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Comparative Analogy of Overcrowded Effects in Classrooms versus Solving 'Cocktail Party Problem' (Neural Networks Approach)

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Abstract— This piece of research addressed a systematic approach for evaluation of an interdisciplinary educational challenging phenomenon observed in children's classrooms. Introduced phenomenon is associated with effects of the physical educational environment on learning performance in classrooms. Specifically, it describes the serious problematic issue of overcrowded effect on classrooms' learning / teaching performance. It has been comparatively presented here versus a challenging phenomenal problem of human's selectivity auditory scene analysis. This problem deals with an auditory perception phenomenon, namely known as Cocktail Party Problem (CPP), which originated by the process carried out by the auditory system of a human (child) while listening. Commonly, this process experienced as following one speaker (teacher' speech) in the presence of another overcrowded classroom noisy effect. Herein, the adopted approach presented comparative study which motivated by insight into auditory perception, which is derived from original Marr's vision theory. In nature, observed OCR as well as pattern recognition processes, both have been carried out under non ideal environmental learning condition (under effect of noisy data). Furthermore, introduced proposal for active audition modeling is motivated by analogous active vision processes, such as that observed during Optical Character Recognition (OCR).

Index Terms— Artificial neural network modeling, noisy crowded learning environment, signal to noise ratio, cocktail party problem.

I. INTRODUCTION

The effects of the physical learning environment in classrooms includes three distinct effective factors namely: noisy level in classes, overcrowded classroom space, and housing and neighborhood quality. Specifically, this work explores pupils' ability to listen to, and follow, one speaker in the presence of others. More precisely, it considers investigational answer for a challenging question: How students could focus on teachers' interactive speaking in noisy crowd environment? When discussing the auditory system it is important to understand the difference between the physical mechanism of the ear and the central auditory nervous system in the brain responsible for processing auditory information [1]. Commonly, this process experienced as following one speaker in the presence of another. Such common experience, we may take it for granted as called: "the cocktail party problem" CPP. It can be trivial experienced process for a normal human (student) listener. From a neurological P.O.V., sounds all enter the ear as one cacophonous roar, but the brain processes all the information and tunes into one sound, such as a person's voice, and filters out the rest [2]. Interestingly, referring to brain functions and anatomical structure, sound and light are processed by different receptors and neural pathways in the brain. However, by considering current knowledge of how auditory and visual stimuli sensations are responding to sound and light respectively. They are represented in the nervous system in similar complexity and that undergo with similar initial processing by the nervous system [3]. Furthermore, by referring to findings announced after some experimental work, the results published therein at [3] have implicitly declared that auditory and visual short term memory employ similar mechanisms. Consequently, modeling of Artificial Neural Networks (ANNs) has been adopted for realistic simulation for students' selective attention in overcrowded classrooms. Therefore, an ANN unsupervised model has been suggested herein, to measure performance of selective attention and recognition for visual signal specifically optical character recognition (OCR) subjected to various contaminating noisy levels (Signal to noise ratios) [4]. Finally, obtained simulation results declared the effect of Neural Network's parameters' relation between extrinsic {various noisy levels (corresponding learning rate values)} and intrinsic {individual students' differences (corresponding to various gain factor values)} factors on recognition and selective attention performances. Additionally, presented obtained findings proved to be in well agreement with recently published results considering the dealing with noisy environmental learning problem [5]. The Rest of this paper organized as

follows. A brief for practical educational model in performing of interactive learning processes at the next second section is presented. It also introduces the effect of noisy environment on the process of optical character recognition (OCR). The third section presents a brief revising of concerned with two interrelated problematic issues namely overcrowded classroom and Cocktail Party Problem CCP. This revising section for both problems is based on two references introduced at [5]&[2] respectively. The simulation tabulated and graphical obtained results have been given in details at the fourth section. Finally, at the fifth section conclusions have been introduced.

II. BASIC EDUCATIONAL MODELING

Referring to Fig.1, it illustrates teaching / learning interactive model that well qualified to perform realistic simulation of brain cognitive selectivity/ tuning function. That figure, considers noisy physical environmental inputs to stimulate the ANN model as unsupervised learning paradigm. However, conversely, in case of adopting supervised learning paradigm. Teachers play a dominant role for improving the input noisy contaminated data. That's by reducing environmental noise and redundancy of input pattern model and its implicit signal to noise S/N ratio. Firstly, that model given at Figure.1 can be provided with cleared data by maximizing its S/N ratio. Such improvement of S/N ratio in noisy learning environment results in better hearing for understanding quality as recently announced findings "The psychological component is that it's a sound we want or need to hear, which is why we can tune into it" [1]. In other words, that improvement implies the need of less number of training cycles, tuning / selectivity to One Person at a Loud Party could be attained analogously to OCR process (as shown at Table 1) and introduced by graphical form in Figure 2. More precisely, in nature, optical character recognition OCR as well as pattern recognition processes observed to be carried out under non ideal environmental condition (under effect of noisy data)[4]. Interestingly, obtained simulation results for OCR Under different environmental noisy levels are given in a tabulated form at both Tables 1. Similarly, improvement of learning rate values results in better quality of tuning / selectivity performance indicated by decreased learning response (convergence) time. Furthermore, such improvement illustrated well by simulation results presented graphically at Figure.3 and tabulated (on the average) at Table 2. Secondly, tutors' experience observed to be transferred via a link to children's brain model (ANN) as a correction simulating signal in noisy learning environment. So, that experience may be capable of increasing number of neurons contributing to better tuning process convergence [5]. Specifically, those increased neurons are placed at hippocampus children brain area [6].

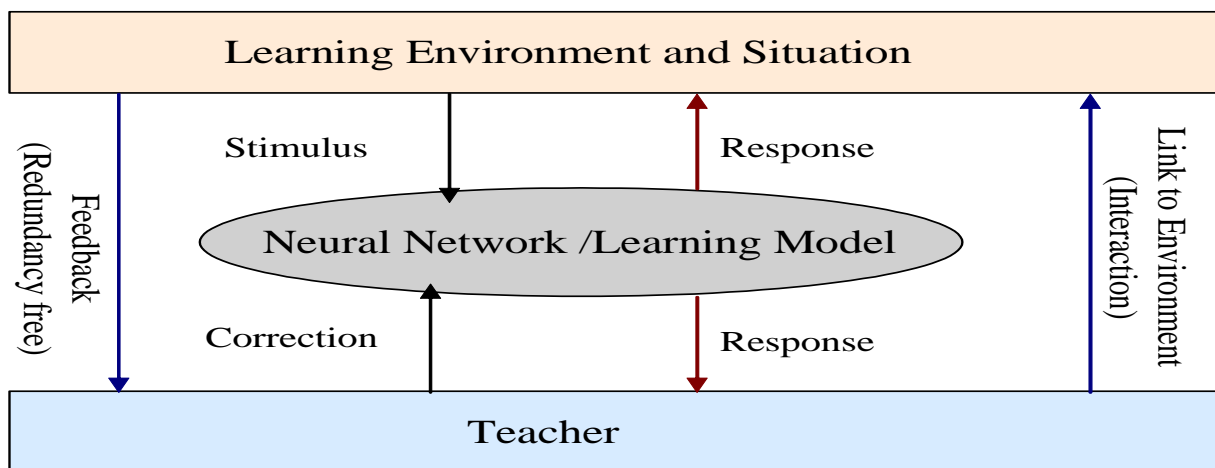


Fig 1. Illustrates a simplified view for interactive educational process adapted from [7].

Table 1. The relation between S/N power ratio, noise power, and learning response time

Signal to noise power ratio	5	10	20
Noise power σ at learning environment	0.2	0.1	0.05
Learning response time	85	62	47



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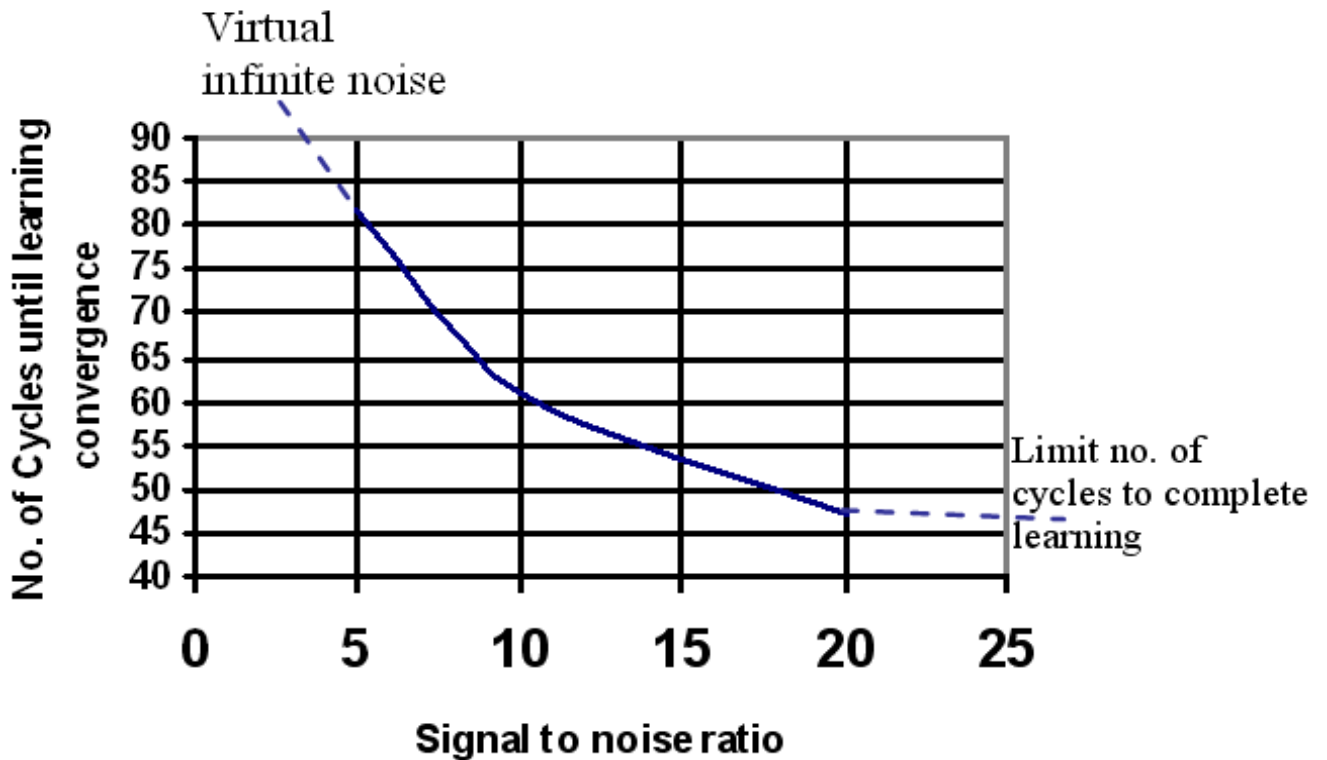


Fig 2. Graphical presentation for learning performance under noisy conditions with reference to above Table 1.

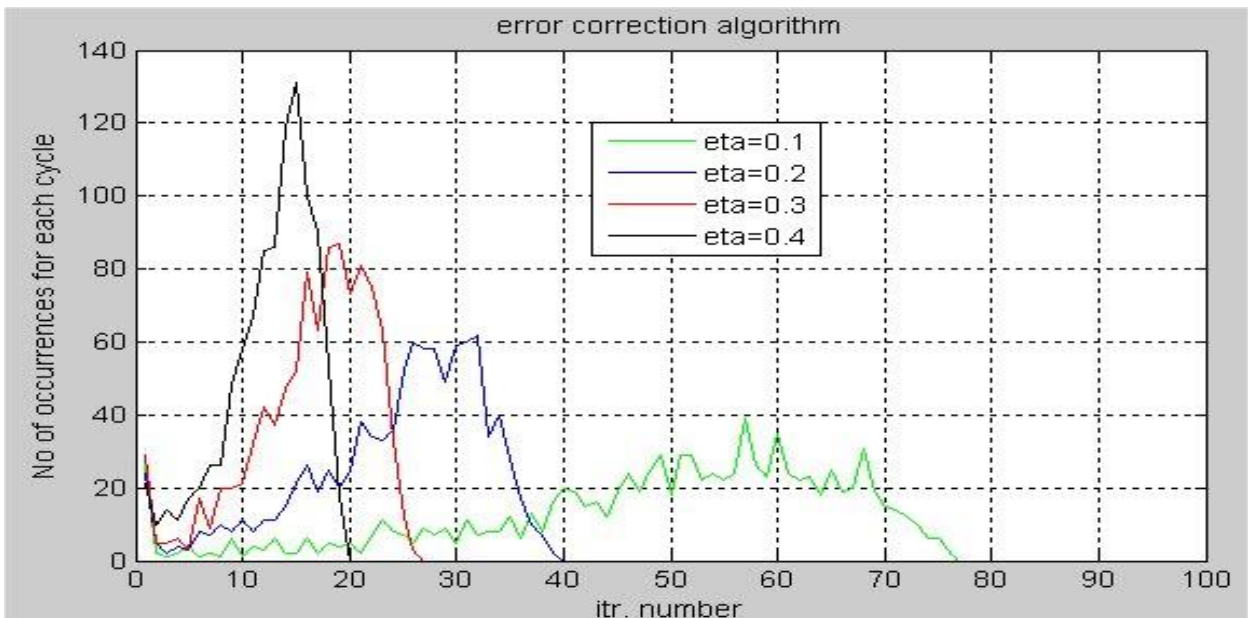


Fig 3. Illustrates the statistical distribution of learning convergence time for different learning rate values (eta) noting that time response obeys Gaussian distribution in an approximate manner. That is similar to bell shape form. adapted from [8].

Table 2. The relation between learning rate values and on the average convergence (response) learning time. It is derived from the above Figure. 3

Learning rate Value (η)	0.1	0.2	0.3	0.4
Average Response time	55	27	17	13



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III. REVISING FOR OVERCROWDED CLASSROOM AND COCKTAIL PARTY PROBLEM

This section presents two revising briefs for Overcrowded Classrooms, and Cocktail Party problematic issues at two subsections (A.&B.) respectively, as follows.

A. *Overcrowded classroom problem*

Classroom size has been a hotly contested debate in the education realm for some time. Teachers and students alike have a stake in the size of a classroom, and the effects are far-reaching on both sides of the issue. In fact, many parents base their decision on whether to send their child to a particular school on the prospective size of the child's classroom.[9]

In public as well as private schools, effects of disproportionate classroom size are far-reaching. When educators deal with more kids than they are accustomed to teaching at one time; they put in extra hours outside of the classroom, grading more exams and homework assignments. Kids don't receive enough attention from their teachers. Moreover, since classrooms without size restrictions often result in too many kids per class, effects can also include a lack of supplies for kids, as well as more discipline problems, as it is harder for the teacher to watch everyone [9]

1) *Overcrowding in public school classrooms*

Overcrowding in public school classrooms is an ongoing problem. As schools across the country get shut down, those students get sent to another school. Those schools end up having larger classrooms for the most part. Eventually, those schools become overcrowded. Unfortunately, overcrowding of classrooms lead to many problems in the long run for the most part. This is one of the reasons that the public school system in the United States has taken such a bad rap. But, the short-term and long-term effects of overcrowded classrooms are very detrimental. What are the effects in the first place?. The first effect would be a drop in grades for the most part. With so many students packed into one classroom, the teacher is not going to be able to have one-on-one time with the students that need help. Students with learning disabilities are just generally weak in one subject or an aspect of any subject will be at a grave disadvantage. The single teacher would not be able to dedicate his/her time to all the students. The students who need help from the teacher will probably not receive it due to the number of students in the classroom. Also in that respect, expect students' grades to drop in the process. Grades and size of classroom do usually go hand and hand with one another. As a result, when in college, one might choose to pick a small to medium-sized classroom over a larger classroom. Conclusively, Kids tend to be very chatty when grouped together. Even with a small to medium-sized classroom, the teacher will still have work cut out trying to keep them quiet. In the case of an overcrowded classroom, the teacher will lose valuable lesson time because the kids cannot keep quiet Damage.

2) *Overcrowding in private school classrooms*

In the case of a private education classroom, things can get even more hectic. At that type of education, children classrooms usually hold the most unruly of kids. In an overcrowded classroom in regards to private education, it can be very chaotic. Plus, their grades could possibly drop even further. Due to the size of the classroom, some kids can huddle together and do things behind the teacher's back. Additionally, overcrowded classrooms put the next school at risk of being shut down. With aspects such as standardized testing, a lack of teachers, and so forth, overcrowded classrooms can hinder kids' performance. If they performance is hindered, the overall school performance goes down. Thus, the schools get a low performance rating. As a result, the school could receive decreased funding. In the end, the school could get closed down.

B. *Cocktail Party Problem*

Briefly CCP is a challenging problem in auditory perception. Historically, this CCP observed at cocktail party phenomenon, the delineation of which goes back to a classic paper by Cherry in 1953 [10][11]. In this section, it is worthy to address the following issues associated to CCP: (1) human auditory scene analysis, which is a general process carried out by the auditory system of a human listener; (2) insight into auditory perception, which is derived from Marr's vision theory; (3) computational auditory scene analysis, which focuses on specific approaches aimed at solving the machine cocktail party problem; (4) active audition, the proposal for which is motivated by analogy with active vision, and (5) discussion of brain theory and independent component analysis,



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on the one hand, and correlative neural firing, on the other [12]. Interestingly, the ability to maintain a conversation with one person while at a noisy cocktail party has often been used to illustrate a general characteristic of auditory selective attention, namely that perceivers' attention is usually directed to a particular set of sounds and not to others [13][14]. Part of the cocktail party problem involves parsing co-occurring speech sounds and simultaneously integrating these various speech tokens into meaningful units ("auditory scene analysis"). That auditory scene analysis framework to be neuro-biologically feasible, it would have to accommodate the ability to switch the focus of attention from one speech signal of interest to another and do so with relative ease [12].

IV. SIMULATION RESULT

At this section, obtained simulation results presented by a set of three graphical figures to illustrate the effect of environmental noise power on selectively attending performance to auditory objects as well as the noise effect at overcrowded classrooms [15][16]. Furthermore, both figures (Fig.4 & Fig.5) have been introduced considering ANN modeling for associated interrelations of kids' activity for tuning in to one person (tutor) at a loud party (in overcrowded classrooms) [2][15][16]. However, the effect of intrinsic individual children's differences (gain factor values) on selective attention performance is presented at Fig.6.(considering four examples of individual differences of gain factor values: 0.5, 1, 10, and 20).

At Figure 4, the three changes of Noise power values σ (0.2, 0.1, and 0.05). These values correspond to noisy environmental values of S/N (5, 10, and 20). Additionally, they considered to be in correspondence with the three learning rate values η (0.05, 0.1, and 0.3) respectively. Noting that the nearness of balance point (at the x-axis) is a suggested measure for degree of exact tuning to understand the speech of one person. Furthermore, after running of the suggested realistic simulation program, it results in the set of three distribution curves at Figure 4., that considering different learning rates and fixed time (#cycles = 300) & gain factor = 1. Obviously, arbitrary children responses differs in accordance with their individual differences. More precisely, In the case of an overcrowded classroom, not all children are equal. There are some children students who may need more help than others [17]. Consequently, they have to contribute tuning with larger number of neurons as given recently at [5]. Therein, this differences presented by the effect of Neurons' number on percentage degree of lesson focusing (equivalent to tuning process)[5].

Referring to Figure 5, It is worthy to note that statistical variations (on the average) relating learning rate values versus corresponding selectivity convergence (response) time. That time is measured by the number of iteration cycles., obtained output results (of response time) corresponding to the learning rate values (0.1, 0.2, 0.4, 0.6, and 0.8), are given respectively, as (330, 170, 120, 80, and 40) iteration training cycles. Conclusively, convergence time (number of training cycles) is inversely proportional to the corresponding learning rate values. Moreover, it is an interesting remark that under more noisy environmental conditions, learning rate tends to have lower value. Conversely, creatures performing learning rate improvement by interaction with environment, implies increase of their stored experience. Consequently, such creatures have become capable of responding spontaneously to input environmental stimuli in optimal manner, [18][19].

Referring to Figure 6, the obtained results for various individual different gain factor values are comprehensively presenting in statistical graphical form. These results illustrate gain factor effect on improving the value of time response measured after selective focusing (attention process) convergence. These four graphs are concerned with the improvement of the learning parameter response time (number of training cycles). Roughly, observed improvement obtained by various gain factor values (0.5, 1, 10, and 20) those resulted in corresponding training cycles values (10, 7.7, 5, and 3) respectively, (on approximate averages).

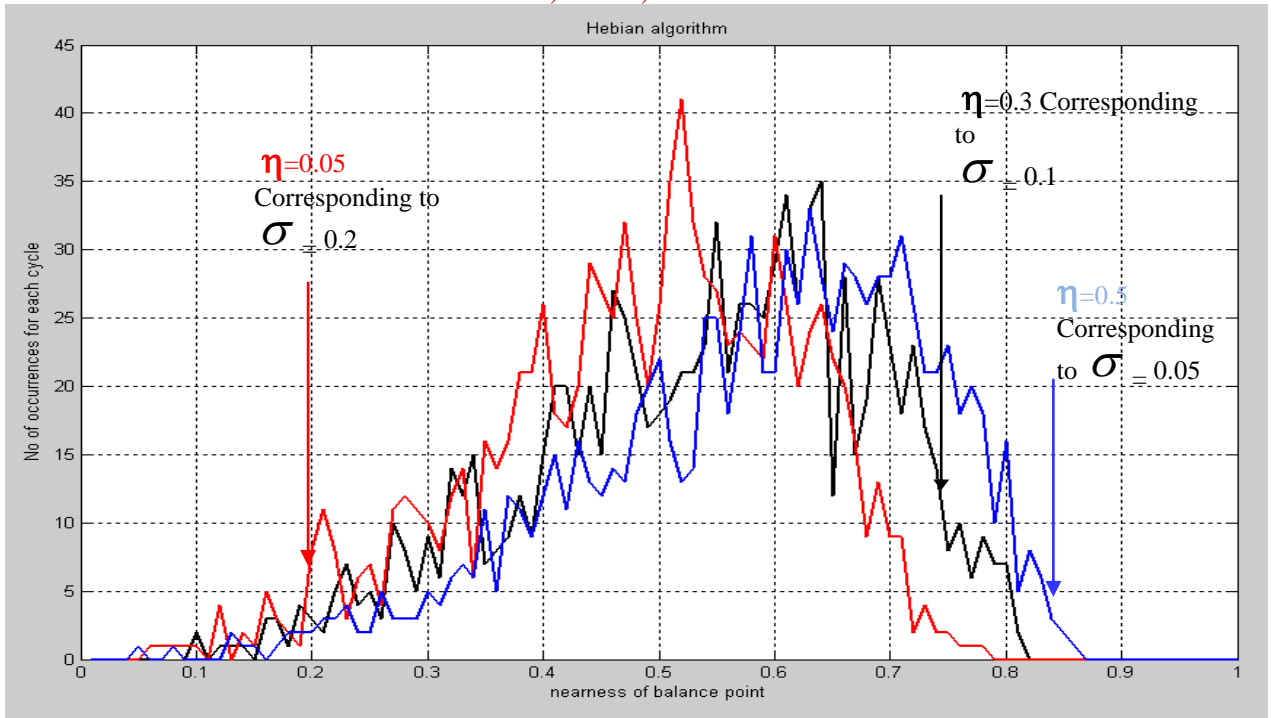


Fig 4. The three changes of Noise power values σ (0.2, 0.1, and 0.05) in noisy environment considered to be in correspondence with three learning rate values η (0.05, 0.5, and 0.5).

Convergence to Selectivity
time (cycles)

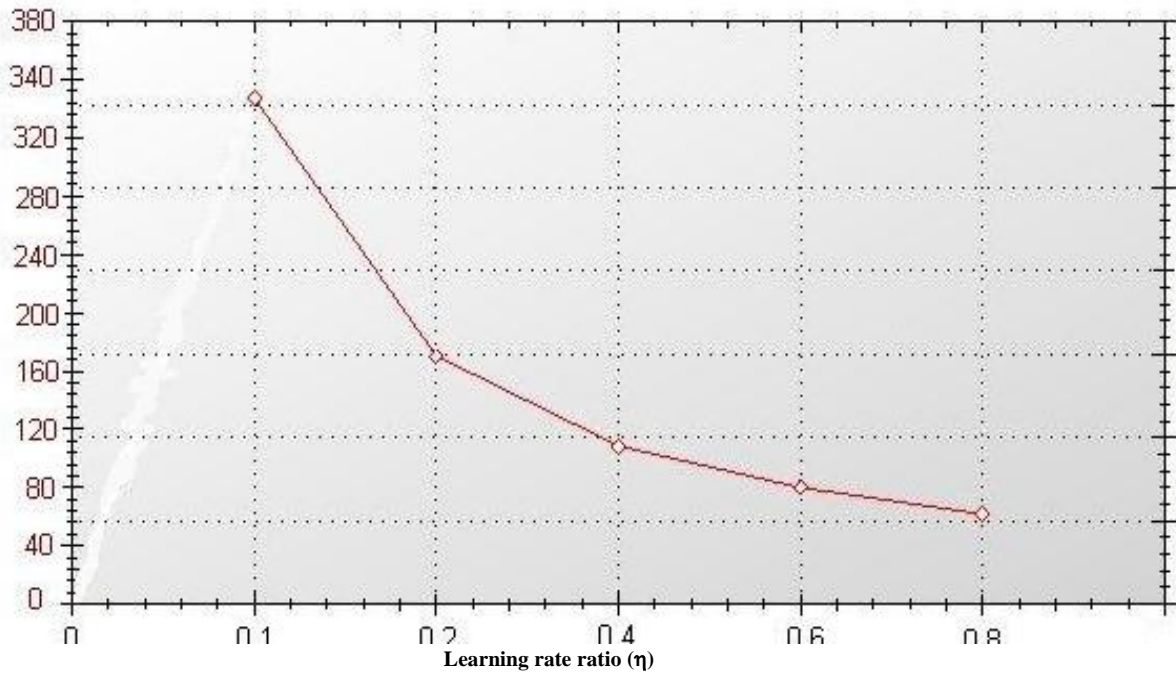


Fig 5. Illustrates the average (of statistical distribution) for selectivity response time (number of iteration cycles) versus different learning rate values (η).

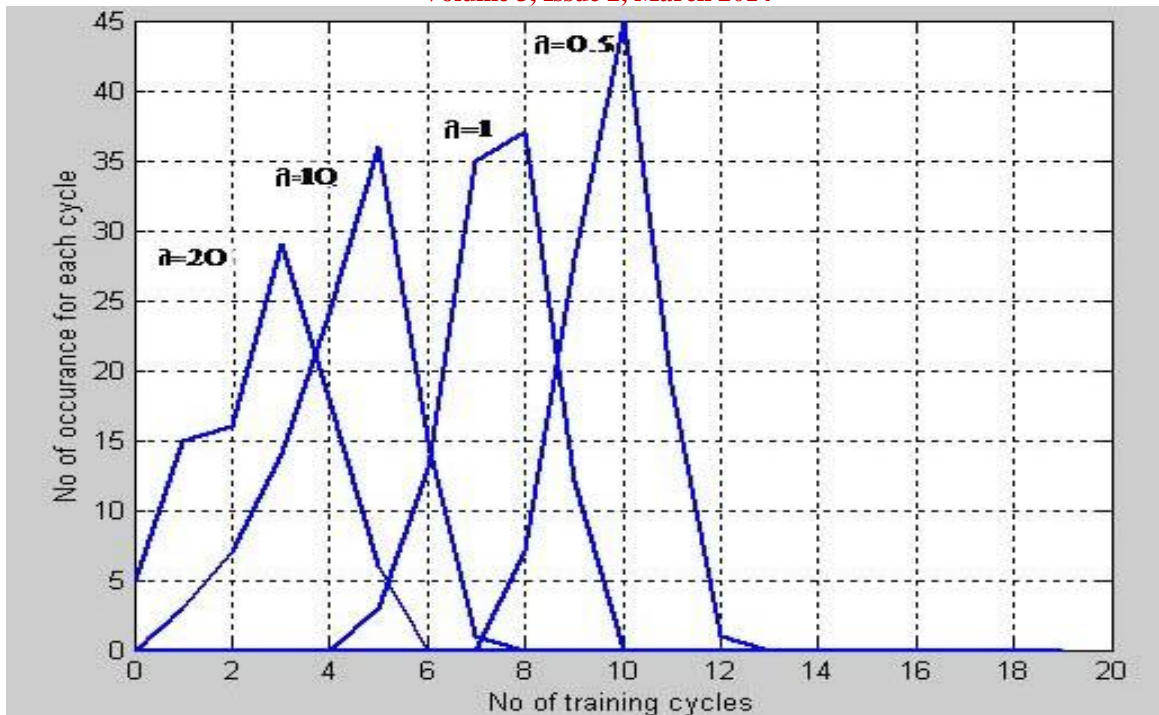


Fig 6. Illustrates improvement of average response time (selective focusing) by increase of the gain factor values

V. CONCLUSION

Generally, at any level of education, school bears their responsibility in order to create relevant enhancing of learning environment. That is based on modern skills and knowledge and facilitates students' understanding of the world of technology. That learning environment is regarded as the ensemble of the intellectual, social, and physical environments. Accordingly, schools' responsibility have to take into account students' developed learn performance aside from noisy contaminated (undesirable) effects on created learning environment. This work illustrates clearly the analogous undesirable effect observed by effects of both overcrowded classroom as well as Cocktail Party Problem on learning performance phenomenon. The learning environment supports the student's development into an independent and active learner, carries the basic values of basic education and the school's mental attitude, and preserves and refines the traditions of the region and the school community. Furthermore, the learning environment creates prerequisites and conditions for acquiring a subject as well as for the development of the student's personality.

Interestingly, referring to ANN modeling context, the two parameters: Learning rate and Gain factor are considered by the presented simulated comparative study. Accordingly, interesting simulation results have been obtained by the end conclusion of this work declaring the interrelation between learning rate values versus different noisy levels. As well as, the effect of intrinsic individual children's differences (gain factor values) on selective attention performance is presented. Furthermore, the work illustrates specifically the analogous effect between Artificial Neural Networks modeling of noisy audible data (education in classrooms), versus the noisy physical visual data such as Optical Character Recognition (OCR). The overcrowding in classrooms shown to have negative effect on educational process similar to the noisy learning environmental effect. The interesting results have been obtained indicating an extendable future challenging research.

In future, this work is recommended to be extended by more elaborate practical educational field application, in order to investigate systematically both observed educational phenomena presented herein.



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REFERENCES

- [1] H. Karabulut "The Neuro-Building Blocks of Learning: Improving School Readiness and Overcoming Learning Difficulties" Journal of Education and Future, year: 2013, issue: 4, pp.1 – 15.
- [2] K. Carollo "The Cocktail Party Effect: How We Tune In to One Person at a Loud Party" Published on Apr 18, 2012. Available online at:<http://abcnews.go.com/blogs/health/2012/04/18/the-cocktail-party-effect-how-we-tune-in-to-one-person-at-a-loud-party/>
- [3] K. M Visscher, Elina Kaplan, Michael J Kahana, and Robert Sekuler "Auditory Short-Term Memory Behaves Like Visual Short-Term Memory" Published: February 20, 2007 Available online at: <http://www.plosbiology.org/article/info%3Adoi%2F10.1371%2Fjournal.pbio.0050056>.
- [4] Ghonaimy M.A., Al – Bassiouni, A.M. and Hassan, H.M "Leaning Of Neural Networks Using Noisy Data". Published at the proceedings of Second International Conference on Artificial Intelligence Applications, held in Cairo, Egypt, Jan 22-24, 1994. PP. 387-399.
- [5] Mustafa H, et al. "On Quantified Evaluation Of Noisy Data Impact On Children's Mental Development Using Artificial Neural Networks" Published at ICERI2013, the 6th International Conference of Education, Research and Innovation held in Seville (Spain), on the 18th, 19th and 20th of November, 2013.
- [6] Z. et al, 1998" Interpreting neuronal population activity by reconstruction." Journal of Neurophysiology, 79:1017-44.
- [7] Mustafa , H.M. , Al-Hamadi ,A., and Kortam , M. H.(2010) "On Assessment of Teaching A Mathematical Topic Using Neural Networks Models (with a case study) " Published at conference proceeding of Technology and its Integration into Mathematics Education Time 2010 , held in Malaga , Spain , on July 6th-10th, 2010.Available online at: <http://nms.lu.lv/MCG/>
- [8] Mustafa, H.M. 2007:On Quantifying Learning Creativity Using Artificial Neural Networks (Nero-physiological Cognitive Approach) Published at National Conference on Applied Cognitive Psychology. India,29 –30 November, 2007.
- [9] Lynda Moultry Belcher, Ehow Contributor "The Effects Of Classroom Size" Available online at http://www.ehow.com/print/info_7864556_effects-classroom-size.html
- [10] Cherry, E. C. (1953). Some experiments on the recognition of speech, with one and two ears. Journal of the Acoustical Society of America, 25, 975–979.
- [11] Cherry, E. C., & Taylor. K. (1954). Some further experiments upon the recognition of speech, with one and, with two ears. Journal of the Acoustical Society of America, 26, 554–559.
- [12] S. Haykin, and Zhe Chen "The Cocktail Party Problem" Adaptive Systems Lab, McMaster University, Hamilton, Ontario, Canada L8S 4K1.
- [13] Source: Cell "Solving the 'Cocktail Party Problem': How We Can Focus On One Speaker in Noisy Crowds", Date: March 6, 2013. Available online at: <http://www.sciencedaily.com/releases/2013/03/130306134218.htm>
- [14] J.Hamilton Tuning in to the Brain's 'Cocktail Party Effect', Date: November 23, 2010 2:33 PM Available online at:<http://www.npr.org/2010/11/23/131545319/go-wild-birds-bats-share-in-cocktail-party-effect>
- [15] A. C, Arnott SR. "Selectively attending to auditory objects" Published at Front Biosci. On 2000 Jan 1; 5:D202-12. Referred to Rotman Research Institute, Baycrest Centre for Geriatric Care, and Department of Psychology, University of Toronto, Canada. calain@rotman-baycrest.on.ca .Available online at: <http://www.ncbi.nlm.nih.gov/pubmed/10702369>
- [16] P. Khan and Mohammad Iqbal "Over crowded classroom: a serious problem for teachers" Available online at www.elixirpublishers.com (Elixir International Journal) Educational Technology Elixir Edu. Tech. 49 (2012) 10162-10165. Available online at [http://www.elixirpublishers.com/articles/1351260412_49%20\(2012\)%2010162-10165.pdf](http://www.elixirpublishers.com/articles/1351260412_49%20(2012)%2010162-10165.pdf)
- [17] Can Tran "Effects of **overcrowded** classrooms - Education Space 360, Published on January 4, 2011. Available online at: <http://www.educationspace360.com/index.php/effects-of-overcrowded-classrooms-5-5757/>
- [18] F., M., et al., 1988: Two level Neural Networks: Learning by Interaction with Environment, 1st ICNN, San Diego.
- [19] Mustafa, H.M, "brain functional phenomena; and open learning systems" A tutorial presented at the International Conference on Digital Information and Communication Technology and its Applications (DICTAP2011) held from June 21-23, 2011 , at University de Bourgogne, Dijon, France.