princes Alia University College. So, this study came to know the significant obstacles facing eLearning by assuring the following questions:

1. What are the most critical obstacles to eLearning from the undergraduate student's perspective at Al-Balqa Applied university?
2. Are the obstacles facing the undergraduate student's perspective at Al-Balqa Applied university differ due to majors?
Materials and methods

The researchers adopted two types of curricula, the descriptive and analytical approaches. The descriptive method is the definition of e-learning, neural networks and their fields of use and construction, and the application of a questionnaire to identify e-learning obstacles. The analytical approach applies the artificial neural network model to identify e-learning obstacles.

The researchers have followed the survey method in this study using a questionnaire to determine the most critical obstacles facing eLearning from an undergraduate student’s perspective.

The study population consisted of (186) female undergraduate students in three different majors, child education (ChE) (80) students’, special education (EpE) (50) students’, and educational counselling (CoE) (56) students at Al-Balqa Applied University for the year 2021-2022. To achieve the study’s objectives, the researchers developed a questionnaire to determine the critical eLearning obstacles from undergraduate students’ perspectives. They designed the questionnaire by the researchers after referring to the previous studies related to the present research. The questionnaire in its preliminary form consisted of 39 items; each item included five degrees expressing various levels starting from very satisfied = 5 points, somewhat satisfied = 4 points, neither satisfied nor dissatisfied = 3 points, somewhat disappointed = 2 points, and very unhappy = 1 point.

Six experts in education specialising in teaching the teaching curriculum and learning reviewed the questionnaire. The researchers asked them to present their opinions regarding what they see as relevant from addition, omission, or modification regarding the soundness of the questionnaire items and the appropriate linguistic wording.

Considering the reviewers’ opinions, the relevant modifications performed by the (80%) agreement between the judges for the items’ final number to be (35) paragraphs distributed over four areas: University Administration (8) paragraphs, the faculty members (9) statements, infrastructure and technical support (9) statements and the students (9) statements.

Then confirm the reliability of the questionnaire by applying it to a pilot sample from outside the study populations, consisting of 30 female students, then calculate the reliability coefficient using the Cronbach Alpha equation with a value of (0.85).

Variables used to build the ANN:

The independent variables are; child education, special education, and educational counselling.

The dependent variables are; the university Administration, the faculty members, the infrastructure and technology and the students.

Research Program

To achieve the objective of the current study, the researchers took the following procedures:
1. The researchers prepare the questionnaire to find undergraduate students’ perspectives on eLearning obstacles.
2. The researchers introduced the questionnaire to the reviewers and made the relevant modification based on their perspectives.
3. The researchers applied the questionnaire to a pilot sample to calculate the stability coefficient.
4. Applying the questionnaire to the study sample, undergraduate students at Al-Balqa Applied University / their majors were child education students, special education students, and educational counselling students.
5. Collecting the data and then analysing it statistically.

The Artificial Neural Networks (ANN) model was built and tested its accuracy using the IBM SPSS Statistics 20 (MLP) module. The input/output variables pair prepared were transforming Normalisation. No specific method exists in the classification of data encountered. According to Dobbin, Simon [5], the data is 80% training and 20% training or 70% training and 30% testing. In this study, the researchers randomly assigned to exercise (60%), testing (20%) and holdouts (10%) and used the holdout data to validate the model [6].

The automatic architecture ANN model selected three minimum units in the hidden layer and 50 maximum units in the hidden layer. Therefore, the hyperbolic tangent function was determined to be the interlayer activation function for the output layer. The researchers used the scaled conjugate gradient batch training to train the ANN. According to Marwala [7], the conjugate gradient method solves optimisation problems and is more computationally efficient than the gradient descent.

**Literature review**

E-learning is a method of learning using modern communication technology mechanisms such as computers and networks, searching mechanisms, electronic libraries, internet portals, and various media such as show movement, images, graphics, and sound, whether remotely or in the classroom. The important thing is to use all kinds of technology to deliver information to the learners in less time and effort, with more profit [8].

Studies confirm that learning via the electronic network provides the best methods, means, and techniques to create an educational learning environment that attracts the learners' interests and urges them to exchange opinions and experiences. In addition, the a great possibility of working on cooperative projects between different schools and universities so that learners develop their knowledge of topics of interest to them through contacting colleagues and experts with the same interests [9].

They also have the responsibility to search for and formulate information, which leads to their thinking skills. Communication via the electronic network develops writing skills, providing students and teachers with written texts on various topics and levels [10].

Meanwhile, several studies have addressed the eLearning obstacles from the students' perspectives, such as the investigations of Barakat, Ahmad, Shahen [8]. The study of Barakat, Ahmad, Shahen [8] aimed to identify the barriers to using e-learning obstacles related to (administrative, material, teacher, student, and e-learning). The results showed that barriers to administration and material came first, followed by barriers related to teacher and student. Third place is the obstacles of e-education, in the study of Al-Edwan, Abueita [11] aimed to know the eLearning problems in the shadow of the pandemic of COVID-19 from a
graduate student’s perspective at Al-Balqa Applied University. The study results showed the most critical weak were the internet and the instability of the academic links.

In contrast, a survey by Sujarwo, Sukmawati, Akhirudin, Ridwan, Sirajuddin [12] aimed to examine students' perspectives on internet-based learning and the extent of internet-based learning’s benefits in the shadow of the Corona pandemic. The study showed that students did not use learning through the internet before the pandemic because teaching was face-to-face in the classroom. However, with the prevalence of Corona pandemic, students became interested in using the vast knowledge of the internet, which can be flexible at any time and place. One can conclude that the COVID-19 pandemic positively influenced the student’s perspective on learning through the internet. The study of Abdul-Hussein, Ibrahim [13] objective was to determine the reality of eLearning and the barriers to its implementation in higher education from the perspective of the students at the Great Imam University College in Iraq. In addition to standing on the reality of the infrastructure in the college. The study adopted a descriptive methodology, with (463) college students making up the study sample. They were then given an electronic questionnaire with 22 items. The most noticeable results of the study showed that the reality of e-learning at the College of the Great Imam came at an average level. The results also showed a barrier between the students and the teachers. The results also revealed the weakness of the infrastructure in the college departments. The study of Coman, Țîru, Schmitz, Stanciu, Bularca [14] shed light on determining how the Romanian universe could provide knowledge during the pandemic when universities decided to adapt to the educational process for learning and teaching exclusivity through the internet. The perspective of what 762 students thought about learning through the internet and how well they understood the information. The results revealed that higher education institutions in Romania were not ready for learning through internet exclusivity.

Along the same line, other studies identified the advantages of learning through the internet were low in value while the defects became obvious. The technical problems were the most important, followed by the teachers' lack of technical skills and their teaching method inappropriately adapted to it concerning the internet environment, lack of student interaction with the teachers or work communicatively with them. Alnagar [15] aimed to examine the extent of student satisfaction with e-learning at Tabuk University using artificial neural networks to identify the factors that affect student satisfaction. The study utilised a survey questionnaire that included 321 participants. The model predicted student satisfaction with e-learning for each 92.2% correct classification rate. The study of Rashid, Yadav [16] goal was to find out how students at the College of Education of the Iraqi University use eLearning platforms (using the Edmodo platform as an example).

The research findings indicated that students could use the platform and learn about its components and how to obtain scientific material. According to Rasheed, the disadvantages of the Edmodo platform are that students have faced many difficulties, one of which is the poor availability of internet networks throughout the country, villages, and countryside regions. The study of Borayah, Aqoon [17] aimed to uncover obstacles to the application of e-education from students' viewpoint in the Faculty of Humanities and Social Sciences. The results showed that the main barriers from the student's perspective were
the availability of material resources and equipment, the level of training and education, and the availability of platforms and programs to achieve average e-education. Herwiana, Laili [18] explored the benefits and pitfalls of student experiences while learning online during the COVID-19 pandemic. The study was a qualitative research design with an objective analysis. The study showed that students became tech-savvy and had more positive attitudes. However, the obstacles were difficulty understanding the course material, poor communication between students, poor time management, lack of a lecturer's guide, too many assignments, and cheating in exams. Alfayez [19] explored the reality of Saudi learners' acceptance of Massive Open Online Courses (MOOC) platforms in the Light of the Technology Acceptance Model (TAM). The researchers adopted a descriptive methodology, and the survey included responses from 1583 students. The results indicated that most Saudi learners accepted MOOCs platforms represented by the Doroob platform and had a positive attitude towards the intention to use Doroob. Also, there were statistically significant differences between students' educational levels. The holders of a bachelor's degree have a higher acceptance of Doroob than the learners with a high school diploma, master's, and doctorate.

By examining the barriers to eLearning applications in universities, the researchers concluded that while the titles of the earlier studies differed, they were all characterised by convergence in their coverage of the same subject.

The current study benefited from the previous studies in developing the study tool and classifying the challenges into four areas. This study differs from the earlier studies by using the artificial neural network to predict the obstacles of e-learning. According to the researchers, no studies used neural networks in data analysis prediction.

Contemporary studies in various fields of science have dealt with several quantitative or qualitative methods, and processing these multiple data has led to the emergence of a new branch in statistics that results in numerous data that require more complex statistical methods. Researchers have successfully used deep learning techniques to simulate the spatial navigation capabilities of the human brain in multiple joint research projects between scientists from various disciplines, opening up new research directions for the application of artificial intelligence technology [20].

Neural networks are one of the most powerful types of artificial intelligence, as they simulate the dynamic neural network in the human brain [21]. Principles and techniques from machine learning and artificial intelligence have helped predictive research and answer more predictive questions than more explanatory ones. Artificial neural networks represent a new technology that has emerged as a potential alternative to regression analysis and other classical statistical methods under certain conditions [22].

As presented in Figure (1), an Artificial Neural Networks (ANN) model consists of an interconnected set of neural networks and processed information using an associative approach to computing [23]. The ANN model operates in diverse areas of information systems such as eLearning [23]. Networks are separated into multiple layers, whereas the first layer is the input layer, which feeds data into the grid. The last layer is the output layer, which provides the results, and between the input and output layers, one can find one or more hidden layers for data processing.

Figure 1: A simple concept of a biological neural network and an artificial neural network.
In this ANN analysis, the student’s perspective of the obstacles taken as the input variable, also called the input layer, corresponds to the independent variable in statistics. The predictive variables are the four dimensions of the obstacle university administration, the faculty members, infrastructure and technical support, and the students.

**Research results**

To answer the first question, "What are the most important eLearning obstacles from an undergraduate student's perspective?" The researchers conducted this study to investigate the undergraduate student's perspective on eLearning obstacles and to create MLP neural network models to analyse the data. The run summary of data in the ANN analysis appeared in Table 1.

**Table 1**

<table>
<thead>
<tr>
<th>Sample</th>
<th>N</th>
<th>Per cent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Training</td>
<td>116</td>
<td>62.4%</td>
</tr>
<tr>
<td>Testing</td>
<td>49</td>
<td>26.3%</td>
</tr>
<tr>
<td>Holdout</td>
<td>21</td>
<td>11.3%</td>
</tr>
<tr>
<td>Valid</td>
<td>186</td>
<td>100.0%</td>
</tr>
<tr>
<td>Excluded</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>186</td>
<td></td>
</tr>
</tbody>
</table>

Table 1 shows that the whole data set splits into training (62.4%, n=116), testing (226.3%, n=49), Holdout (11.3%, n=21) and validation 100%. All data used were valid, and no excluded data.
The model summary, shown in Table 2, provides information related to the results of training (and testing) and holdout sample

<table>
<thead>
<tr>
<th>Training</th>
<th>Sum of Squares Error</th>
<th>.079</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Relative Error</td>
<td>.001</td>
</tr>
<tr>
<td></td>
<td>Stopping Rule Used</td>
<td>Ten consecutive step(s) with no decrease in error</td>
</tr>
<tr>
<td></td>
<td>Training Time</td>
<td>00:00:00.000</td>
</tr>
<tr>
<td>Testing</td>
<td>Sum of Squares Error</td>
<td>.030</td>
</tr>
<tr>
<td></td>
<td>Relative Error</td>
<td>.002</td>
</tr>
<tr>
<td>Holdout</td>
<td>Relative Error</td>
<td>.001</td>
</tr>
</tbody>
</table>

Table 2

Dependent Variable: Total Pers

* Error computations are based on the testing sample.

The structure of the established ANN model and the neural networks appear in Figure 2. The Sum of Squares Error and Relative Error found for the training level were .079 and .001, while the values for the testing level were .030 and .002. The Relative Error for the validation levels was .001 indicates the power of the model to predict and the significance of independent variables influencing students' perspectives. Figure 2 gives the effect of each independent variable in the ANN model in terms of relative and normative significance. The weights of linking for artificial neural cells in the web could determine the independent variables' importance rates, which are presented and defined in percentages.

**Figure 2** The structure of the established ANN model and the neural networks
Analysis of both Figure 2 and Figure 3 reveals that faculty members were the most crucial variable in the ANN diagram for undergraduate students' perspective of the eLearning obstacles.

The second question: "Are the obstacles facing the undergraduate student's perspective at Al-Balqa Applied university differ due to majors?"

In answering the second question, the researchers calculated the means and standard deviations of the obstacles facing undergraduate students at Al-Balqa Applied University according to their major. Then an ANOVA test was conducted for the barriers, as shown in tables 3 and 4.

Table 3

<table>
<thead>
<tr>
<th>Major</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Std. Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>ChE</td>
<td>80</td>
<td>32.3750</td>
<td>6.60911</td>
<td>.73892</td>
</tr>
<tr>
<td>EpE</td>
<td>50</td>
<td>33.4800</td>
<td>7.00216</td>
<td>.99025</td>
</tr>
<tr>
<td>COE</td>
<td>56</td>
<td>33.1964</td>
<td>5.33060</td>
<td>.71233</td>
</tr>
<tr>
<td>Total</td>
<td>186</td>
<td>32.9194</td>
<td>6.35005</td>
<td>.46561</td>
</tr>
<tr>
<td>ChE</td>
<td>80</td>
<td>30.4125</td>
<td>7.12047</td>
<td>.79609</td>
</tr>
<tr>
<td>EpE</td>
<td>50</td>
<td>35.1200</td>
<td>4.93897</td>
<td>.69848</td>
</tr>
<tr>
<td>COE</td>
<td>56</td>
<td>34.7679</td>
<td>4.80148</td>
<td>.64162</td>
</tr>
<tr>
<td>Total</td>
<td>186</td>
<td>32.9892</td>
<td>6.32626</td>
<td>.46386</td>
</tr>
</tbody>
</table>
The results of (the ANOVA) of the majors' means showed a significant difference between them in three areas. Yet, in the student's place, it showed no significant difference between majors at the significance level (0.05) since the (F) value reached (.539).

There were statistically significant differences in infrastructure and technical support obstacles in favour of the particular education major, educational counselling, and child education.

There were statistically significant differences related to the university administration obstacles. These differences include the educational counselling major, special education, and child education.

There were statistically significant differences related to faculty members' obstacles. The differences came in favour of the particular education major, child education, and educational counselling.

### Discussion

The researchers attributed the results of the first question to the fact that most faculty members relied on face-to-face learning. Their plans did not include the adoption of e-learning, so the students noticed the weak experience of faculty members in the field of e-learning, and this type of education is a novelty that needs practice and improvement.
of faculty member skills. The students consider that the faculty members are the closest and most people they communicate with them. The students turn to the faculty members when they face obstacles and problems. Therefore, they feel the weakness of the faculty members in using e-learning. This weakness is due to the lack of incentives for those who master and use e-learning, the weak financial support needed to employ e-learning, the absence of reward that encourages continuity, and its lack of material, human and on-the-ground capabilities to promote e-learning. These results in consistent with previous studies, such as the study of Coman, Țiru, Schmitz, Stanciu, Bularca [14] that teachers lack technical skills and teaching practice.

The following variable belonging to the faculty members' obstacles is infrastructure and technical support obstacles (95.4%). The researchers attribute that to the insufficient infrastructure capabilities availability compared to the number of undergraduate students. E-Learning requires an infrastructure of computers, the internet and software for the university to ensure the participation of the most significant number of students in eLearning. Despite the deficiency of infrastructure capabilities availability as computer labs at the university, the students are not allowed to use them for daily assignments. The devices have allocated laboratories to perform exams only. This finding aligns with some studies, such as the study of Abueita [1].

University Administration obstacles were (81.1%). This result is due to the lack of material capabilities and human experience. The university management systems consider eLearning a secondary issue. It lacks comprehensive visions, and our universities' decision-makers are unaware of the eLearning philosophy. This finding aligns with some studies, such as the study of Özncar, Dericioğlu [2] research and Barakat, Ahmad, Shahen [8], which reported that administrative and material obstacles came first from the viewpoint of secondary school teachers. The researchers attributed this to the lack of financial capabilities to start eLearning work.

Students' obstacles were (80.3%). These variables have minor significant barriers, and this is due to the lack of an eLearning culture because of the lack of training, the provision of appropriate preparation for this type of education, the eLearning goals are not clear to them, and the students' preoccupation with sites unrelated to eLearning. The weakness of students in responding and interacting with eLearning is due to the lack of proficiency in the skills to use it, and the university does not offer courses to train them in investing time skills. This finding aligns with some studies, such as the study of Alqudah et al. [4], Borayah, Aqoon [17], Herwiana, Laili [18]. However, the study of Rashid, Yadav [16] does not align with the result of this study, which indicated that students had skills to use the platform and navigate to get information about the subject content.

These results show that undergraduate students have a negative perspective on eLearning. The recent study's results are inconsistent with previous studies' outcomes, such as Alqudah, Jamal, Saleh, Khader, Obeidat [4], that stated that participants were dissatisfied with eLearning as the sole method [18] and [3]. Learning online from the students' perspectives has positively influenced Corona Pandemic. However, the studies of Rashid, Yadav[16], Coman et al. [14] and Sujarwo et al. [12] disagree with the recent study results because learning through the internet has many advantages. One of these advantages is flexibility in reaching the internet at any time and place.
The results of (the ANOVA) of the majors’ means showed a significant difference between them in three areas. The result agrees with the results of Borayah, Aqoon [17], Al-Edwan, Abueita [11], Alnagar [15], Etfita et al. [3] and [18] studies. Yet, in the student's place, it showed no significant difference between majors at the significance level (0.05) since the (F) value reached (.539). The students with different majors shared similar challenges concerning access to resources, teachers, and course content. They agreed that the most significant obstacles were faculty members, infrastructure, technical support, and university administration.

There were statistically significant differences in infrastructure and technical support obstacles in favour of the particular education major, educational counselling, and child education. There were statistically significant differences related to the university administration obstacles. These differences include the educational counselling major, special education, and child education. This result is because the academic counsellors communicate with the administration more than the other two majors. They realise the role and nature of the work of the educational administration in developing the educational process.

There were statistically significant differences related to faculty members' obstacles. The differences came in favour of the particular education major, then child education, and then educational counselling; this is because the nature of the work of these two majors is teaching, so they realised the importance of the teaching member possessing the skills and competence for the educational process's success. The result aligns with the results of Barayah, Aqoon[17], Al-Edwan, Abueita [11], Alqudah et al. [4] studies.

**Conclusion**

The government should make a group of procedures to motivate and facilitate the adaptation to the eLearning to enable the universities to develop training courses for the teachers or develop programs to encourage the teachers’ role and performance to guarantee the quality of the teaching process. Also, schools should consider the planning for innovative usage of the eLearning planning strategies since the students' perspective will improve eLearning after experiencing some of the benefits and when enjoying a new eLearning experience. Technical problems are the most difficult to solve because of the server's volume processed by the universities. Al-Balqa Applied University has tried solving these problems and improving the work of eLearning platforms. Still, technical issues face the students, including ineffective communication with the internet shortage in the relevant digital devices, especially for students who live in far regions or from low-income families. Universities can build programs to satisfy these needs and help students to overcome these situations.

**Abbreviation**

ChE: Child Education.
EPE: Special Education.
CoE: Educational Counselling.
UnAd: University Administration.
FacMe: Faculty Members.
FrcTech: Infrastructure and Technical Support
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