

**Review Article**

# Artificial Neural Networks in E-Learning Personalization: A Review

**Rana Khudhair Abbas Ahmed**

Computer Techniques Engineering Department, Alrafidain University College, Baghdad, Iraq

**Email address:**

rana\_ruc@yahoo.com

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**Abstract:** Finding the appropriate personalized learning resources is a difficult process for users and learners on the web. Artificial Neural Networks show a great significance in helping users in personalizing their own learning interests from a large number of resources by giving suggestions to users and learners based on their preferences and all of this with less time and effort. This paper discusses the importance of using neural networks in E-Learning personalization and shows some current applications of them with their improvements and limitations.

**Keywords:** E-Learning, Personalization, Neural Networks, Artificial Intelligence, Applications

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## 1. Introduction

Artificial Neural Networks are relatively crude electronic models based on the neural structure of the brain. The brain basically learns from experience. It is natural proof that some problems that are beyond the scope of current computers are indeed solvable by small energy efficient packages. This brain modeling also promises a less technical way to develop machine solutions. This new approach to computing also provides a more graceful degradation during system overload than its more traditional counterparts [1].

These biologically inspired methods of computing are thought to be the next major advancement in the computing industry. Even simple animal brains are capable of functions that are currently impossible for computers. Computers do rote things well, like keeping ledgers or performing complex math. But computers have trouble recognizing even simple patterns much less generalizing those patterns of the past into actions of the future [1].

E-Learning is the use of technology to enable people to learn anytime and anywhere. E-Learning is internet enabled learning. By making use of video conference, live lecture can be conducted which supports audio, chat and whiteboard. By communication with students, sharing of applications becomes easy [2].

Recently, E-Learning has become an active field of research and experimentation, with remarkable investments from all parts of the world. It represents the Web-based delivery of personalized, comprehensive, dynamic learning contents, aiding the development of communities of knowledge, linking learners and practitioners with experts. E-Learning supports the different phases of traditional learning and in some cases it is the only possible method of learning, allowing knowledge acquisition also in particular conditions (e.g. impaired students, absence of teaching structures, etc.). In this context, an important role is played by the definition of educational structure that must be contextualized and tailored on the basis of the requirements of: i) teachers, who have personal teaching approaches, and ii) students, who have personal studying approaches [3].

Personalized learning technological systems support learners to set their own learning goals, manage their learning, managing both content and process, communicate with others in the process of learning, and thereby achieve learning goals. These systems may be composed of one or more sub-systems which may in turn built on desktop based application or on web-based services [4].

## 2. Theoretical Background

E-Learning is a delivery of learning, training or education programs by electronic means. It involves the use of a computer or electronic device in some way to provide training, educational or learning material. E-Learning is the use of technology and services to deliver curricula and to facilitate learning. Delivering education in E-Learning is a tool used within each point of the education process and powerfully coordinates the organization. The following seven great reasons to use E-Learning are: Scalable/Efficient and Fast, Capacity and consistency, Higher Learning Retention than traditional learning, E-Learning saves you time and money, Measuring learning activity and proving return on investment, Reduce your carbon footprint, Flexibility and finding hard to reach people [5].

The main advantage of E-Learning is the use of technology to enable people to learn anytime and anywhere. E-Learning is more cost effective than traditional learning because less time and no travel expenses. The various types of E-Learning are: means of communication, schedule, E-Learning class structure, Technologies used [5].

Artificial Intelligence (AI) utilizes programming algorithms to simulate thought processes and reasoning that produce behavior similar to humans. A successful implementation of AI could be tested using a Turing Test approach, in which a human interacts with an interface that could have either a human or computer on the other end. The test is considered successful if the human is unable to determine whether there is a computer or a human on the other end. The applications of AI within E-Learning can produce the potential of creating realistic environments with which students can interact. The student essentially would interact with the intelligent agents which in turn perceive changes in the simulated environment. The intelligent agents would then communicate perceived changes in the environment back to the student who then makes decisions based upon their own perceptions of the environment [6, 7]. Current learning technologies can help create trained novices more efficiently, but they are really not up to the job of creating true experts [6].

Intelligent Tutoring Systems (ITS) – was founded by members of the AI community who had migrated to the educational community. Their motivation was as follow: “Research in AI is founded upon the conjecture that cognition is, in some sense, a computational process than can be studied through the construction of “intelligent” systems that serve as functional models of the otherwise inaccessible processes of the human mind. If machines can be programmed to display intelligent behavior, there is no reason, at least in principle, that systems could not be designed to assume the role of a skilled teacher [6, 8].

## 3. AI Methods and Techniques: Neural Networks

AI methods and techniques enable computer programs and software applications to think and act intelligently and

rationally. To achieve this goal, AI utilizes methods and techniques, like: Neural Networks, Genetic Algorithms, Reinforcement Learning, and Fuzzy Logic [6].

Neural Networks do not rely on ruled-based programming for their performance. Instead, neural networks use learning algorithms to “tune” outputs to inputs. The technology finds use in situations in which rules are not explicitly available, and in which “tuning” inputs to outputs is easier than analyzing the internal reasoning process. Currently, data mining uses neural networks to analyze the large volumes of data [6, 9].

Basically Computers are good in calculations that basically takes inputs process then and after that gives the result on the basis of calculations which are done at particular Algorithm which are programmed in the software’s but ANN improve their own rules, the more decisions they make, the better decisions may become. The Characteristics are basically those which should be present in intelligent System like robots and other Artificial Intelligence Based Applications. There are six characteristics of Artificial Neural Network which are basic and important for this technology [10 ].

## 4. Personalized E-Learning

Personalized learning is the tailoring of pedagogy, curriculum and learning support to meet the needs and aspirations of individual learners. Data personalization is to facilitate the expression of the need of a particular user to enable him to obtain relevant information when he accesses an information system. The data describing the user’s interests and preference is often gathered in the form of profile. One can identify business and /or ordinary customers, and monitors their behavioral profile over different providers through intelligent techniques. Personalization can also be achieved through navigate the documents of data sources, so that content is extracted from the Learning object repository [11].

Personalization in E-Learning is the use of technology and student information to tailor interactions between a tutor and individual students in a way that students achieve better learning outcomes. Studies relating to personalization in E-Learning concentrate on two main aspects: first, the management of learning materials and other information; second, the learning process, with a strong focus on the people engaged in learning activities [12].

## 5. Methods of Personalization.

### 5.1. Knowledge Driven Model for Personalization

E-Learning solutions should be more than just a collection of technological solutions. Apart from sophisticated, stylish multimedia delivery, it should focus on enhancing the learning and intellectual interaction at the cognitive, behavioral, and physiological levels. Another impediment to the successful adoption of E-Learning is the lack of learning personalization. The learner-centric aspect of E-Learning is often neglected. All the learner has to do is to simply follow the prescribed

paths through the whole courseware (dictated SME's subject matter experts) right from pre-assessment to post assessment. Another problem is that most of the courses are offered within the time frame of an academic semester, without consideration of the learners preferred pace and expertise [11].

### 5.2. E-Learning Scenarios Using Two Complementary Personalization Levels

Personalization in an E-Learning system can be achieved through two levels of personalization. Level 1 allows the personalization of learning contents and structure of the course according to a given personalization strategy and level 2 defines the personalization strategy. Teacher has to choose and apply the personalization strategy which matches the

learner's characteristics and the specifics of the courses [10].

## 6. Current Applications of Artificial Neural Networks in E-Learning Personalization

We have arranged a table which summarizes some applications through last years which had used neural networks in their E-Learning systems to show the influence of neural networks in personalization. Table 1, illustrates the current applications of neural networks in E-Learning personalization since some last years.

*Table 1. Current applications of neural networks in E-Learning personalization.*

SL No.	Author and year of Research	Explanation of Application	Limitations
1.	J. E. Villaverde_, D. Godoy_w, A. Amandi, 2006.	The authors had described an approach based on feed-forward neural networks to infer the learning styles of students automatically. We have selected the back-propagation algorithm to train the ANN described in this work. In addition, we have described a neural network architecture that learns the associations between students' actions in E-Learning environments and their corresponding Felder–Silvermans learning style of engineering education. The advantage of this approach is twofold. First, an automatic mechanism for style recognition facilitates the gathering of information about learning preferences, making it imperceptible to students. Second, the proposed algorithm uses the recent history of system usage so that systems using this approach can recognize changes in learning styles or some of their dimensions over time [13].	The resulting dataset built for testing the network consisted of 100 pairs of input–output values [13].
2.	Hassina Seridi, Toufik Sari and Mokhtar Sellami, 2006.	The authors used Artificial Neural networks for generating adaptive lessons, their work showed the usefulness of the techniques based on some training, which is considered the main drawback of classical methods [14].	The authors proved their work efficiently on their chosen dataset with different Neural Networks techniques but they had poor results on other datasets and this problem is due to not enough training and also training a very small dataset and results didn't reach the global minima [14].
3.	P. Ralph and J. Parsons, 2006.	Authors proposed a framework for automatic online personalization through recommendation process and they applied some datasets on several artificial neural network techniques [15].	Authors work did not provide any kind of semantics to provide the automatic discovery, composition, and invocation of those data sets [15].
4.	Pao-Hua Chou and Menq-Jiun Wu, 2009.	Authors proposed a mining technique applied to e-Learner's navigation behavior, to discover patterns in the navigation of E-Learning websites automatically with back-propagation network (BPN) model using the footstep graph. The authors gained high accurate results about delivering the learners their personalized requirements and needs [16].	Authors work was not efficiently working on learner's who didn't describe well their navigation patterns. And in order to fix this problem, learners should know how to use the web site and how to express their interests [16].
5.	Ahmad B., Gh. A. Montazer., 2009.	Authors proposed a personalized multiagent E-Learning system based on item response theory (IRT) and artificial neural network (ANN) which presented adaptive tests (based on IRT) and personalized recommendations (based on ANN). These agents add adaptively and interactivity to the learning environment and act as a human instructor which guides the learners in a friendly and personalized teaching environment. Experimental results showed that the proposed system can provide personalized and appropriate course material recommendations with the precision of 83.3%, adaptive tests based on learner's ability, and therefore, can accelerate learning efficiency and effectiveness. Also their research reported the capability of the neural network approach to learning material recommendation. [17].	The results show that the testing error was a function of network architecture. And authors only used four artificial neural networks [17].
6.	Norsham Idris et al., 2009	Authors used soft computing techniques as an alternative to a rule-based adaptation for an adaptive learning system. The authors work used concept-based classification of learning object using artificial neural network	Good results can be found from classifications which samples having bigger size of hidden nodes [18].

SL No.	Author and year of Research	Explanation of Application	Limitations
7.	J. Bernard et al., 2015.	<p>(ANN). Self-Organizing Map (SOM) and Back Propagation (BP) algorithm to discover the relation between the learning object and the learner's learning need. The obtained results show that ANN were able to select up to 100% of learning objects as selected by the domain expert for each student [18].</p> <p>Authors introduced LSID-ANN, an artificial neural network approach for identifying students' learning styles based on the Felder-Silverman learning style model. LSID-ANN was evaluated with real data from 75 students, showing that it outperforms the leading approach, DeLeS, in three out of four dimensions of the FLSM and achieved the same results for the fourth dimension. By identifying students' learning styles with higher accuracy, adaptive learning systems can use this learning style information to provide more accurate personalization. Furthermore, teachers can use this learning style information to provide more accurate advice to their students [19].</p>	<p>Only students who spent more than 5 minutes on filling out the ILS questionnaire, submitted more than half of the assignments, and attended the final exam were considered for the authors study, leading to a dataset of 75 students [19].</p>

## 7. Conclusion and Future Work

E-Learning is a field that takes advantage of the current advances in technology and integrates many techniques from different fields, such as profile identification and modeling, educational theories, knowledge representation, AI methods and optimization procedures among others. A neural network has been proved to have good results in finding the similarity of the domain concept data representation pattern between the student's and the learning object's profiles. We have discussed in our paper some applications of artificial neural networks in E-Learning personalization since some years and discussed its significance and limitations in this field.

Future work may be by using different artificial intelligence techniques and neural networks together. Try to apply bigger and different datasets to deal with more E-Learning applications. More extensive experiments should be conducted by using larger training and test sets. Making Comparison between of ANN with SVM, KNN, etc., can be used to check the performance of each method regarding reducing development, application time and cost. Also collaborative filtering should be considered as a method to provide a solution to personalize content and communication, by finding learning style neighbors and predict what preferences a user has, for different learning hemispheres

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