On Interdisciplinary Comparative Study of Analogical Feedback/Assessment Models Applied in Blended Learning Versus Computer Aided Learning using Artificial Neural Networks

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ABSTRACT

This paper provides educationalists as well as researchers in computer science and engineering with a study of an interdisciplinary challenging pedagogical issue. More specifically, that presented study resulting in a set of interesting findings originated from adopted realistic Artificial Neural Network's (ANN^s) modeling, which associated to two educational analogical feedback / assessment processes. This piece of research considers comparative analysis and evaluation study of an educational phenomenon issue for two diverse teaching/learning methodologies namely:{Blended Learning (BL), and Computer Aided Learning (CAL)}. More precisely, introduced issue of this work addresses the two summative and formative assessment processes applied in educational field practice. Accordingly, this issue concerned mainly with modeling of two practical field case studies considering the two items of educational feedback/assessment. In other words, assessment is used in many ways in education, a great deal of attention is now given to its use in helping teaching and learning, described as the two performance assessment items (summative and formative). These both are classified as: assessment for learning *(A f L)*, or formative assessment. and assessment of learning *(A O L)*, or summative assessment. It is noticed that *(A f L)*, did predict a substantial amount of course outcome and its validity observed to pave the way for diagnostic use and remedial teaching. However, *(A O L)* is focused on summarizing what students know or can do at certain times in order to report their academic progress, and achievement. Herein, two parametric factor values of ANN *(gain, and learning rate factors)*, have been considered for the two suggested instructional methodologies. That is considered in order to compare, analyze, and evaluate dynamically two items of academic performance namely: *(Academic achievement outcome & Learning convergence time)* for both methodologies. Interestingly, after running of realistic ANN computer modeling for different numbers of neurons -that are contributing to learning process- results in a investigative, comprehensive, and innovative systematic analysis of individual students' differences. Finally, after performing perceptive evaluation comparing between two case studies of obtained experimental field results, two interesting findings have been concluded. Firstly, while comparing computed sets of statistical parameters, associated to the presented instructional methodologies *(BL&CAL)*. that resulted in the observed analogy between both sets. Secondly, in the context of Feedback/Assessment performance, regarding both *(BL& CAL)* ; either *Formative, or Summative* feedback /assessments, have been observed to be well analogous to each other.

Keywords

Blended learning; Brain based learning; Computer Aided Learning; Neural Networks Modeling; Formative, and summative feedback /assessments.

1. INTRODUCTION

The field of learning sciences is represented by a growing community conceiving knowledge associated with educational system performance as well as assessment of technology-mediated learning (TML) processes. These processes consider learning environment in which learning and teaching. materials such as bidirectional interactive assignments between learners and instructors via advanced information technologies [1]. Therefore, Technology can be used to improve teaching and learning and help our students be successful. However, technology can be a “force multiplier” for the teacher. Instead of the teacher being the only source of help in a classroom, students can access web sites, online tutorials, and more to assist them. So, a set of evolutionary instructional trends have been adopted by educationalists besides their learners due to rapid technological and social changes [2][3]. In more details, by referring to [2], influences of information technology on mathematical education have been illustrated. Therein, a suggested approach for leading to build a better integration of information technology to teach and learn mathematics; and to point out some problems that emerge when the use of software is intense in such integration. Moreover, referring to [3], the Technology Integration Planning Model (TIP Model) shows teachers how to create an environment in which technology can effectively enhance learning. Furthermore, these teachers have been able to see in more depth their role in shaping the f educational technology in future. More precisely, that great innovative education means employing technologies aiming to fulfill the vision they make possible: a worldwide social network and a global community that learns and grows together. Therefore, they are facing increasingly challenges arise in this time considering modifications of various educational field applications [4][5][6]. It is good to remember what some authors say: "Computers are transforming the way mathematicians discover, prove and communicate ideas" (Horgan, 93)[7]. "Computers and computation have changed the entire modern world, but their effects in the fields of sciences and engineering have been especially deep" (Aragón, 96).[8]. it is more instructive to examine the potential of technology for changing the relationships between mathematicians and engineers, and for connecting their respective bridging between mathematics and engineering knowledge domains in new ways [9]. More specifically, in the context of teaching, and learning a selected mathematical topic titled: Long Division process [10][11]. That topic has been applied at classroom regarding two diversified multisensory models of Computer Aided Learning (CAL), given at [5][12][13][14]. Recently, by referring to the paper published online on: 8/29/2018 for, furthering educational methodology, it could be asked the challenging question: (Can you imagine modern education without computer software or the internet?).Whether you're taking a class online, researching for a paper or sharing work via the cloud, computer science pros have helped make this possible. E-learning platforms and applications give students new tools to problem-solve and study, which has changed the academic world [15] The ability to take classes online is also a huge benefit for the world—as it creates access to education for students whose locations, abilities or finances were a barrier [16]. Moreover, It is announced that: "Online education can provide mid-career training without forcing individuals to quit their jobs or move to locations with appropriate educational institutions." [17]. Recently, some innovative developed methodologies of instructional technology have been adopted and introduced for practical application in the educational field such as Virtual reality(VR), Massively Open Online Courses (MOOCs), and Blended Learning (BL). VR, is also being explored as a tool to increase immersive learning .According to Erica Orange, member of Devry University's Career Advisory Board, "The next generation of MOOCs will be sensorial immersive, leveraging virtual reality to put students in the world they're studying." [18] There are many examples of corporate research being done into this subject . An interesting research work concerned with MOOCs is presented under the question title". "What according to you is the future of MOOCs?"[19]. Therein, declared that *The future of MOOCs is the future of education itself.* The World of Comenius project employed a Leap Motion controller and specially adapted Oculus Rift DK2 headsets to teach biology at a school in the Czech Republic in 2016 (Sharma, 2016)[20]. Google launched Pioneer Expeditions in September 2015, where classrooms can access a library of hundreds of virtual "trips" (Moynihan, 2016)[21]. Virtual reality platforms such as Altspace VR and Lecture VR allow students to make avatars in order to collaborate with other players (Reede, 2016) [22] In fall 2015, Harvard began streaming its most popular class, CS50, in virtual reality on edX (Fahs, 2016) [23]. As teaching and learning today are not limited to the walls of the classroom and most universities and schools provide learning opportunities for their students through online and blended learning environments, assessment practices also gain much more importance (Stein & Graham, 2014) [24].Within the recent 10 years the introduction of the new technological innovations such as Blended Learning (BL) filled the gap between traditional face-to-face learning and distributed learning environments. Regarding extended deep analysis of (BL) literature, it is stated that BL would have a great role in the future and it would be dominated by the distributed learning environments [25]. In 2017, Jennifer Hofmann made the argument that Blended Learning represents a true shift in the profession. Since then, BL has cemented itself as so much more than a passing fad. But now that blended learning is here to stay, how do we prove its value to our organizations? [26] Accordingly, the expansion of online and blended learning environments allows students to enjoy a potentially better teaching and learning experience. It is, therefore, vital that researchers as well as teachers that have online and blended learning classes adopt appropriate assessment. [27]. Recent literature review of BL research area in addition to suggesting key implications for tutor development, student retention and student progression have been introduced at [28]. More recently, Claire Johnson stated that:"The idea of blended learning arose as a flexible and easy way to *incorporate technology* into any classroom without adding too much to the already packed curriculums"[29]. Furthermore, this research work argues for standardizing early intervention via feedback to allow students to access specialist support where necessary, so as to address difficulties earlier in the course of studies so as to allow more students to reach their academic potential. Accordingly, in order to develop advanced skills of students in critical thinking and analysis congruent with degree-level qualifications, meaningful feedback and 'feed-forward' must be offered in order to facilitate such improvement. Research findings were encouraging. A statistical model incorporating feed-forward was developed which accounted for a large effect in the improvement of results for the summative item. Importantly, there was improvement across student ability levels. [30]. In the context of learning and feedback in Artificial Neural Networks ANN [31]., the back propagation algorithm, in combination with a supervised error-correction learning rule, is one of the most popular and robust tools in the training of ANN. Back propagation passes error signals backwards through the network during training to update the weights of the network [32]. Error-Correction Learning, used with supervised learning, is the ANN technique of comparing the system output to the desired output value, and using that error to direct the training. In the most direct route, the error values can be used to directly adjust the tap weights, using an algorithm such as the back-propagation algorithm. If the system output is ***y***, and the desired system output is known to be ***d***, the error signal can be defined as ***:***

(e = d-y) . Error correction learning algorithms attempt to minimize this error signal at each training iteration. The most popular learning algorithm for use with error-correction learning is the back-propagation algorithm, discussed below [33]. Obviously, in the context of educational technology, the optimality of academic achievement (best learning outcome) for any instructional teaching/learning system could be attained (*if and only if the value of error signal (e) approaches to have its value equals to zero).*That obvious learning concept is deduced by details in below, and given by equation (8) based on synaptic connectivity as:{ $\Delta W_{kj}(n) = 0$ }. The rest of this paper is organized as follows.

At the next section, two folds of this research's motivation have been presented. Generalized model of interactive blended learning is introduced at the third section. At the fourth section simulation results are presented. Finally, some conclusive comments are given at the end of this paper.

2. RESEARCH MOTIVATIONS

This research work has investigated systematically via two motivations briefly given at the next two subsections as follow.

First Motivation: During the nineteenth of last century, technologies of computer, Information, and mobile devices play an essential role in how an individual's brain performs its working, living, playing, and, more importantly, learning. Accordingly, the decade (1990-2000) is called decade of the brain as announcement in 1989 WHITE HOUSE REPORT in U.S.A. [34]. Therefore, the overwhelming majority of neuroscientists have adopted the above brain concept which suggests that huge number of neurons in addition to their synaptic interconnectivities constituting the central nervous system for performing dominant roles for learning processes in mammals besides human [35]. More specifically, this motivation is supported by what revealed by National Institutes of Health (NIH) in USA that children in elementary school, may be qualified to learn "basic building blocks" of cognition and that after about 11 years of age, children take these building blocks and use them [36][37]. The extremely composite biological structure of human brain results in everyday behavioral learning brain functions. At the educational field, it is observable that learning process performed by the human brain is affected by the simple neuronal performance mechanism [38]. In this context, neurological researchers have recently revealed their findings about increasingly common and sophisticated role of Artificial neural networks (ANN$). Mainly, this role has been applied for systematic and realistic modeling of essential brain functions (learning and memory) [39]. Accordingly, neural network theorists as well as neurobiologists and educationalists have focused their attention on making interdisciplinary contributions to investigate observed educational phenomena associated with brain functional performance such as optimality of learning processes [6][[40][41][42].

Second Motivation: This motivation consider mainly the question :What Does The Brain Have To Do With Learning Process?. Referring to (Ned Herrmann, 2014), “The brain is involved in all aspects of the learning process. It is the single bodily organ that is the central processor of all learning activities.” Blended learning is a blending of different learning methods, techniques and resources and applying them in an interactively meaningful learning environment. Interestingly, it is announced therein: ultimate aim of blended learning being to provide realistic practical opportunities for learners and teachers to make learning independent, useful, sustainable and ever growing. Current research shows that in order to achieve good blended learning results, there are three essential questions to answer when building a blended learning educational process is characterized by three main features as follows; *1. Learners:* What is the best method for the target audience? *2. Learning Design:* What is the best instructional model and delivery method for the content?
3. Learning Environment: What is the best method to meet your organizational constraints and requirements?. Furthermore, some recently published papers which have announced developed findings of the considered future of BL is presented. These findings have been introduced at the four very recent published research papers : [44],[45],[46], and [47]. (Kintu et al.,2017)&(Katherine Gotovsky, Cindy Lee, Jawad Bhimani, Kevin Ding, Marium Vahed, Rakeeb Hossain, Ryan Min, Ryan Yu, Sartaj Javed, and Tanya Nguyen,2017)&(Rasheed F.,Wahid A.(2019)), and (Susan Mengel *and* others,2017). Therein, Blended learning is defined as the usage of various programs and applications in the provincial learning management system (LMS). It serves to supplement and teach learning in classes, equipping students with online tools to supplements face-to face lessons and web-based coursework. Also, these reference considered the application of realistic ANN modeling of e-learning and BL systems.

2.1 A Block Diagram of Interactive Learning Processes Modeling

This Block Diagram is based on a Neural Network model which composed of a set of biological neurons (nodes) represented as circles that depicted as circles (4-3-2) in Figure 1. Accordingly, that network's activity function is given by the Feed Forward Artificial Neural Networks (FFANN) structure presented schematically as follows:

1) The activity of the input comprises four nodes, represents the raw information that is fed into the network.
2) The activity for each node of the hidden layer is determined by the activities provided by the four input layer's nodes and the synaptic weights' connections between the input nodes and the hidden layer's nodes.
3) The behavioral activity of the output nodes depends on the activity of the hidden nodes and the weights between the hidden and output nodes.

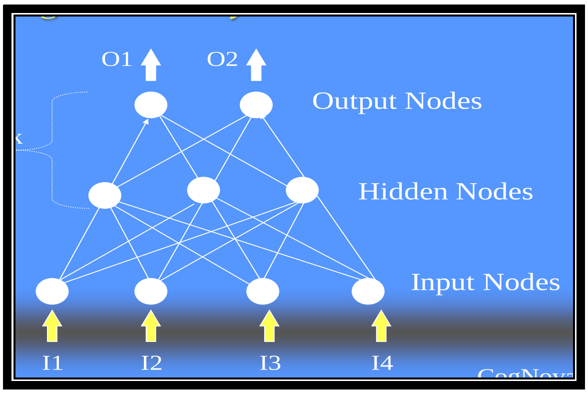

Figure 1. A simplified schematic diagram for a (FFANN) model (adapted from, [48]).

A simplified block diagram for Artificial Neural Network model which simulating the Face to face interactive tuition process is presented at Figure 2. Inputs to the ANN learning / teaching model are provided by linking signals from the environmental in addition to correction signals provided by environmental stimuli in case of (unsupervised learning). However, in the case of learning using a teacher's guidance, the correction signal (s) is /are given as output response (s) of the model..That is evaluated under supervision of a teacher considering (supervised learning). Additionally, any tutor plays a role of improvement input data (stimulating learning pattern) by reducing the noise and redundancy of model pattern input. That is motivated by the tutor’s experience while performing conventional (classical) learning. Consequently, the tutor provides the learning model with cleared data via maximizing of the signal to noise ratio [49]. Conversely, in the case of unsupervised/self-organized learning, which is based upon Hebbian learning rule [50] it is mathematically formulated by equation (7) presented at the next subsection *(C).*

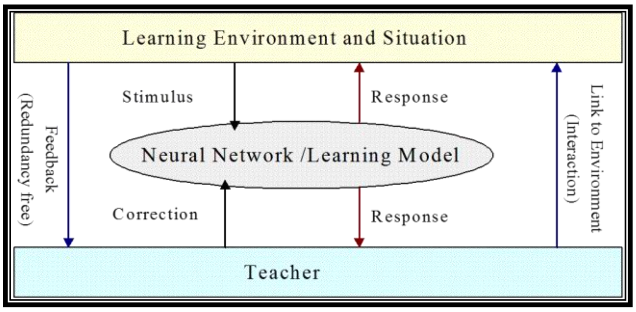

Figure 2. Simplified view for interactive learning process {Adapted from [51]}.

- **Mathematical Formulation of Interactive Learning**

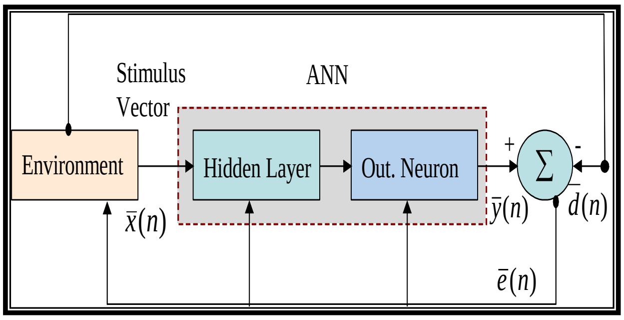

Figure 3. Generalized ANN block diagram simulating two diverse learning paradigms adapted from [52].

At Figure 3, an interactive learning model, that becomes in close similarity with a three layers FFANN given at figure 1. That adopts correction feedback stimulating well qualified signals to perform realistic simulation for evaluating learner's performance. At Figure 2, illustrates inputs to the neural network learning model which provided by stimuli unsupervised by either learning environment or instructors' guiding correction signal [51]. The correction signal for the case of learning with a teacher is given by responses outputs of the model will be evaluated by either the environmental conditions (unsupervised learning) [53] or by the instructor. The instructor plays a role in improving the input data (stimulating learning pattern), by reducing noise and redundancy of learning model pattern input .In accordance with instructor's experience, he provides illustrated model with clear data by maximizing learning environmental signal to noise ratio [54]

By more details, referring to above Figure 4; the error vector $\bar{e}(n)$ at any time instant (n) observed during learning processes is given by:

$$\bar{e}(n) = \bar{y}(n) - \bar{d}(n) \tag{1}$$

Where $\bar{e}(n)$ = is the error correcting signal vector that is controlling adaptively the learning process outcome,

$\bar{y}(n)$ is the obtained outcome (output) signal developed by ANN model, and $\bar{d}(n)$ …… is the desired vector or numerical value(s). Moreover, the following four equations are deduced:

$$V_k(n) = X_j(n) W_{kj}^T(n) \tag{2}$$

$$Y_k(n) = \varphi(V_k(n)) = (1 - e^{-\lambda V_k(n)})/(1 + e^{-\lambda V_k(n)}) \tag{3}$$

$$e_k(n) = |d_k(n) - y_k(n)| \tag{4}$$

$$W_{kj}(n+1) = W_{kj}(n) + \Delta W_{kj}(n) \tag{5}$$

Where X is input vector and W is the weight vector. φ is the activation function. Y is the output. e_k is the error value and d_k is the desired output. Note that ΔW_{kj} (n) is the dynamical change of weight vector value. Above four equations are commonly applied for both learning paradigms: supervised (interactive learning with a tutor), and unsupervised (learning though student's self-study). The dynamical changes of weight vector value specifically for supervised phase is given by:

$$\Delta W_{kj}(n) = \eta e_k(n) X_j(n) \tag{6}$$

Where η is the learning rate value during the learning process for both learning paradigms. At this case of supervised learning, instructor shapes child's behavior by positive/ negative reinforcement Also, Teacher presents the information and then students demonstrate that they understand the material. At the end of this learning paradigm, assessment of students' achievement is obtained primarily through testing results. However, for unsupervised paradigm, dynamical change of weight vector value is given by:

$$\Delta W_{kj}(n) = \eta Y_k(n) X_j(n) \tag{7}$$

Noting that e_k(n) equation (6) is substituted by y_k(n) at any arbitrary time instant (n) during the interactive learning process. Referring to Figure 2, the correction signal which provided by a tutor should take into consideration the noisy environmental level inside classrooms (such as noisy crowdedness) .In other words, that level is quantitatively measured as signal to noise (S/N) ratio or equivalently the additive noise power (σ) to the ideally sensory clear signal. Consequently, the response time response measured by number of training cycles (n) { as defined at the subsection in the above *(B)* by the two equations (6) & (7)}. Noting value of (n) should have been increased until reaching learning convergence instant ,when:

$$\Delta W_{kj}(n) = 0 \tag{8}$$

That above condition given by equation (8), could be fulfilled only if the desired output learning has been obtained after some number of training cycles learning convergence (response time) in fulfillment of the above two equations (6) & (7).

3. REVISING OF TWO FEEDBACK/ASSESSMENT CONCEPTS

In this section, a brief presentation for educational assessment phenomenon basics have been introduced. It is well known that assessment issue has a broad and rapidly growing field, with a strong theoretical and empirical base [55]. However, an assessment expert couldn't be found who is capable to employ sound practices to guide any teaching process. That for obtaining more systematical investigation towards planning as well as implementation for programming of observed learning assessment phenomenon [56].The basic concepts needed to more systematic investigation of suggested assessment analysis and evaluation are presented at [57]. Formative: Given throughout the learning process, formative assessments seek to determine how students are progressing through a certain learning goal. Summative: Given at the end of the year or unit, summative assessments assess a student's mastery of a topic after instruction. The next two subsections *(A, and B)* introduce a brief revising for formative assessment, summative assessment, and student's self-assessment respectively: Firstly, formative assessment which includes formal and informal processes teachers and students use together evidence for the purpose of improving learning. Secondly, summative assessment that provide evidence of student achievement for the purpose of making a judgment about student competence or program effectiveness. In their widely read article "Inside the Black Box," Mr. Black and Mr. Wiliam demonstrated that improving formative assessment raises student achievement. Now they and their colleagues report on a follow-up project that has helped teachers change their practice, and students change their behavior so that everyone shares responsibility for the students' learning [58]. Additionally, this work interestingly motivated by formative assessment and learning regulation for different mathematical conceptions published at [59]. Assessment is used in many ways in education. a good deal of attention is now given to its use in helping teaching, and learning, described as assessment for learning (A f L), or formative assessment. Here the focus is on assessment of learning, or summative assessment describe as assessment of learning (A O L), which is used to summarize what students know or can do at certain times in order to report achievement and progress [60][61].

3.1 Formative Assessment

Formative assessment is also known as Assessment for Learning that is defined as the process of seeking and interpreting evidence for use by learners and their teachers to decide where the learners are in their learning, where they need to go and how best to get there". It do not result in an evaluation. Information about what a student knows, understands and is able to do is used by both the teacher and the learner to determine where learners are in their learning and how to achieve learning goals. In more details, this kind of assessment refers to the gathering of information or data about student learning during a course or program that is used to guide improvements in teaching and learning. Furthermore, Formative assessment activities are usually low-stakes or no-stakes; they do not contribute substantially to the final evaluation or grade of the student or may not even be assessed at the individual student level. For example, posing a question in class and asking for a show of hands in support of different response options would be a formative assessment at the class level. Observing how many students responded incorrectly would be used to guide further teaching [62]. Therefore, this paper adopts that model capable for learning assessment via online testing for a virtual group of 500 students. These students have been subjected to twenty Multiple Choice Questions (MCQ^s), which concerned with some computer science curriculum. Herein, attention paid to search for optimal estimated penalty value in case of erroneous (incorrect) selected answers. These selected answers have been assigned freely (with randomized probability value) by any arbitrary virtual student member out of 500. Furthermore, By using suggested ANN model, a fairly unbiased estimated penalty values have been obtained after measuring simulated outcomes of proceeded MCQ^s virtual testing sessions. During examination sessions, fixed number of MCQ^s have been submitted to the student. Interestingly, examined students have provided with their ability to skip (freely at his request) all provided answers for any submitted question.

3.2 Summative Assessment

Conversely, to the above concept presenting formative assessment at subsection A , summative assessment is known as Assessment of Learning *(AOL)*results in an evaluation of student achievement. Referring to [63], Summative assessment aims to evaluate student learning and academic achievement at the end of a term, year or semester by comparing it against a universal standard or school benchmark. Summative assessments often have a high point value, take place under controlled conditions, and therefore have more visibility. *Four types of summative assessment*: End-of-term or midterm exams& Cumulative work over an extended period such as a final project or creative portfolio& End-of-unit or chapter tests, and Standardized tests that demonstrate school accountability are used. The goal of summative assessment is to evaluate student learning at the end of an instructional unit by comparing it against some standard or benchmark. Furthermore, unlike formative assessments' activities which usually have low-or no-stakes; often summative assessments have high stakes, which means that they have a high point value. They are usually include as examples : a midterm exam, a final project, a paper, and a senior recital. Interestingly, information from summative assessments can be used formatively when students or faculty use it to guide their efforts and activities in subsequent courses. Therein, at that reference, exploration for the extent to which assessment information can be used for both summative and formative purposes, without the use for one purpose endangering the effectiveness of use for the other.

3.3 A Briefing Review of Interactive Blended Learning

Blended learning is defined as the usage of various programs and applications in the provincial learning management system (LMS). Its philosophy is to simulate active learning, individual learning and learner centered learning strategy. Blended learning has a positive influence on the learning process as it is characterized with some advantages such as flexibility in both time and place of the study. More precisely, blended learning environment integrates the advantages of e-learning method with some advantageous aspects of traditional method, such as face-to-face interaction. Blended learning brings traditional physical classes with elements of virtual education together[64] [Finn & Bucceri, 2004]. Blended learning, is also known as mixed, sandwich, hybrid learning, is a method that conflate traditional learning environments in which led by teachers and technological based e-learning environments [65][66][67](Ayala, 2009; Young, 2002; Valiathan, 2002). During the process of choosing blended learning environments, the educators need to think about the skills that are being taught, learning resources, practicality, time and cost, learners' qualifications and suitable learning theories. The relation between Blended Learning and the traditional learning is illustrated schematically at the Figure 4. in below after [68] [Tayebinik, M., 2012] . Additionally, a similar figure is given at:[69] [Ceylan, V. K., & Elitok Kesici, A. (2017)]. Referring to [70][Washington, D.C., 2009 US Dept of Education, 2010], therein it is stated that: "In studies contrasting blends of online and face-to-face instruction with conventional face-to-face classes, blended instruction has been more effective." Moreover. by referring to [71] Çobanoğlu and Ateş (2015; p.92) B-Learning's relation between Face to Face (F2f) learning and online learning via widespread definition. In 21st century, today's students represent the first generation to grow up with new technologies and are considered as the Z-generation digital natives. They spend their entire lives surrounded by and using computers, videogames, digital music players, video cams, cell phones, and all the other toys and tools of the digital age. Today's average college graduates spend less than 5,000 hours of their lives reading, but over 10,000 hours playing video games (not to mention 20,000 hours watching TV) [72](Prensky, 2001). Computer games, email, the Internet, cell phones and instant messaging are integral parts of their lives. Accordingly, instructors should not ignore new developments in Educational Technologies, which create rich learning environments. Also, instructors should include digital materials to their learning environments so that more sharing and accessibility will be possible with the Z-generation students, who has new skills and interests in different instructional materials.

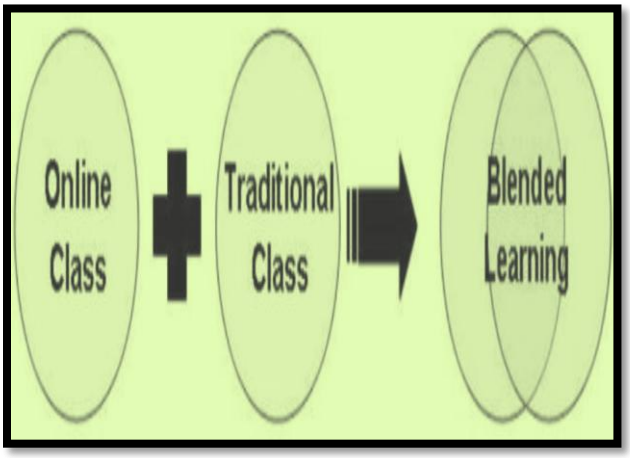

Figure 4. A Schematic Drawing that presents the construction of Blended Learning Environment.

{Adapted From [Tayebinik, M., 2012]}

4. PRACTICAL FIELD EXPERIMENTAL RESULTS

The obtained practical field results after experimental educational processes have been presented at this section by four tabulated numerical results as follows. At the two tables numbered as (1 & 2), obtained practical results after performing experimental work by Computer Aided Learning (C A L) using different software packages. However at tables numbered as (3&4) presents results after some Blended Learning experimental work. Both educational methodologies are subjected to FB / Assessment processes compared with the classical Face to Face (F 2 F) teaching/learning and the details explanations are introduced in the two following paragraphs. Referring to the following two tables : (Table.1 & Table.2), given in below, they have been adapted from [12] (H. M. Mustafa, and Ayoub Al-Hamadi,2009). Both tables illustrated the obtained practical field results after performing pre-assigned three different learning experiments. At Table.1, illustrated results are classified in accordance with individual students' difference learning styles after the application of three teaching/learning experimental methodologies, as following. Firstly, the classical learning style is carried out by students/teacher interactive Face to Face (F 2 F) inside the classroom presenting the control group (15 students). Secondly, learning is taken place using a suggested software learning package without association of teacher's voice, i.e. by using only the computer Visual Display Unit (V D U). The last educational experimental methodology is carried out using (C A L) package that is associated with teacher's voice, i.e. simultaneously visual and audible signals . This table gives students' academic achievements represented by (obtained outcome marks). The tabulated marks are normalized w. r .t. the maximum virtual mark be 100. At the Table.2, shown in below, the detailed statistical analysis and comparison among the three obtained experimental outcomes resulting marks, is given. It is noticed that the two suggested corrective feedbacks / assessments are presented at the second and third rows at Table 1. They are presenting two experimental groups(each composed of 15 students), they are respectively in correspondence with the Summative and Formative Feedback/Assessment w. r. t. the Face to Face (F 2 F)outcome given at the first row(Control group).

Table1. Illustrates students' marks after performing three educational experiments associated to CAL

Classical Learning	**35**	**43**	**29**	**50**	**37**	**17**	**10**	**60**	**20**	**48**	**15**	**55**	**40**	**8**	**20**
CAL without Voice	**39**	**29**	**52**	**60**	**50**	**68**	**62**	**30**	**55**	**42**	**40**	**59**	**48**	**70**	**2**
CAL with Voice	**65**	**70**	**50**	**75**	**45**	**50**	**62**	**90**	**85**	**50**	**80**	**90**	**58**	**55**	**60**

Table 2. Illustrates statistical analysis of the above (Table 1.) obtained students' Academic Achievements (outcome marks)

Educational Experimental Methodology	**Students' average Achievement score**	**Variance σ**	**Standard deviation $\sqrt{\sigma}$**	**Coefficient of variation ρ**	**Improvement of Academic Achievements [%]**
Classical	**32.46**	**265.32**	**16.28**	**0.50**	**-**
CAL(without tutor's voice)	**46.80**	**297.49**	**17.24**	**0.36**	**44.1%**
CAL(with tutor's voice)	**64.33**	**283.42**	**16.83**	**0.26**	**98.2%**

Table 3. Illustrates students' marks after performing three educational experiments associated to BL.

Classical (F2F)	**54**	**43**	**55**	**53**	**45**	**62**	**55**	**44**	**45**	**61**	**56**	**45**	**54**	**47**	**43**
Summative FB/Assessment	**52**	**80**	**82**	**73**	**64**	**65**	**61**	**53**	**80**	**64**	**65**	**55**	**71**	**70**	**72**
Formative FB /Assessment	**83**	**73**	**79**	**81**	**80**	**82**	**62**	**73**	**71**	**63**	**72**	**83**	**72**	**80**	**62**

Table 4. Illustrates statistical analysis of the above obtained (Table 3.) students' Academic Achievements (outcome marks).

Educational Experimental Methodology	Students' Average Academic Achievements (M)	Variance σ	Standard deviation $\sqrt{\sigma}$	Coefficient of variation $\rho = \sqrt{\sigma}$ / M	Improvement of academic Achievements [%]
Classical (F2F)	50.8	40.02	6.32	0.124	-
Summative FB/Assessment	67.13	85.04	9.22	0.137	**32.14 %**
Formative FB /Assessment	75.2	42.29	6.5	0.086	**48.03%**

5. SIMULATION RESULTS AND INTERPRETATIONS

Herein, one of ANN models' design parameters namely gain factor value (λi) has been adopted for explicit simulation for measuring the learners' individual differences, as an Index of learners' Learning Styles. That adopted parameter is motivated by Felder-Soloman Index of Learning Style (ILS) measures learners' styles [73][Felder, R. M., and Brent, R., 2005]. Variances on students' blended learning perception according to learning style preferences. The gain factor values (λi) could be considered relevantly to represent learners' individual differences including their intrinsic characteristics, preferences, and personalities. That is simulated by various gain factor (slope) values and different neurons' number as well, contributing to the learning process. In Figure 5, a general normalized ANN learning model is shown as a set of performance curves. It represents various gain factor values (denoted by λ design parameter). This set of λ_i values are originated from the odd sigmoid activation function given by:

$$y(t) = \frac{1-e^{-\lambda t}}{1+e^{-\lambda t}} \tag{9}$$

For $0 \le t \le \infty$

By changing values of this parameter, results in various response time (speeds)in reaching optimum (desired) achievements in accordance with the following equation:.

Y(n)=(1-exp(-λ_i(n-1)))/(1+exp(-λi(n-1)))
(10)

Where λ_i represents one of gain factors (slopes) for odd sigmoid function given by equation (8) and (n), represents the learning convergence (response) time expressed in number of training cycles (epochs).

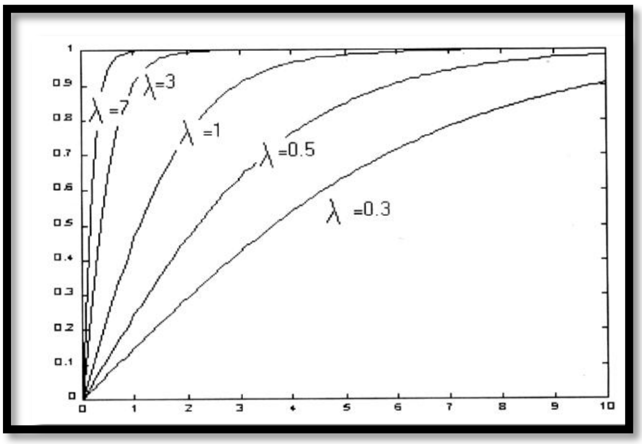

Figure 5. A set of personalized intrinsic learners' performance curves of model with various learning styles' values that corresponded to gain factor (λ) values.

Referring to some recently findings announced at [74][Chang, 2014]. These findings illustrated that: (a) There were no significant differences in academic achievement test scores between blended e-learning and traditional (face to face) learning; (b) students in the experimental group obtained significantly higher scores on self-assessment than students in the supervised control experimental group; (c) students' academic achievement test scores on self-assessment were significantly higher after studying through blended e-learning than before.

6. EFFECT OF NEURON'S NUMBER ON LEARNERS' SCORES

Figure 6 introduces the flowchart for simulation program which applied for performance evaluation of behavioral learning processes. That Figure presents a simplified macro-level flowchart which briefly describes the algorithmic steps for realistic simulation program of adopted Artificial Neural Networks' model for different number of neurons. The obtained depicted three graphs at Figures 7 and the other tree graphs shown at Figure 8 have been derived after running of simulation program for different neurons' number following feedbacks/assessments that simulated by different learningrate values (0.05, 0.1, and 0.3). Noting, these values η simulate respectivel the three educational methodologies (F2F & Summative, and Formative) FB/Assessments. Interestingly, both figures consider the individual differences of learners as each of them characterized by his own fixed intrinsic Gain Factor Value (λ).Similarly, the three obtained graphs depicted at Figures 9 (representing the academic achievement outcome) and the other three graphs given at Figure 10 (representing the learning convergence time). Both have been derived after running of simulation program for different Gain Factor (λ) values which correspond to intrinsic individual learners' differences, and different number of neurons contributing to learning process. Interestingly, both figures consider the individual differences of learners as each of them characterized by his own intrinsic graph (Gain Factor (λ) value), for fixed learning rate value η = 0.3.

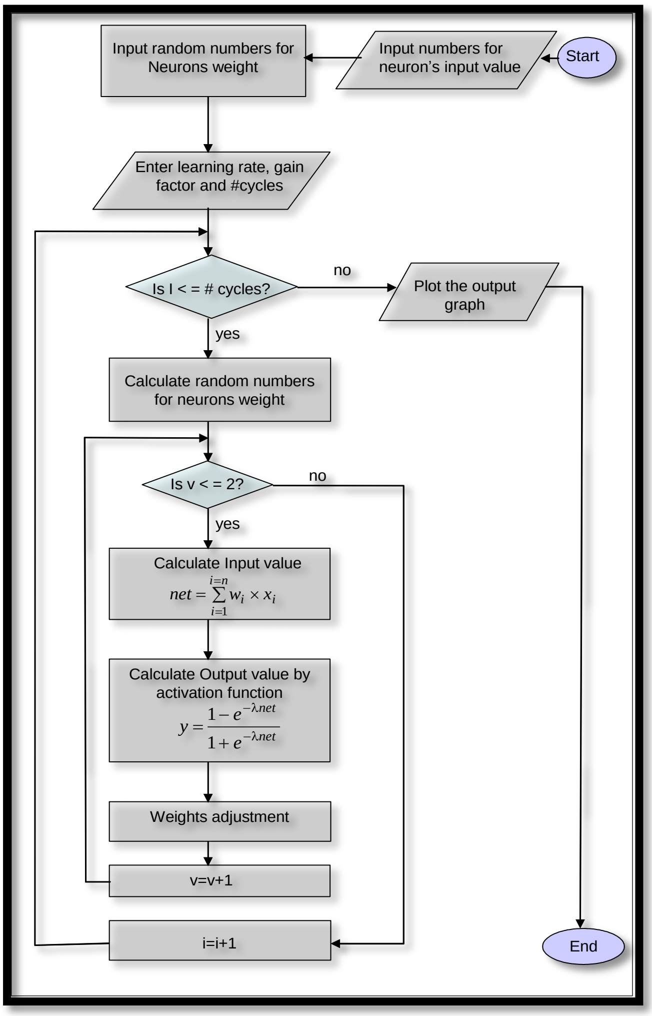

Figure 6. A simplified macro level flowchart that describing algorithmic steps for Artificial Neural Networks modeling considering various neurons' number.

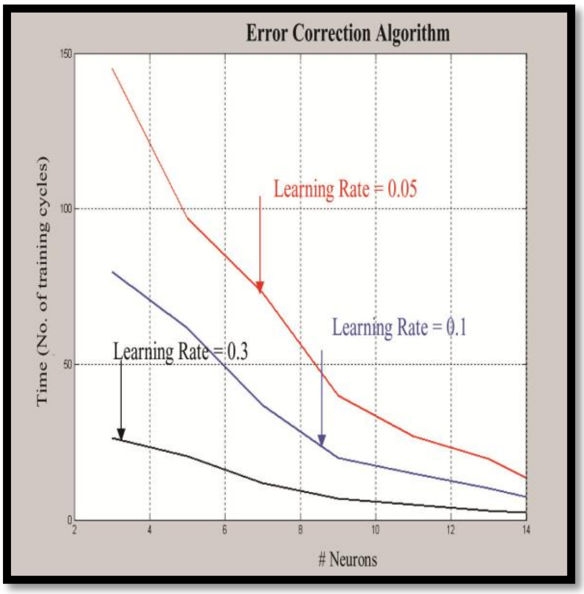

Figure 7. Illustrates learning by using error correction algorithm based on time response (learning convergence)parameter that is measured by No. of training cycle for three different learning rate values η (0.05,0.1, and 0.3) considering the fixed value of gain factor = 0.5

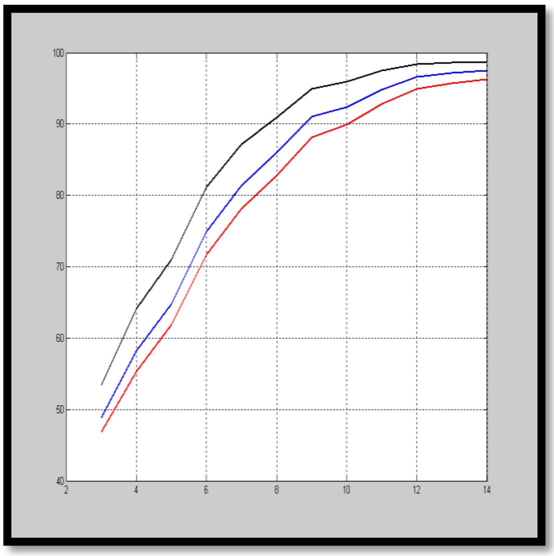

Figure 8. Illustrates simulated academic achievements (learning outcomes) presented as normalized degree versus # Neurons for different learning rate values η (0.3, 0.1, and 0.05) and constant gain factor = 1. These values of learning rate parameter η values are observed to be inversely proportion to the corresponding educational noisy environment.

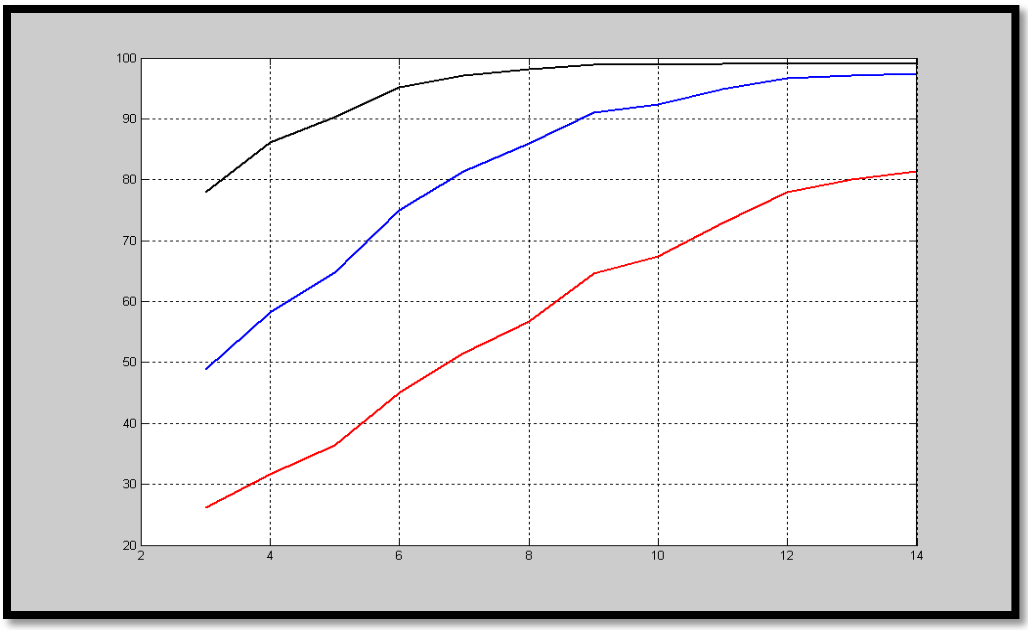

Figure 9. Illustrate students' academic achievement for versus different gain factor values(0.5,1, and 2) when fixed # training cycles = 300, and learning rate value = 0.3.

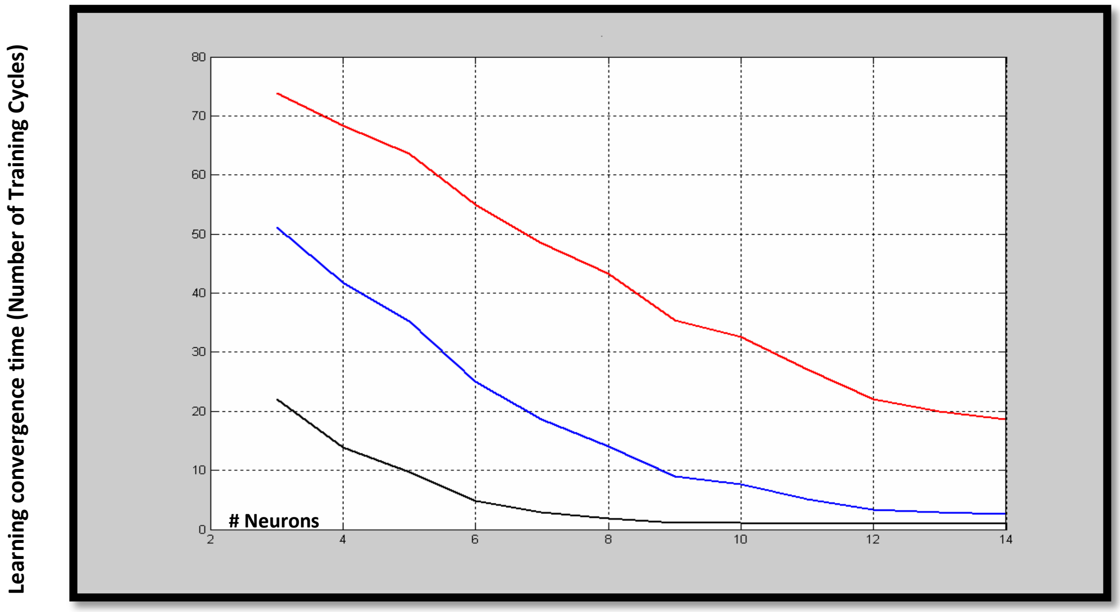

Figure 10. Illustrates time response (learning convergence time)parameter that measured by No. of training cycle for three different gain factor values (0.5,1, and 2) by fixed learning rate value = 0.3.

7. CONCLUSIONS

This research work adopted the novel interdisciplinary and challenging research approach tightly coupled to the application of realistically ANN modeling of the BL, E-learning, individual learners' differences , such as that introduced by six papers [76]&[77]&[78]&[79]&[80], and [81]. More precisely, analysis and evaluation of Formative, or Summative feedback/assessments for e-learning systems, BL, and CAL packages have been adopted by using realistic ANN modeling . In other words, it is motivated by pieces of research integrating three fields of : education, cognitive science, and psychology with computer science and neurobiology to searching for optimality of the ways to learn. Noting that "By Understanding how we learn we can increase the ability to learn" as has been stated by Professor Lili Saghafi at [75](Saghafi, 2015). Specifically, the introduced work inspired by a strong belief that interdisciplinary combining of realistic Artificial Neural Networks (ANNS) modeling with observed challenging phenomenal educational issues such as e-learning, and Blended Learning for introducing its investigational study, analysis, and evaluation.

Accordingly, neural networks' theorists as well as educationalists have recently working together focusing their attention on searching for optimal realistic simulation and modeling of some selected critical educational issues. That's results in an ANN model contributing to optimal investigation of teaching/learning performance functions such as distinct assessment procedures formative (A f L), and summative(A O L)}. Interestingly, it is revised that (A f L), did predict a substantial amount of course outcome and its validity observed to pave the way for diagnostic use and remedial teaching. However, (A O L) is focused on summarizing what students know or can do at certain times in order to report their academic progress, and achievement. Specifically, this piece of research considers the modeling of importance of summative assessment procedures in harmony with procedures of formative assessment by implementation of a relevant software computer assessment package in addition to considering the different number of neurons contributing to learning process.

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