Deep Learning: The Impact on Future eLearning

Kaleeswari S[1], Rajalakshmi T[2], Dr. Jai Ruby[3], Mrs. J. Steffi[4]

[1, 2]PG Scholar, Department of Computer Applications and Research Centre, Sarah Tucker College (Autonomous), Tirunelveli, Tamil Nadu, India
[3]Associate Professor, Department of Computer Applications and Research Centre, Sarah Tucker College (Autonomous), Tirunelveli, Tamil Nadu, India
[4]Assistant Professor, Department of Computer Applications and Research Centre, Sarah Tucker College (Autonomous), Tirunelveli, Tamil Nadu, India

---***---

Abstract - *eLearning has a huge cost hurdle in increasing its services as technology becomes more available in higher education. Artificial intelligence-based deep learning is becoming more popular, and it is influencing many elements of eLearning. It delivers straightforward algorithms and automated eLearning content delivery through current LMS systems to future online learners. This paper will look at a range of deep learning applications for producing eLearning platform resources, including how to leverage predictions, algorithms, and analytics to create more personalized future eLearning experiences. There are also deep learning models for creating the contents of the eLearning platform, as well as a deep learning framework for integrating deep learning systems into eLearning and its development. Deep learning models for developing eLearning platform contents, deep learning frameworks that enable deep learning systems into eLearning and their development, benefits and future trends of deep learning in eLearning, and relevant deep learning based artificial intelligence tools such as CNN, Logistic Regression, and KNN a platform that allows developers and learners to quickly reuse resources are also summarized. As a consequence, deep learning has evolved to include determining ways to recycle existing resources in order to save money on future eLearning development.*

Key Words: eLearning, Deep Learning (DL), Learning Management System (LMS), Artificial Intelligence, Machine Learning.

1. INTRODUCTION

There have been several applications in Higher Education as a result of the emergence of information and communication technology (ICT) in the current age (HE). In this environment, eLearning was introduced as a means of meeting new educational expectations. Learning management software systems that synthesis the features of computer-mediated communications software and online means of providing course materials have been described as eLearning [7]. One of the most compelling arguments for investing heavily in web-based technology is its ability to improve teaching and learning [22], as well as stimulate the development of student-centered, autonomous learning [30] and nurture a more in-depth approach to learning [12]. According to [9], the time spent developing eLearning material for one hour ranged from 49 to 125 hours. Although the scalability of the eLearning environment promises more flexible and autonomous learning, it might still be a barrier for schools who cannot afford the initial expenditure.

As AI advances, new approaches such as deep learning and artificial neural networks are created to increase the efficacy of machine learning and make AI applications far-reaching and meaningful.

Machine learning aims to model the world, while deep learning aims to mimic the human brain in order to construct and maintain its own representations of the world. Deep learning refers to algorithms that anticipate probable outcomes based on user input, allowing a machine to demonstrate taught behaviours rather than human interactions. It facilitates automation by allowing computers to learn from data and generate predictions. The deep learning model becomes more intuitive with each new piece of data it gets.

It's difficult to index and utilize existing material on the web due to tremendous information overload. The challenge of indexing and reusability might be solved by classifying information according to domain-specific concept hierarchies. As a consequence of the challenges in human categorization, automated classifiers are in great demand. Deep learning may help with eLearning development by enhancing the categorization of content pieces, since digital learners want material to be available in a number of formats and platforms. The deep learning process takes occur autonomously in the eLearning arena, from obtaining and assessing data sets from the LMS to forecasting what online learners need based on their prior performance.

This study discusses how deep learning will affect eLearning in the future and analyses its implications on resource management in eLearning. We examine four important elements from the viewpoints of both learners and developers.:

- Motivations of applying deep learning

- Deep Learning Framework for developing the contents of eLearning platform
- Tools and platforms that enable deep learning systems into eLearning and its development
- Benefits & future trends of eLearning

The rest of the paper is planned as follows: Section 2 focuses on a survey related to deep learning in eLearning. Section 3 describes deep learning techniques in the development of eLearning platform. Section 4 covers the benefits of DL in eLearning. Tools, platforms and Future trends of DL in eLearning is discussed in section 5 and section6 concludes the summary.

2. LITERATURE REVIEW

Deep learning models the hierarchical organization of the human brain by processing input from a lower level to a higher one and eventually assembling growing semantic notions. Deep learning is becoming more used as a method for massive data analysis [40] and artificial intelligence [40]. Artificial intelligence has made significant progress in numerous domains, including face recognition [40], image processing [3], and voice recognition [2]. Inspire by this, a survey on the effect of deep learning in an eLearning setting was conducted.

2.1 eLearning

ELearning is a form of remote education delivery system that allows for synchronous and asynchronous resource sharing through a communication network [23]. It is a technological and social framework that surrounds the learner and the teacher and encourages communication and cooperation between students and instructors [24]. Distance learning, sometimes known as e-learning, is a systematic teaching and learning framework designed to be done remotely via electronic correspondence [11]. Many colleges and universities have begun to use course management software (such as Blackboard, LMS, WebCT, and Moodle) to supplement conventional classroom education. According to authors in the literature [32] and [1], eLearning provides a balance between technological enablers and acceptability issues. In [32], Rosenberg provided a significant blueprint for maintaining e-learning in a sustainable and ongoing expansion by displaying a twenty-year timeline of e-Learning progression.

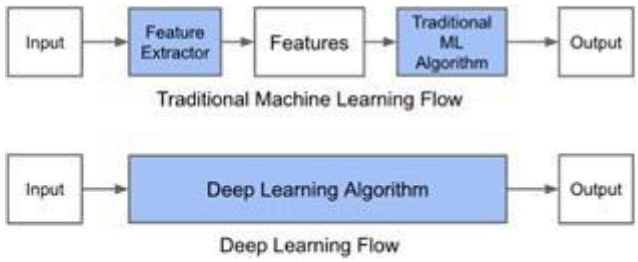

Fig -1: Machine learning vs. Deep Learning

Incorporating modern technology Web 2.0 into the learning process is difficult, but it has the potential to transform the learning and training paradigm. Podcasts, weblogs, wikis, and other online sharing tools have prompted the emergence of e-Learning 2.0 [16]. The emphasis in the E-Learning 2.0 environment is on involving students in the learning process.

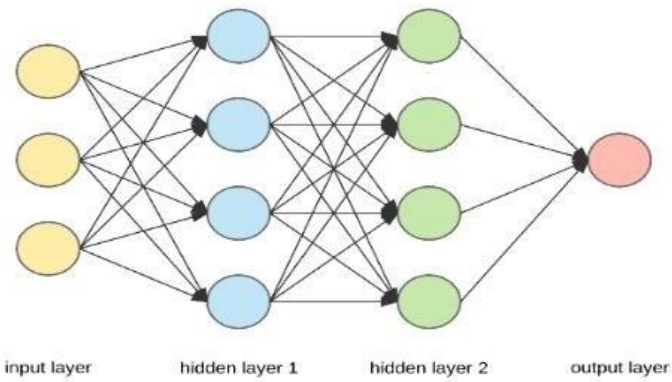

Fig -2: Deep learning with two hidden layers

The feature engineering process, which involves domain knowledge and is time-consuming, is the major distinction between classical machine learning and deep learning algorithms (Fig.1). Deep learning techniques use automated feature engineering, while typical machine learning algorithms need us to create the features. To learn intricate patterns in vast volumes of data, deep learning combines increases in processing power with neural net-works with multiple layers (Fig. 2). It's a variation on a standard neural network that employs extra hidden layers to allow algorithms to handle complicated input with a variety of structures [14].

- Deep learning uses four basic algorithms to predict future events and identify patterns based on individual user data.
- A supervised learning system predicts outcomes based on previous instances and fresh data sets. To train the software, the system begins with specified inputs and outputs. The system may then create outputs or goals for new datasets automatically over time.

- There are no labels or data classifications in unsupervised learning algorithms.
- The system analyses data to find patterns and provide conclusions or predictions.
- A semi-supervised learning method combines unlabelled data with human-based training, in which labelled web resources are used to accurately map out certain inputs and outputs.
- A particular objective or goal for the system is included in the reinforcement learning algorithm. It gets input during the process in order to learn the necessary behaviours for the most effective approach via reinforcement signals.

2.2 Deep learning applications in eLearning

Personalized learning route [10]: This is an eLearning technique that highlights the learner's unique goals and objectives, as well as preferences for course mapping. A learning path is defined by a series of courses or learning resources that enable learners to gradually expand their knowledge. It is dynamically created and altered depending on learner employment responsibilities, areas of interest, progress, learning preferences, demographic data, competences or knowledge levels, and so on. A learner model is often constructed in the backend to detect, gather, and update variables in order to customise distinct material for each unique learner.

Chatbots [34]: They operate as a virtual assistant, providing conversational replies, serving as a fast reference guide, and as a knowledge management tool, they may tap into a variety of sources of information spread around the business. An intelligent tutoring system introduces a learning idea via a series of dialogues that provide coaching and performance assistance.

It is utilized to discover a specific learning pattern, such as substantial changes in course shortcomings, so that instructors may counsel students before it is too late. It will also allow for a more efficient analysis of student engagement data and the identification of trends. As a result, the content redesign recommendation will give extra help to learners who are struggling to finish a course or a learning activity.

Georgia Institute of Technology developed the virtual teaching assistant [35] to online classrooms to answer problems with unique and obvious replies. Students may ask the same questions again and over, which will help them expand their knowledge base in various circumstances.

3. DEEP LEARNING FRAMEWORK FOR ELEARNING

There are five wide spread kinds of information [17]:

- Sequences
- Association
- Classifications
- Clusters
- Prediction

Similarly, the general purpose of deep learning model is to provide powerful solutions to associations, classifications, clusters and predictions problems. In the eLearning applications, the commonly used deep learning models include:

1. **Convolution Neural Network (CNN)**: [26] designed and implemented the CNN for high-dimensional image processing for the first time. It is made up of convolutional filters that convert 2D to 3D.
2. **Recurrent Neural Network (RNN)**: It is a neural network design that features recurrent connections between hidden states and can learn sequences and represent temporal dependencies. The recurrent connections are utilized to identify relationships across time as well as between inputs. As a result, it's ideally suited to health issues that often entail modelling clinical data changes over time [41].
3. **Deep Belief Network (DBN)**: This model features a two-layer unidirectional link at the top of the layers. Each sub-hidden network's layers serve as a visible layer for the following layer.
4. **Deep Neural Network (DNN)**: It contains more than two layers, allowing for a complex non-linear interaction.

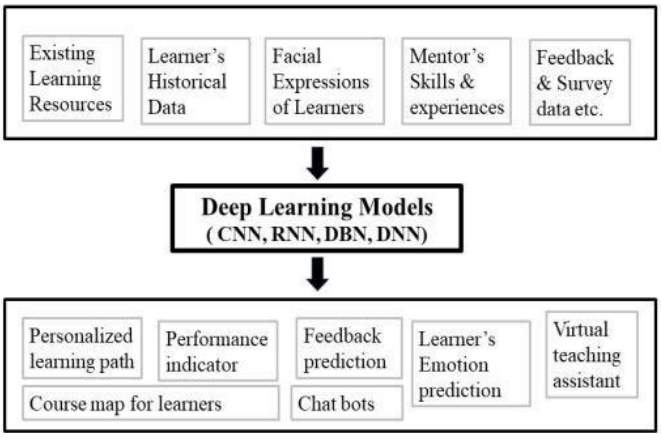

Fig -3: Deep Learning Framework for eLearning environment

The framework (see Fig. 3) illustrates how deep learning models may help with eLearning creation by incorporating:

Existing learning materials to create a customized learning path and categorize information depending on the learner's interests. Learner's historical data to predict their performance and associate course map for individual learners. Facial expressions of learners to predict their emotions in eLearning environment. Mentor's skills and experience to support peer-to-peer interactions with the learners. For example, information may be available in a video, an infographic, a text file including the video transcript, and a chat-based quiz that provides feedback.

4. MATERIALS AND METHODS

The researchers employed observation, participant observation, and a case study model as part of their approach. Furthermore, document analysis was used. In addition, a survey of students (past, present, and future) was undertaken. This was done to acquire an overall idea of how much AI and machine learning knowledge the student population has, as well as to better appreciate the potential and difficulties that AI and machine learning provide in higher education. The survey was carried out using the model described in the article "AI in Higher Education: Promises, Perils, and Perspective". Because we are all university professors active in learning processes and everyday interactions with students, we employed observation and observation with engagement. Literature analysis or document analysis is also appropriate for social sciences and secondary research to compare and complement our results with relevant views. A survey is a useful technique for gathering data that can be utilized for quantitative analysis and hypothesis testing. It is regarded as a low-cost tool in its digital (online) version, as well as useful for identifying persons who effectively utilize technical tools.

With qualitative data analysis, we were able to retain neutrality and eliminate bias by having many persons code the data. This enabled participants to examine our findings. We utilized several statistical studies to ensure that the findings were accurate. A thorough literature analysis enabled us to confirm our results using other data sources and look for alternative explanations.

Table 1 summarizes the recent applications deep learning in eLearning, technical advantages and limitations of each deep learning models.

Table -1: Deep Learning Models Summary in eLearning

Model	Recent Applications in eLearning	Advantages	Limitations
CNN	Predict the latent factors of the learning resources [36]. Using facial expression to detect the emotions of students [37].	Provide very good performance for 2D data. Model learning is fast	Need lots of labeled data for classification
RNN	Student Feedback Prediction using Kinect [20]	Learn sequential events and model time dependencies. Provide good accuracy in speech & character recognition and NLP related tasks	Need big datasets. Has many issues due to gradient vanishing
DBN	Natural language understanding [33], Large-vocabulary speech recognition [18],[25]	Supports both supervised and unsupervised learning model	Initialization process makes the training process computation all expensive
DNN	Visual representational trans-formations in distance learning [29]	Widely used with great accuracy	Training process is not trivial as the error propagated back to the previous layers and becomes very small Learning process is also too much slow

Table -2: Deep Learning Tools and Platforms in eLearning Applications

Tools & Platforms	Features
AIaaS (AIaxa Service) [4]	Cloud based AI tools and algorithms for the eLearning development
Microsoft Azure [27]	Cloud based AI applications, such as image recognition or bot-based apps

IBM's Watson [21]	Cloud-based AI services to use with Watson platform
Amazon Web Services [5]	Amazon's cloud-based AI services
Google's Tensorflow [38]	An open-source artificial intelligence library, using data flow graphs to build models and allows developers to create large-scale neural networks with many layers
Caffe [8]	Across-platform support C++, MATLAB, and Python programming interfaces
MXNet [28]	An open source of ware library for numerical computation using data flow graphs and supports DL architectures CNN and RNN
Theano	Provides capabilities like symbolic API supports looping control(scan), which makes implementing RNNs easy and efficient
Keras	The an obased deep learning library
ConvNet [13]	MATLAB based convolutional neural network toolbox
Deep learning [15]	An open-source, Apache2.0-licenseddistributedneuralnetlibraryinJavaandScala
Apache Singa [6]	Open-source library for deep learning

4. DEEP LEARNING TOOLS FOR ELEARNING PLAT FORM DEVELOPMENT

Table 2 lists the deep learning technologies and platforms available in eLearning applications. The availability of commercial DL tools and components enables eLearning creators to buy or license algorithms rather than building their own, saving time and money.

When considering using deep learning in the eLearning development, it's advisable to choose a platform carefully as each platform has its own strengths and weaknesses. It also depends on the needs of the developers and learners as well as the technical skills of the developers who will be binding these tools and services to create deep learning enhanced eLearning tools.

5. RESULT AND DISCUSSION

Deep learning provides more tailored eLearning material by predicting outcomes based on historical performance and individual learning objectives, allowing for more customised chevalier content. For more proficient online learners, it may skip multiple e-learning courses or follow a more complete, linear approach for individuals who still need fundamental information. In addition, if an online learner's past suggests that they favour tangible eLearning activities, the system modifies the learner's course map to provide suggestions that develop associated skills and abilities. [31] Proposed a framework for autonomous online personalization through a recommendation process based on artificial neural network methods applied to various datasets.

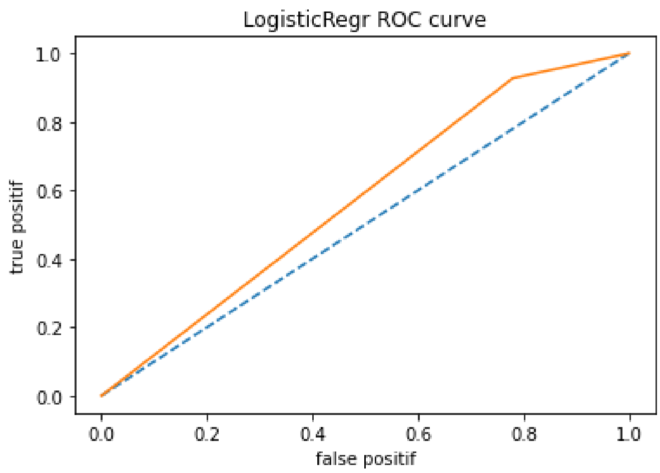

Fig -4: ROC Curve Logistic Regression

	precision	recall	f1-score	support
0.0	0.69	0.22	0.33	50
1.0	0.62	0.93	0.74	69
accuracy			0.63	119
macro avg	0.65	0.57	0.54	119
weighted avg	0.65	0.63	0.57	119

Fig -5: Logistic Regression Accuracy Result

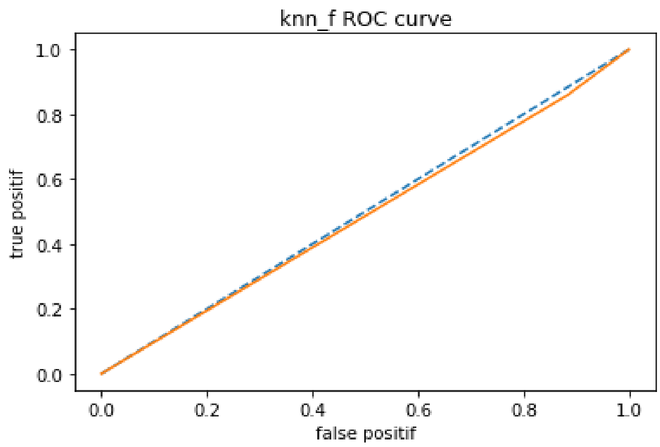

Fig -6: ROC for KNN

	precision	recall	f1-score	support
0.0	0.19	0.12	0.14	26
1.0	0.78	0.86	0.82	93
accuracy			0.70	119
macro avg	0.48	0.49	0.48	119
weighted avg	0.65	0.70	0.67	119

Fig -7: KNN Accuracy Result

metric	Logistic regression	KNN	CNN
f1 score	71	48	77
accuracy %	79	70	80
confusion matrix	[16 19] [6 78]	[3 23] [13 80]	[15 8] [5 36]
ROC score	69	49	77

Fig -8: Comparison Result

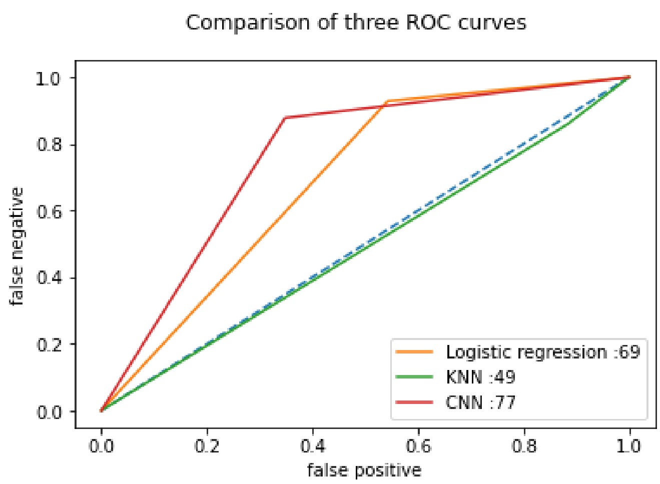

Fig -9: Comparison ROC

6. CONCLUSIONS

Deep learning provides more tailored eLearning material by predicting outcomes based on historical performance and individual learning objectives, allowing for more customized chevalier content. For more proficient online learners, it may skip multiple eLearning courses or follow a more complete, linear approach for individuals who still need fundamental information. In addition, if an online learner's past suggests that they favor tangible eLearning activities, the system modifies the learner's course map to provide suggestions that develop associated skills and abilities. [31] Proposed a framework for autonomous online personalization through a recommendation process based on artificial neural network methods applied to various datasets.

REFERENCES

[1] A. Fayyoumi, H. Mohammad, and H. Faris, "Mobile based learning and examination: Students and instructors' perceptions from different Arab countries," Journal of Software Engineering and Applications, vol. 6, 2013, doi: https://doi.org/10.4236/jsea.2013.612079

[2] A. Graves, R. Mohamed, and G. Hinton, "Speech Recognition with Deep Recurrent Neural Networks," Acoustics, Speech and Signal Processing, IEEE International Conference, vol. 6, 2013, pp. 6645 - 6649, doi: https://doi.org/10.4236/jsea.2013.612079

[3] A. Krizhevsky, I. Sutskever, and G. E. Hinton, "Imagenet classification with deep convolutional neural networks," Advances in neural information processing systems, vol. 6, pp. 1097 - 1105, 2012, doi: https://doi.org/10.1145/3065386

[4] AIaaS. https://www.bmc.com/blogs/ai-as-a-service-aiaas/

[5] Amazon Web Services. https://aws.amazon.com/machine-learning/

[6] Apache Singa. http://singa.apache.org/en/index.html

[7] Britain, S., and Liber, O., "A Framework for the Pedagogical Evaluation of Virtual Learning Environments Report 41, JISC Technology Applications Programme, 2004.

[8] Caffe. (2018). http://caffe.berkeleyvision.org/

[9] Chapman, B. (2010). How Long Does It Take to Create Learning? [Research Study]. Available from: www.chapmanalliance.com

[10] Colace Francesco, Santo, Massimo De and Greco, Luca, "E-Learning and Personalized Learning Path: A Proposal Based on the Adaptive Educational Hypermedia

System," International Journal of Emerging Technologies in Learning (iJET), vol. 9, pp. 9-16, 2014, doi: https://doi.org/10.3991/ijet.v9i2.3211

[11] Clark, R. C., and Mayer, R. E. (2003). E-Learning and the science of education: Established strategies for consumers and designers of machine learning systems. San Francisco, CA: Jossey-Bass/Pfeiffer.

[12] Collis, B. (1997). Tele-learning in a digital world: The future of distance learning. London: International Thomson Computer Press. ConvNet, https://github.com/sdemyanov/ConvNet,lastaccessed2019/05/15.

[13] Deep learning in Oncology. (2013) Available from: https://www.techemergence.com/deep-learning-in-oncology/

[14] Deep learning https://deeplearning4j.org/,lastaccessed2019/05/15.

[15] Ebner, M. (2007). E-Learning In Conf. on Availability, Reliability and Security. IEEE ARES, 1235-1239.

[16] Edelstein, H.A. (1999). Introduction to Data Mining and Knowledge Discovery. 3rd Edition, Crows Corporation, Potomac.

[17] G. E. Dahl, D. Yu, L. Deng, and A. Acero, (2012). Context-dependent pre-trained deep neural networks for large-vocabulary speech recognition. Int. Conf. IEEE Acoustics,

[18] Speech and Signal Process. Vol. 20, pp. 30 – 42. https://doi.org/10.1109/tasl.2011.2134090

[19] Hassina Seridi, Toufik Sari and Mokhtar Sellami. (2006). Adaptive Instructional Planning using Neural Networks in Intelligent Learning Systems, The International Arab Journal of Information Technology, vol. 3, pp.183-192.

[20] Hu, Shanfeng et al. (2018). A Dual-Stream Recurrent Neural Network for Student Feed-back Prediction using Kinect. In: SKIMA, Cambodia. https://doi.org/10.1109/skima.2018.8631537

[21] IBM's Watson. https://www.ibm.com/watson/

[22] Jenkins, M., Browne, T., and Armitage, S. (2001). Management and implementation of Virtual Learning Environments. Report. UCISA. Available from: https://www.ucisa.ac.uk/

[23] Khan B.H. (1998). Web-based Instruction (WBI): An Introduction. Educational Media International, vol. 35, pp. 63-71.https://doi.org/10.1080/0952398980350202

[24] Khan B.H. (2000). Discussion of resources and attributes of the web for the creation of meaning full learning environments. Cyber Psychology & Behavior, vol. 3, pp. 17-23.

[25] L. Deng, G. Hinton, and B. Kingsbury. (2013). New types of deep neural network learning for speech recognition and related applications: An overview, in Proc. Int. Conf. IEEE Acoustics, Speech and Signal Process., Vancouver, BC, Canada, pp.8599–8603. https://doi.org/10.1109/icassp.2013.6639344

[26] Lecun Y, Bottou L, Bengio Y, et al. (1998). Gradient-based learning applied to document recognition. In: Proc IEEE Inst Electr Electron Eng 86: 2278–324.https://doi.org/10.1109/5.726791

[27] Microsoft Azure. https://azure.microsoft.com/en-us/overview/ai-platform/

[28] MXNet. http://mxnet.incubator.apache.org.

[29] Patrick McClure and Nikolaus K. (2016). Representational Distance Learning for Deep Neural Networks. Front Comput Neurosci, 10: 131. https://doi.org/10.3389/fncom.2016.00131

[30] Pahl, C. (2003). Managing evolution and change in web-based teaching and learning environments. Computers in Education, 40. 99-114. https://doi.org/10.1016/s0360-1315(02)00100-8

[31] P. Ralph and J. Parsons. (2006). A Framework for Automatic Online Personalization, Proc. 39th Ann. HawaiiInt'l Conf. System Sciences. https://doi.org/10.1109/hicss.2006.10

[32] Rosenberg M.J. (2002). E-Learning: Strategies for Delivering Knowledge in the Digital Age, NewYork, NY, USA: McGraw-Hill, Inc.

[33] Ruhi Sarikaya, Geoffrey E. Hinton, and Anoop Deoras. (2014). Application of DBN for natural language understanding. IEEE / ACM Trans. Audio, Speech and Lang. Proc. 22 (4): pp. 778 - 784. https://doi.org/10.1109/taslp.2014.2303296

[34] Sayan Guha (2018). AI Chatbots In eLearning: Trends Embracing across Digital Land-scape. https://elearningindustry.com/ai-chatbots-in-elearning-trends-digital

[35] Science Daily. (2016). Artificial intelligence course creates AI teaching assistant. Available from: https://www.sciencedaily.com/releases/2016/05/160509101930.htm.

[36] Shen Xiaoxuan, et. al. (2016). Automatic Recommendation Technology for Learning Re-sources with Convolutional Neural Network. 30-34.

[37] Sun, Ai., Li, Ying-Jian., Huang, Yueh-Min., and Li, Qiong. (2017). Using Facial Expression to Detect Emotion in E-learning System: A Deep Learning Method. 10.1007/978-3-319-71084-6_52.

[38] Tensorflow. https://www.tensorflow.org

[39] Wang, M., Vogel, D., and Ran, W. (2011). Creating a performance-oriented e-learning environment: A design science approach. Information and Management, 48(7): 260-269.https://doi.org/10.1016/j.im.2011.06.003

[40] Y. Shen, X. He, J. Gao, L. Deng, and G. Mesnil. (2014). Learning semantic representations using convolutional neural networks for web search, Proceedings of the companion publication of the 23rd international conference on World wide web companion, pp.373-374.https://doi.org/10.1145/2567948.2577348

[41] Zachary C Lipton, David C. Kale, Charles Elkan, Randall Wetzel. (2016). Learning to Diagnose with LSTM Recurrent Neural Networks. International Conference on Learning Representations (ICLR).