Sociological Impact on Education
An Analytical Approach Through Artificial Neural network

P. R. Jayathilaka, K.L. Jayaratne, H.L. Premaratne.

Abstract—This research presented in this paper is an on-going project of an application of neural network and fuzzy models to evaluate the sociological factors which affect the educational performance of the students in Sri Lanka. One of its major goals is to prepare the grounds to device a counseling tool which helps these students for a better performance at their examinations, especially at their G.C.E O/L (General Certificate of Education-Ordinary Level) examination. Closely related sociological factors are collected as raw data and the noise of these data are filtered through the fuzzy interface and the supervised neural network is being utilized to recognize the performance patterns against the chosen social factors.

Keywords—Education, Fuzzy, neural network, prediction, Sociology

I. INTRODUCTION

IT is the great desire of a teacher and a counselor to see all the students of his/her school getting through their exams successfully. Unfortunately every year there is a considerable number of students who are unable to get through their G.C.E. O/L examination. Sri Lankan education system is free from primary education to the first degree. This includes free text books, cloths for uniforms and even food supplements to some selected schools. Each year government spends near hundred billion rupees to provide these facilities. However, According to the statistics each year 350 to 450 thousand students sit for G.C.E. O/L examination but less than 50% get themselves qualified to do their G.C.E. A/L. Spending nearly eleven years in a school and failing G.C.E. O/L examination is really a sad situation. Hence it is obvious that the fact is not mere a personal grief but a social, economical and political issue. Less educational qualification produces less employment opportunities and it causes the increasing of the unemployment problem. This creates youth unrest which even could be leads them for anti social and anti government actions.

Hence, this research is to help these students to perform better at their G.C.E O/L examination. Basically it is an attempt to trace closely related sociological factors as parental relationship, peer relationship, teacher-student relationship, etc and map them against O/L examination results. This would help to identify key factor which affect each individual students and finally it is to help them.

RRev. Piyal Jayathilaka, Student University of Colombo, Sri lanaka, email. piyaljaya@yahoo.com, 0094776189503.
Dr. K.L. Jayaratne, Senior Lecturer, University of Colombo School of Computing.
Dr. H.L. Premaratne, Senior Lecturer, University of Colombo School of Computing.

II. PREVIOUS WORK

A. Philosophical, Psychological and Sociological Aspect of Education

Learning does not imply the academic aspect alone and it could be formal or informal. But in this work the thruster is towards the formal educational aspect. Etiological meaning of the word education is to take out with in which means education is not putting something into a person from the out side but it is to take some thing out of him. The concept of education is built on three major perspectives namely philosophical, psychological and sociological. Philosophical aspect deals with the norms and rules which govern the education while psychological aspect deals with the path way of education in an individualistic perspective and sociological aspect is considered as the source of education and also the receiver of the fruits of the education because education is the process of socialization or the process of an individual becoming a part of a society. Hence what is taught is what is required by the society what it produce is also the necessity of it.According to the great philosopher Plato education is the key to create and sustain his *Republic*, which is the ideal society, Plato proposed in his book *Republic*. For him education is holistic and it should include every human discipline possible as art, skill development, physical discipline, and music.Moore says that philosophy of education is partly connected to the general philosophy by its purpose and more directly connected with it by its methodology [11]. The problems arising from the education are not merely conceptual questions or arguments like in metaphysics but real problems arising from day to day practice. They should be solved instead of dissolving for the sake of analyzing the concept. Though philosophers of education are not interested in metaphysical concept and they are really engaged in activities of justifying educational theories and practice. This justification involves philosophical analysis, analysis of educational concept and scrutinizing various theories of education etc.Educational psychology according to Blonskii is a branch of applied psychology which studies the application of the conclusion s of theoretical psychology to the process of education and teaching [16]. However at present the accepted general view is that education is a distinct discipline which owns its own theories, principles research methods, problems and techniques because its primary goal is to improvement of education[19].The key factors involve in educational Psychology are learner, learning process, learning experience, learning situation or the environment and the teacher [9].Educationists as Pestolozzi, Herbert, and Froebel who emphasis the important of psychology in education, also admit the influences of sociological factors in the child's

development. Ottoway say that educational sociology starts with an assumption that education is an activity which is going on in the society and society in turn determines the nature of the education [3].There had been many researches on the sociological impact on education. Loveless and Holman observing Chinese families, pointed out that biggest problem of migrant workers is the education of their children. As they move to place to place their children get disturbed in their educational activities [8].Social class to which the family belongs also would have a great impact on once education. Willis studied this situation and discovered that children from upper classes do not appreciate education while the children from the lower classes make their own value system as a hindrance to their personal development. Children from the working class show an anti social behavior and do not appreciate academic work in the school [18].

B. Social impact, self concept and Self Descriptive Questionnaire

Social impact could have different interpretations and one such definition of social impact define it as the attitudes collectively hold by the society which is creeping into budding members of the society. This impact over the person actually changes his or her personality.

The Latin term for personality is 'persona' which means 'mask' which implies that personality is the visible part of the person and the study of a person means the study of his or her personality. Personality also includes inner psychological experiences which are collectively called as self. Therefore personality is what makes a person unique and personality governs person's feelings, behaviour, thought patterns and so on. Though personality is psychological it is bonded with biological processes. It is not random, but it is an organization of different aspect for a better interconnected self. Personality cause things to happen and influences the way the individual interaction [1].

Hence, when we say that the society changes persons it actually changes one's personality. Then the question is 'how does society changes personality or person?' There are goals set by different spheres of the social structure and they play a major role to determine the goal of an individual. These goals means the values hold by different groups and the personal goal is the desired value system of the person which help him or her to feel important and accepted. Here comes the mechanism of changing of personality. Person evaluates himself against these values of the society and tries to give him or her, a positive or a negative mark. This triggers the changing mechanism and it ether causes oneself to become a socially accepted figure or an anti-social figure.

In popular social sciences the evaluation of self is called *self-esteem* and ones cognition of his or her self is called *self-concept*. Herbert Marsh in his 25th Vernon-Wall Lecture at the education section of the British Psychology Society quotes Nathaniel Branden, an eminent philosopher and psychologist, who attests to the significance of self-concept and self-esteem.

Nathaniel says that:

It does not exist a single psychological problem – from anxiety to depression, to underachievement at school or at work, to fear of intimacy, happiness or success, to alcohol or drug abuse, to spouse battering or child molestation, to co-dependency and sexual disorders, to passivity and chronic aimlessness, to suicide and crimes of violence – that is not traceable, at least in part, to the problem of deficient self-esteem [7].

According to Rao, self concept is crucial as it is operate as the core function of a person. It is the mechanism of the personality development and the drive for self actualization or improvement or perfection, which is the ultimate goal of an individual [12].

Robinson says that even Americans intuitively believe that poor self esteem is undesirable and it even link with loneliness. When it is said evaluation it does mean a total self evaluation. It is an overall affective evaluation of one's worth or importance.

However, social concept may or may not influence self esteem. For example, believing one can sing well could be a part of one's self concept but it may not let him or her to feel of self-worth. On the other hand one could end up one's life being severally depressed because he or she could not sing. Here exactly the social impact comes to the scene. Another simple example is football world cup season. During this time it could be noticed that many are trying to play football and those who are playing well attract the public attention which leads some others also to do so [13]. So, it means that the cognition of oneself or self-concept is valued against social values and it finally decides the personal goals of an individual.

When it comes to the performance in education this fact holds a greater truth. Quoting Burns, Downey says that self esteem or one' realization of his or her personality greatly affects his or her entire educational life. Poor self concept creates low self esteem and finally leads to low motivation and under achievement. Pupil with low self esteem exhibits behaviour of a fairly negative kind and unwillingness to accept blame for failure. On the contrary the pupil with positive self concept is socially well adjusted and they are working with confidence and realistic and optimistic about their future [5].

Hence. it is obvious that methods should be devised to gather data which brings the facts of one's self-esteem which create one's self concept as a worth human being.

As it involves, conceptual and methodological problems, to make valid measurement of self-esteem is difficult. Conceptual confusion is created as a result of concurrent use of the term in ordinary language and academic psychology and also, due to the lack of common notion of the term, because, the concept of self-esteem goes by variety of names such as self-worth, self-regard, self-acceptance, self-respect and etc. Hence this confusion is required to be minimized, in order to get a clear understanding of the term and to have a common ground for both academic and ordinary usage. Otherwise it would be possible to create miscommunication between the researches and the participant of the research.

Methodological problems arises when it comes to make a standardize measure of self esteem basing on the assumption that single measure would accommodate all needs. People like Rosenberg and Gergen give more importance to the global self as key to self evaluation while Fleming, Shavelson and

others concentrate on the facets of self-esteem or the component and sub components which contribute to the global self-esteem. During the course of time many different theoretical approaches to measure self concept is being constructed and number of studies being carried out on the ways to evaluate self-esteem.

However, despite the many approaches to evaluate the self-esteem, self reporting has been recognized as an exclusive method of measuring self concept because it is difficult to conceive behavioral or psychological measure that would capture self esteem directly   due to the subjective nature of self-esteem. Self reporting measures could be either direct or indirect. An advantage of one over the other is highly debatable. Some favors direct face valid questionnaire which uses items that could be scored higher or less additively while others prefer more indirect measures using complexly scored questionnaire such as self-ideal discrepancy score. However researches prefer the former and at present many prefer simple self reporting measures.

The Self-Esteem Scale by Rosenberg was originally designed to measure adolescent's global feeling of his or her self worth or self acceptance. The Feelings of Inadequacy Scale by Janis and Field was developed to quantify the feelings a person's inferiority. Coopersmith proposed The Self-Esteem Inventory to evaluate different attitude pertaining to self. Piers-Harris Children's Self Esteem Scale is another popular instrument to measure the self concept of children and adolescents specially relating to their behavior. Self Descriptive Questionnaire (SDQ) proposed by Herbert Mash is hierarchical multifaceted model to measure multidimensional self concept [13]. My data gathering tool is also designed in accordance with the SDQIII which is regarded as having strong empirical foundation [20].

C. Neural Network Approach

The raw data of the research is categorical. For example, one question is "Do others think that you are pretty or handsome?" The answer should be 1, 2, 3 or4 (1-wrong, 2-wrong than correct, 3-correct than wrong, 4-correct). These data represent a psychological state of an individual at a particular time period and the answer is also relative to the person. Even if two people give the same answer (suppose-3) it does not mean that their psychological states are equal. Hence to predict a result with such qualitative, categorical and noisy data is really a challenge. Statistical tools and neural network tools could be utilize to process these data to get the expected results. However according to many researches, neural network has proved to be better than statistical tool when it comes to deal with the data as this research do. Van Learhoven in his research, Real-time Analysis of Data from Many Sensors with Neural Networks, stressed the fact that neural networks play a better role with tracking records on noisy data than statistical methods or expert systems [15]. Saiful Anwar, who did a research under the title Comparing Accuracy Performance of ANN,MLR, and GARCH Model in Predicting Time Deposit Return of Islamic Bank agreed that Artificial Neural Networks perform better when it comes to prediction comparing to traditional statistical approaches[14]. Comrei who conducted a research on Comparing Neural

Networks and Regression Models for Ozone Forecasting presents neural network as a better approach to forecast non linear and complex process as Ozone formation [4].
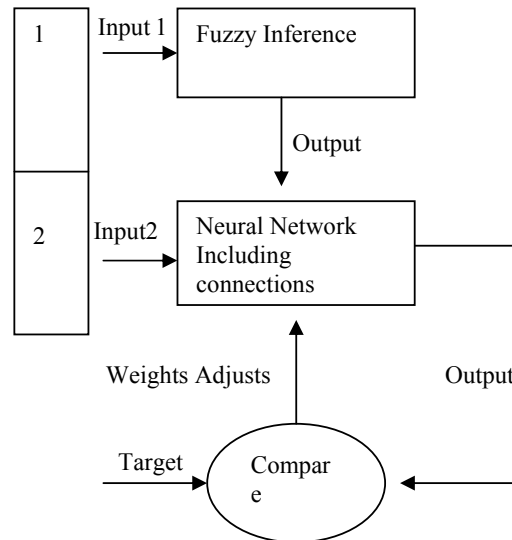
III METHODOLOGY

A. MYSDQ

Fig. 1 Outline of the work

The figure (Fig.1) represent the entire work and it is composed with three parts namely the data gathering tool, fuzzy interface and the neural network.

A. MYSDQ

MYSDQ is the data gathering tool that I prepared basing on the SDQIII. It measures eight facets of self concept in the early adolescents. These facets are, one's state of mind regarding his or her self concept as a positive or negative, parental relationship, sibling relationship, concept of physical self, peer relationship, teacher-student relationship, educational performance relative the class in which the student does his or her learning. For each category I have included at least two questions in order to get more accurately the self concept presented by the particular psychological facet of the person. For example the category which evaluates the negativity or positive nature of the self concept includes three questions. They are "Others consider you as a pretty or a handsome person.", "I am happy." and "I would like to be born as I am if I got a chance to be born again." By looking at the marks given to each of these questions the personal approach of a particular student to his or her self concept could be measured and due to the subtle nature of these questions and answers fuzzy interface is utilized and further details of it will be discussed under the subtopic 'fuzzy'. Hence it is clear that these categories are fed to the neural network after going through the fuzzy inference system. But there are other separate eight questions which are fed directly to the neural network. In responding a questionnaire there is a tendency to answer in a social desirable fashion which means the person could answer the way that the society appreciates

him or her. When it comes to the students who are subjected to the research this could be valid and also there is a possibility of responding the questionnaire for the sake of doing it. Hence it is obvious that some answers could represent deviated self concept or false self concept. In order to minimize this, the eight questions are utilized. These questions are based on the daily routine of the student such as the number of hours spent for the studies, games, entertainment, helping other, etc per a day. When I go through the answers I found that for some the total hours spend exceeds even twenty four hour. Hence, by feeding the answer directly to the neural network I hope to let the neural network to recognize the answering pattern of each student.

B. Fuzzy Inteface

The human brain is capable of dealing with imprecision and incompleteness. In everyday life this is expressed in many different linguistic terms such as little, more, less, not less than and etc. Fuzzy set theory provides a systematic method to deal with such imprecise occasions using linguistic variables and to perform numerical computations by using such variables set by membership functions.

Fuzzy logic is based on the fuzzy set which a set without clear boundary as the crisp set does. Crisp set or the classical set is a set with a definite boundary. For example, the set of days of the week without any doubt includes Monday, Tuesday, Wednesday, Thursday, Friday, Saturday and Sunday. However, let's consider a set of days comprising weekend. According to crisp set theory it includes Saturday and Sunday. But one can argue that partly, Friday also becomes a weekend. This situation cannot be handle by the classical set theory but it is possible with fuzzy as for fuzzy the truth of a statement becomes a matter of degree. In other words Friday is a weekend day to the degree of x where x is a value stipulated by the membership function. In a crisp set x could have only two values that is '1' and'0' but for fuzzy set it could be any value between '1' and'0'. Membership function could be simply define as a curve that defines how each point in input space or universe of discourse is mapped to membership value between '1' and'0'. Classical set could be expressed as

$$A = \{x \mid x > 6\}$$

Here A is a set of x elements where x is greater than 6. Fuzzy set is an extension of the classical set. If X is a universe of discourse where its elements are denoted by x, then a fuzzy set A in X is defined as ordered pairs as follow.

$$A = \{x, \mu_A(x) \mid x \in X\}$$

Here $\mu_A(x)$ is called the membership function whose task is to map each element in X to a membership values between '0' and '1'.

Fuzzy logical reasoning is a superset of standard Boolean logic or in other words if we keep the fuzzy values at their extremes of '0' and'1' it should hold standard logical operations such as 'AND', 'OR', 'NOT". Hence, the challenge is to identify an operator which preserves the results of standard logical operator and also could be extended to all the values between '0' and'1'. Here *min* and *max* operators fulfill the requirement. In fuzzy A AND B is represented by *min* (A, B) and A OR B is represented by *max* (A, B). Also Not operator is (1-A).

Fuzzy logic is comprised of conditional statements which are formulated by 'If-Then' rule statements. For example,

If *x* is *A* then *y* is *B*

Here *A* and *B* are linguistic values defined by fuzzy sets on the ranges X and Y, respectively. X and Y are universe of discourse. Finally the fuzzy set is being subjected to a process of defuzzification in order to get a single value [6].

Fuzzy inference system plays a major role in my research. It prepares both input and target data. First part of the MYSQD is fed to the fuzzy inference system. It has fifteen questions and eight categories. In preparation of input data fuzzy system carries out two tasks. It reduces the sample size required. Each question has four options and when it comes to fifteen questions, the possible combinations would be 4^{15}. Hence in order to recognize the patterns the sample should be spread in considerably a large spectrum of patterns. When I looked at my sample I found that the patterns are limited to certain areas. In order to avoid it the fuzzy inference system is utilized. Another problem resolved by the fuzzy inference system is reducing the psychological noise of the input data. Psychological noise could be a result of the psychological disturbances prevailed in the student when he or she answers the questionnaire. It could be due to the vague idea of self concept or the other external causes as some quarrels between peers etc. This noise is being reduced by categorizing these questions into eight and utilizing fuzzy inference system to do so. Preparing the target data is also a complex process. G.C.E. O/L examination has nine subjects and each subject has five grades (A-above 75, B- between 75-65, C- between 65-55, S-between 55-45, W- below 45 which failed). In order to get qualified at the examination one has to get six subjects passed including mathematics and vernacular and C for at least three subjects. For Advance Level examination there are four streams namely, Science, Mathematics, Commerce and Art. In order to be qualified to do the examination in Science stream the student should pass the G.C.E. O/L examination and should have at least C for Science subject. In the similar way in order to follow the Mathematic stream the student should pass the examination and should have at least C for Mathematics. Suppose a student got C for Science and Mathematics then the immediate question is to which category he belongs, either Science or Mathematics. This is resolved by the fuzzy inference system.

C. Neural Network

The human brain is a natural and truly a remarkable parallel computer which is capable of processing incomplete information obtained by sensual organs. Although the nerve cells function much slower than electronic gates, human brains process visual and auditory information superseding computers. At the inspiration of biological nervous system, researches modeled an artificial neuron network model which is nonlinear dynamic system mimicking human brain mechanism.

The wonder of the human brain is its adaptive capability and its ability to learn. In neural networks this learning is done by the process of changing synoptic weights until the desired out put comes. As different people use different learning methodologies, artificial neural networks too make use of many approaches in learning. There are two main approaches in learning in relation to artificial neural networks. They are supervised learning, which compares input stimulus with target responses and changes the synaptic weight accordingly and unsupervised learning which does not required a target but simply identify unique features of its input stimulus and categories them.
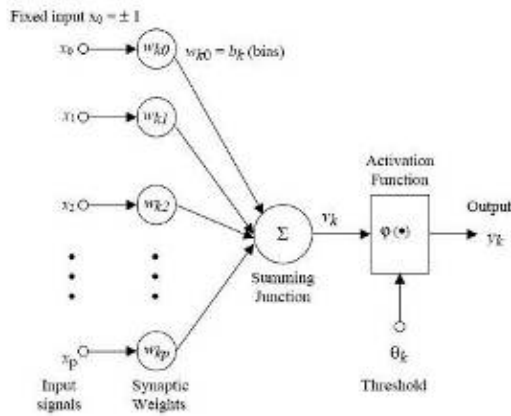

Fig.2 [2]

Fig. 2 is simple representation of an artificial neuron. It has x inputs, y outputs and w synaptic weights. The activation function v:

$$v_k = \sum_{j=1}^{p} w_{kj} x_j$$

In this research the neural network applied is a feed forward network whose learning algorithm is back-propagation. It is a supervised learning network. As the system requires to map its input to particular targets, the network has to be supervise learning one and the reason to chose the back-propagation algorithm is it wider use and the ability to give reasonable answers to inputs that they have never seen. Standard back-propagation algorithm is based on delta rule or Widrow-Hoff learning rule where synaptic weights are moved along the opposite direction of the gradient of the performance function [10].

D. Experimental Results

The experiment is carried with the *nntool* in MATLAB which is an award winning numeric computing environment and a fourth generation programming language [17]. *nntool* is a graphical utility which provides the facility to create a neural network by simply giving input and target data. It also offers many customizable options.

The total sample size is 198 students and out of 198, I reserved 15 for ultimate testing and the rest was used as the training/testing data set. The data was used in five different options of networks and the results are given in the Table 1.

Network1: train-function:-Trainlm, perform-function:-mse, number of neuron in hidden layer-10.

Network2: train-function:-Trainlm, perform-function:-msereg, number of neuron in hidden layer-10.

Network3: train-function:-Trainlm, perform-function:-sse, number of neuron in hidden layer-10.

Network4: train-function:-Trainrp, perform-function:-mse, number of neuron in hidden layer-10.

Network5: train-function:-Traingdm, perform-function:-mse, number of neuron in hidden layer-10.

TABLE I
EXPERIMENTAL RESULTS

Expected Results	Predicted Results				
	Network1	Network2	Network3	Network4	Network5
0.2000	0.2821	0.3761	0.1502	0.3355	0.3981
0.2000	0.2968	0.4306	0.1544	0.4187	0.2123
0.9000	0.4865	0.4808	0.6003	0.5333	0.2148
0.2000	0.3227	0.4198	0.1426	0.3705	0.2951
0.2000	0.4139	0.4236	0.1679	0.3416	0.4303
0.2680	0.6046	0.3982	0.3332	0.2570	0.5422
0.9000	0.5751	0.3991	0.4480	0.3869	0.4878
0.9000	0.5703	0.6092	0.5126	0.5184	0.5186
0.2000	0.5532	0.5957	0.2532	0.4653	0.3092
0.2000	0.2522	0.6016	0.3358	0.6135	0.3688
0.9000	0.8642	0.5604	0.7188	0.4697	0.4108
0.2000	0.6264	0.3964	0.2101	0.2820	0.4728
0.7000	0.8138	0.5113	0.3310	0.4223	0.4371
0.9000	0.8407	0.7049	0.6465	0.6948	0.5235

'.09' in the column under the heading 'Expected result' represents the student category which failed at the examination. '0.2' represent those who are able to select Mathematic stream at the G.C.E. A/L and '0.7' is the category qualified to follow Art stream in G.C.E. A/L. According to the Table I , the result predicted by the Network one is closer to the expected results. However, the system needs to be further improved. This could be done either by tuning the network or by improving the quality, validity and reliability of input data. As a future work further experiments would be carried to improve the system giving priority to the identified drawbacks.

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