Success Prediction of Students by Integrating Communication Skills with Achievement Motivation and Personality

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Abstract—A technique has been recommended for the success level prediction of student professionals. It is achieved by combining communication skills with prior, proven prediction of students' success with narrower domains of Big Five Personality traits [17] along with achievement motivation [16]. The goal is to assess the combined success levels of students in their life beyond academics with the novel and complete mathematical representation, architecture, development and implementation of online decision support system. Regression model has been developed for a test bed of 974 male and female students with training and testing data. Results inferred that on regressing Students-Success-NEO-Achievement Motivation-Communication (SS-N-A-C) incrementally with demographic variables, Students-Success-NEO-Achievement Motivation (SS-N-A) and Total-Communication-group (TComm-g), TComm-g has higher impact over SS-N-A in predicting collective success levels of students. The performance accuracy has been calculated using Chi-square Automatic Interactor Detector (CHAID), classification technique.

Keywords- Big Five Personality traits; Achievement Motivation; Communication Skills; CHAID; Performance Accuracy; Students' Success

I. INTRODUCTION

Communication skills along with personality and achievement motivation are prospective predictors of success of students. To assess various personality traits, the Neuroticism, Extraversion, Openness to Experience Personality Inventory Revised (NEO PI-R) designed by Costa & McCrae (1985a) is found to be the most validated, ideal and agreed upon model in predicting academic success (Dollinger, Matyja, & Huber, 2008). Earlier reviews state that the narrower domains of big five are adequate for researchers in education psychology. (Costa & McCrae, 1985a) and (Major et.al., 2006) found that motivation is highly related to the personality of a human being. Openness domain referred to as "Intellect," underscore its connection to abstract thinking, depth of thought, creativity, and other intellective qualities. Conscientiousness, the strongest predictor is consistently associated with post-secondary academic performance (Richardson & Abraham (2009) and Noftle & Robins (2007)). Self-motivated students require less supervision, limits and springs back easily from obstacles and is quite often more productive. Among students it was found that communication difficulties are often indicators of more deeply rooted problems. Unsuccessful students who lack communication always tend to be pessimistic, very rarely expect success. On the contrary, successful students remain confident, optimistic as they have strong communication skills. Thus it is a skill that is critical to success in every field, but it is crucial to student professionals who put proper efforts and in turn achieve best results. Hence communication is a vital skill, which means the written and oral transmission, dealings and common understanding of each other, a mastery of typical English, the capability to evaluate the needs of others, build trust, and deal with actions for accomplishing long term goals and life's success. Communication is the 'act of imparting of / or transmitting' and the word 'communicate' means 'to impart, to transmit, to be connected' (Simpson and Weiner, 2005). Effective communication involves the most accurate sending and receiving of information, full comprehension of the message by both parties and suitable action taken upon the completion of the information exchange (Terry and Franklin, 2005).

P'Rayan, A. (2011) in his dissertation states that, Karnik, president of NASSCOM (National Association of Software and Services Company) states that only 25 percent of technical graduates are found suitable for employment in the outsourcing industry as they lack abilities, either to converse or write well in English (Karnik, 2007 as cited in P'Rayan 2008:1). There seems to be an overall consensus that the first and foremost important point of attack is the lack of 'soft skills' among college students. "Soft skills are the qualities that make a student fit in a corporate environment. Typically, we group together communication skills, fluency in language, management and leadership qualities, ability to work in a team, positive attitude in critical situations and other such skills among the 'soft skills," says Manikam Ramaswami, chairman, Tamil Nadu State Council of the Confederation of Indian Industry (CII). These are severely lacking in most fresh college graduates, as people in industries believe, and the lack is realized even more among graduates hailing from rural areas. (Shyam Ranganathan, 2008).

Tatar (2005) moreover notices that many students' associate learning with listening. In order to understand the topic, they wish to focus and carefully listen to the instructor. The students also realize that they can improve their language skills by listening. They also make themselves comfortable with English language by observing other learners taking part in discussions. Thus communication is the basis for all human interaction, and interpersonal relationships cannot exist without it. It is by means of communication alone that member in relationships interact to swap information and convey meaning.

Exactness in communication differs with the attitudes of communicators toward their topic. If a person's attitudes are found to be either very positive or very negative, the follow-on communication tends to be less accurate. Communication clarity is also influenced by the attitudes of communicators toward each other. Sharing is perhaps the most important approach to direct communication. All communication is a sharing process: In attempting to communicate with others, we are sharing our views, beliefs, thoughts, values, observations, intentions, doubts, wants, interests, assumptions, strengths, and weaknesses. (J.E. Jones & J.W. Pfeiffer (Eds.)). Also research on listening was conducted in academic institutions and the assumption was that college students learnt by reading textbooks and listening to lectures (Hargie 2007). Even though listening is central to competence, its neglect in practice and in significant ongoing research is startling, as Flynn, Valikoski, and Grau (2008) observe.

"The most basic of all human needs is the need to understand and be understood. The best way to understand people is to listen to them." —RALPH NICHOLS

Interpersonal communication includes much more than just exchanging words. All behavior coveys some message and are a form of communication when it is perceived by others. Because two people who are interacting with each other have a continuous effect on each others' perceptions and expectations of what the other is going to do, interpersonal communication can be defined broadly as any verbal or non verbal behavior that is perceived by another person (Johnson and Johnson, 1994).

All students do not have the same level of proficiency in English. Those students who are from Chennai have better communication skills than those from rural areas. Most students are highly motivated and have earnest desire to improve their abilities to communicate well. The major concern of the pre-final year students is to develop their communication skills and get placed in reputed companies (Albert P'Rayan and Ramakrishna T. Shetty, 2008). It is observed that not much research has analyzed the relationship across the Big Five traits, achievement motivation and communication skills within the same work, though earlier studies recommend relations across personality traits and few aspects of communication, it is observed that not much research has analyzed the relationship across these soft skills within the same study. But we address this gap by directly integrating the personality traits with students' communication and achievement motivation to have enhanced prediction, performance and model accuracy. To evaluate this, a data mining technique is used to predict group membership for data instances. Here CHAID (Chi-square Automatic Interactor Detector), a decision tree classifier is used to evaluate the performance of instruments, validate the chosen study variables and to categorize the success levels of the students. Given a collection of records with a set of attributes and one of the attribute as class attribute, two third of the data considered as training set to build the model and one third of the remaining data as testing set was chosen to determine the accuracy and to validate the model. The performance and model accuracy were incrementally found at each level.

The present study predicted the behavior and success of college students. Specifically, this study addressed the following question: What is the relationship Students-Success-N-A as measured by NEO PI-R and AM, and success measure, Students-Success-N-A-C to predict success of students? It was hypothesized that (a) Students-Success-N-A would be positively related to prediction of success in academics and in life of students. (b) TComm-g would be positively related to prediction of success in academics and in life of students.

Students' community is expected to have strong communication skills. High communicators are visualized as success driven, always takes intelligent step to reach their goals whereas low communicators, inactive participants remain in the same level and stay as unsuccessful individuals. Hence the research with an integrated Communication Skill Measure (CSM) with AMS and NEO-PI-R emerged as effective predictors of students'

success in life. Moreover the significance of counseling, communication skill analysis of students is increasingly realized in educational institutions, both in India and abroad. This awareness has come out as an ever-increasing duty of the student counselor. Results are discussed in terms of evaluating all study variables that are accountable for success prediction.

Implications and suggestions for future work are highlighted. Thus this consolidated research work may help both an individual and institution to understand the effect of all soft skill parameters taken in to consideration, success levels of the students and to take necessary measures to enhance it.

II. METHOD

A. Participants

Sample size consisting of nine hundred and seventy four student professionals (618 male and 356 female; mean age M=17.37, SD=0.483) have taken part in this study. Participants were engineering students belonging to diversified branches of first year B.E. / B.Tech. discipline at Anna University (a State Technical University) in India.

B. Instruments

1) NEO PI-R for Personality Prediction

The NEO PI-R (Costa & McCrae, 1992) is the most widely used inventories to assess the personality of students. This inventory has 30 facets organized under five domains such as Neuroticism, Extraversion, Openness to Experience, Agreeableness, and Conscientiousness and includes 240 items (8 items per facet), presented with a 5-point Likert response scale. This test is designed after 25 years of widespread research work carried out on both clinical and normal adult samples. It was initially developed on and for adults, but later on it appears to work equally fine for student professionals as well.

2) Achievement Motivation Scale

The Achievement Motivation Scale (AMS) is designed by Prof. Shah Beena, University of Madras in identifying low, average and high achievers. The scores for 40 item AMS is classified into four domains according to which an individual can be grouped is Need for Academic Success, Need for Vocational Achievement, Need for Social Achievement and Need for Skill Achievement.

3) Communication Skill Measure

Although NEO-PI-R with AM shows improvement in behavior, success prediction and classification, in this study, Communication Skills Measure (CSM), classified into four domains such as Attitude, Sharing, Listening and Interpersonal Communication, designed and contributed by the authors was used to much more keenly identify and categorize low, average and high achievers. Predicting students' success may be much more decisive, in depth, when it is found by adding CSM to existing NEO-PI-R and AM rather than using them in isolation. Thus it has been analyzed in relation to various demographic parameters, TComm-g with then found success prediction with NEO-PI-R and AM [16], narrower domains of NEO-PI-R [17].

4) Online Decision Support System

An online decision support system (DSS) is designed, developed and implemented by the authors to automate all the instruments used for the study using SQL SERVER and ASP.Net.

C. Procedure

The scores for 15 items CSM was collected through an online DSS.

a) Mathematical Representation for Behavioral Prediction through CSM

Step 1: Obtain communication scores for 15 questions with four groups for user 'u'

 $\operatorname{csmark}(q_i)^u = \operatorname{cmark}(q_i)^u$; q – question; csmark – communication skill mark; i=1,2...15; u=1,2...N; N= number of samples in the study. (1)

Step 2: Calculate overall communication skills scores of students by combining all four groups for user 'u' denoted by OCS^u.

$$OCS^{u} = \sum_{i=1}^{15} csmark(q_{i})^{u}; i=1,2...15; u=1,2...N.$$
(2)

Step 3: Predict overall communication skills range for user 'u' denoted by OCR^u.

$$OCR^{u} = \begin{cases} Low; & 1 \le OCS^{u} \le 45 \\ Average; & 46 \le OCS^{u} \le 60 \\ High; & 61 \le OCS^{u} \le 75 \end{cases}$$
(3)

CSM scores thus collected from the students, explains that these scores along with the success levels predicted with NEO-PI-R and AM are valid, adequate and reliable to be used for research purposes. For each item in CSM, students must choose any one of the five options ranging from Strongly Disagree =1 to Strongly Agree = 5 and accordingly suitable weightage for other alternatives will be given.

The CS range of the students namely low, average and high are thus predicted. The minimum scale value is 15 and the maximum is 75. Higher the score, higher the Communication Skill and Lower the score, lower the Communication Skill is thus identified. All the above findings are thus grouped and generated as a report for all students. Following this identification, knowledge rules have been formulated by integrating this with the success levels achieved with NEO-PI-R and AM [16] to predict the integrated success level of them by again classifying it as less, moderate and high successful.

b) Knowledge Rules for Success Prediction of Students in Life

1. Rules for Students-Success-N-A-C='Less Successful' IF Students-Success-N-A = 'Less Successful' or 'Moderately Successful' and TComm-g = 'Low' or 'Very Low' THEN Students-Success-N-A-C = 'Less Successful' 2. Rules for Students-Success-N-A-C='Moderately Successful' IF Students-Success-N-A = 'Highly Successful' and TComm-g = 'Low' or 'Very Low' or 'Average' THEN Students-Success-N-A-C = 'Moderately Successful' IF Students-Success-N-A = 'Less Successful' and TComm-g = 'Average' or 'High' or 'Very High' THEN Students-Success-N-A-C = 'Moderately Successful' IF Students-Success-N-A = 'Moderately Successful' and TComm-g = 'Average' THEN Students-Success-N-A-C = 'Moderately Successful' 3. Rules for Studens Success N-A-C='Highly Successful' IF Students-Success-N-A = 'Highly Successful' or 'Moderately Successful' and TComm-g = 'High' or 'Very High' THEN

Students-Success-N-A-C = 'Highly Successful'

Out of 974 samples collected, 752 samples were used for training data and 222 samples for testing it. Cronbach's alpha for the current study for Total-Communication-g is 0.71 and Students-Success-N-A-C is 0.82. Hierarchical Regression was used to find a suitable model and a regression equation. Lastly, performance accuracy was found with Chi-square Automatic Interactor Detector (CHAID) to validate the usefulness, effectiveness and correctness of the chosen study variables.

III. RESULTS

A. Training-data

1) Corrected Item-Total Correlation

The correlation between Students-Success-N-A-C and the sum of SS-N-A, TComm-g with r = 1.000 shows that there is a strong, positive correlation between the scores on success measure, Students-Success-N-A-C and the score of TComm-g as a way to assess how well one item's score is internally consistent with composite scores from all other items that remain.

2) Frequencies for training data

Frequency analysis of Training Data for SS-N-A shows that nearly 49.6% of the students are Highly Successful, around 47.7% of the students are Moderately Successful and 2.7% are categorized as Less Successful and for TComm-g, about 30.7% of the students are high in communication, around 43.8% of the students are average and 25.5% of the students are low in communication.

TABLE I. FREQUENCIES FOR VARIOUS LEVELS OF STUDENTS-SUCCESS-N-A-C

Success Levels	Frequency	Percent
Less Successful	162	21.5
Moderately Successful	355	47.2
Highly Successful	235	31.3
Total	752	100.0

Note: Success Levels as 1(Less Successful), 2(Moderately Successful) and 3(Highly Successful) are predicted from rules based on SS-N-A and TComm-g.

As illustrated in Table I, when CSM is integrated with NEO-PI-R and AM, around 31.3% of the students are highly successful, 47.2% are moderately successful and 21.5% are less successful.

3) Development of Model

In order to identify the feasibility in the usage of independent variables in the prediction of the dependent variable, hierarchical regression is used for model construction.

Model	R	RSauare	Adjusted R Sauare	Std.Error of the Estimate	R Square Change	F Change	df1	df2	Sig. F Change
1	0.121	0.015	-0.003	0.722	0.015	0.839	13	738	0.619
2	0.419	0.176	0.160	0.660	0.161	144.018	1	737	0.000
3	0.928	0.861	0.859	0.271	0.686	3642.148	1	736	0.000

TABLE II. FREQUENCIES FOR VARIOUS LEVELS OF STUDENTS-SUCCESS-N-A-C

From Table II, it is observed that $R^2 = .02$; ΔR Square = 0.16 for step 2, ΔR Square = 0.69 for step 3, ***p<.001. The model summary contains three models. Model 1 refers to the first stage in the hierarchy where only demographic parameters are used as predictors. Model 2 refers to the second stage in the hierarchy where SS-N-A along with demographic parameters is used to predict students' success, whereas the final model, model 3 includes demographic parameters, SS-N-A and TComm-g.

4) Anova to show an improvement in each model to predict the outcome variable

Model	Sum of Squares	df	Mean Square	F	Sig.
1 Regression	5.678	13	0.437	0.839	0.619
Residual	384.235	738	0.521		
Total	389.914	751			
2 Regression	68.488	14	4.892	11.217	0.000
Residual	321.425	737	0.436		
Total	389.914	751			
3 Regression	335.880	15	22.392	305.002	0.000
Residual	54.034	736	0.073		
Total	389.914	751			

TABLE III. ANALYSIS OF VARIANCE (ANOVA)

The F-ratio in Table III represents the ratio of the progress in prediction that results from fitting the model tagged "Regression" in the table relative to the inaccuracy that still persists in the model tagged "Residual". The final model in Table III significantly enhances our ability to predict the outcome variable.

5) Coefficients

In hierarchical regression, the model takes the form of an equation that contains the coefficient (B) for each predictor.

Model	В	SE	β
1 (Constant)	1.880	1.067	
2 (Constant)	0.465	0.984	
Branch	-0.023	0.008	-0.094*
SS-N-A	0.532	0.044	0.406***
3 (Constant)	0.482	0.404	
First-Graduate-in-Family	0.064	0.026	0.041*
TComm-g	0.899	0.015	0.935***

TABLE IV. PEARSON INCREMENTAL CORRELATION COEFFICIENTS BETWEEN DEMOGRAPHIC VARIABLES, STUDENTS-SUCCESS-N-A and TCOMM-G

The B values in Table IV depict the relationship between Student-Success-N-A-C and each predictor. For these data, both predictors with positive B values indicate positive relationships. So as Students-Success-N-A-C increases, Student-Success-N-A increases, and as Total-Communication increase, so does Students-Success-N-A-C. The B values also ensure that to what degree each predictor affects the outcome if the effects of all other variables are held constant.

Each of these beta values has an associated standard error demonstrating to what extent these values would fluctuate across different samples, and these standard errors are used to determine whether or not B values differ significantly from zero. The smaller the value of Sig. with t-test and larger the value of t, indicates that the role of that predictor is greater. For this model, SS-N-A, First-Graduate-in-Family and TComm-g were significant predictors as all are statistically, positively significant because their *p*-values are 0.000, 0.0 and 0.000 which is less than p = .001, p = .05 and p = .001 respectively in identifying the students' success. The β value of SS-N-A is .406 and TComm-g is .935. This confirms that TComm-g has better impact than SS-N-A in the model.

The regression equation (Eq.4) thus found can be substituted in the regression form (Eq. 5).

Students-Success-N-A-C-Predicted =
$$.482 + .064 *$$
 First-Graduate-in-Family + $.899 *$ TComm-g (4)
YPredicted = $b0 + b1*x1 + b2*x2$ (or) $v' = bx + a$ (5)

6) Predicting Classification Accuracy with CHAID



Figure 1. Classification tree to predict Students-Success-N-A-C

The tree diagram as shown in Fig. 1, a graphic representation of the tree model in SPSS illustrates that:

- TComm-g is the best predictor of Students-Success-N-A-C when analyzed using CHAID classification technique.
- For all low, average and high TComm-g category, TComm-g is the only significant predictor of Students-Success-N-A-C. Of the students in low category, 83.3% are less successful.
- For the average TComm-g category, 99.4% are found to be moderately successful.
- For the high TComm-g category, the model predicts 98.3% of the students as highly successful.

As the risk and classification tables presents a speedy evaluation of how well the model works, the risk estimate of 0.051% specifies that the category predicted by the model (less, moderate and highly successful students) is wrong for only 5.1% of the cases. Thus the "risk" of misclassifying a student is approximately 5%.

TABLE V. CLASSIFICATION USING CHAID TO VALIDATE THE EFFECTIVENESS OF THE STUDY VARIABLES

	Predicted						
Observed	Less-Successful	Moderately- Successful	Highly-Successful	Percent Correct			
Less-Successful	160	2	0	98.8%			
Moderately-Successful	24	327	4	92.1%			
Highly-Successful	8	0	227	96.6%			
Overall Percentage	25.5%	43.8%	30.7%	94.9%			

As an outcome, the results in Table V are consistent with the risk estimate and this infers that the model classifies 94.9% of the students' correctly.

B. Testing-data

1) Testing of developed model

While substituting Eq.4 in the numeric expression Eq. 5 for the target variable Students-Success-N-A-C-P (Students-Success-NEO-Achievement Motivation-Communication Skills Predicted) with 222 instances to test the generated, hierarchical regression model, the authors got the prediction of Students-Success-N-A-C-P with 55 instances as Less Successful, prediction values ranging from 1.45 to 1.51, 61 instances as Moderately Successful, prediction values ranging from 2.34 to 2.41 and 106 instances as Highly Successful, prediction values ranging from 3.24 to 3.31.

2) Variation in regression analysis

When automatically predicting the students' success, the mean difference between actual and observed data is 0.37% and thus 99.63% model accuracy is achieved against 99.17% model accuracy achieved with AM and NEO-PI-R.

IV. DISCUSSION

The success of an endeavour hinges on the ability to communicate effectively in today's fast paced life. In such a scenario, effective communication holds the key. Effective communication almost centers on the usage of words, speed in delivering it, and pitch modulation and body language. Using the efficient and effective tools to communicate the right messages at the right time can help individuals to come out of crises and motivate them to march towards success. Communication skills in this research are considered as an emanating tool to bring out students' strengths and talents. Vital attributes in communication skills are listening, attitude and interpersonal communication. A wide number of researchers have examined listening and attitude as imperative predictors of performance in both educational and campus recruitments. Also it is highly essential to instruct the students in order to effectively share their views with others.

"One advantage of talking to you is that one knows at least somebody's listening." - FRANKLIN P. JONES.

Communication experts now appear to accept communication as a process with no beginning and no end (Hargie 2007; Wolvin & Coakley 1996). The results of the present study reveals that Student-Success-N-A in second model, First-Graduate-in-Family and TComm-g in final model have a strong positive relationship with Student-Success-N-A-C and thus the final model in regression analysis is the best suitable model.

While observing the frequencies of Training Data for TComm-g, about 30.7% of the students found to have excellent and high communication skills. These students will certainly follow steps in effective listening such as perceive, attend, understand, remember and be a good listener, well-mannered, dedicated, humble, independent, emotionally stable, methodical, friendly, trustworthy, accommodative and loyal.

However 43.8% of the students who are average in communication skills will be fair in listening, sharing, sensible attitude and reasonable interpersonal skills and at last, it is inferred that 25.5% are categorized as low communicators. These set of students will have poor communication skills, low confidence levels and improper body language, rude, dishonest in their speech, negligent and depressed.

From examining the frequencies of Training Data for SS-N-A, about 49.6% of the students are found to be highly successful. About 47.7% of the students who are average in SS-N-A are moderately successful and only 2.7% of the students are less successful. Also it is evident that nearly 31.3% of the students are highly successful in SS-N-A-C, 47.2% are moderately successful and 21.5% are termed as less-successful.

The adjusted R Square in Table 2 gives us an insight of how well our model generalizes. Here the difference for the final model is fair (0.861 - 0.859 = 0.002 or 0.2%).



Figure 2. Histogram to find Students-Success-N-A-C

Thus from the behavioral, motivational and communication skill findings, the combined success levels of promising professionals are predicted and from Fig. 2, histogram it is inferred that almost normal distribution among various success levels are achieved.



Figure 3. Normal Q-Q Plot for Students-Success-N-A-C

Fig. 3 indicates the Normal qq plot between the observed value and expected normal of Students-Success-N-A-C.



Figure 4. Detrented Normal Q-Q Plot for Students-Success-N-A-C

The detrended qq plot between the observed value and deviation from normal of Students-Success-N-A-C was illustrated in Fig. 4.

This work discriminate itself from others in the following ways:

In this work, Individual and Group analysis have been carried out. Most of the past studies uses the data from various foreign universities, but we attempted on the data generated in an Indian institution and found that CS, AM with narrow domains of NEO-PI-R plays an imperative role in judging the students success ahead of usual academic success prediction. All parameters (a total of 12) concerning personality assessment with added AMS (a total of 5) and CSM (a total of 4) were considered to discover the enhanced performance and combined success levels.

This success level investigation helps the students to know their communication variations, in performing the task in accordance with their institution's expectations. This in turn facilitates the institution to know their students' behavior and communication instability, which is very much essential in balancing their behaviors and enhancing their communication levels so as to maintain the efficacy of an institution.

Besides it also helps the student counselor to design and allot the academic work according to student's success levels in order to preserve the desired goal of an institution. Corporates seeking to have a diverse workforce without compromising the integrity of their selection policies may also find comfort in using personality assessments and communication skills testing as a part of their process when the same combined analysis is carried out in pre final year. By analyzing these qualities, the concerned institution authorities can have a better perception about each student.

V. CONCLUSIONS

Overall, this research facilitates the vital role of understanding by integrating the success outcome achieved through narrow domains of big five personality traits with achievement motivation and communication skills in order to have the combined success. Further research could be enhanced by adding few other parameters with these observations. Also this contribution has taken the crucial step to find significant correlations and improvements in judging performance accuracy, variance between the actual and observed values of the model in predicting the combined success. It also lays enhanced foundation for add on measures and highlights several potential strategies for educators. Moreover this combined research may provide performance assessment only to students of Anna University in India but in future, performance assessment may be much more strengthened and passed over to employees in diversified industries, artists, advocates and to any other human. Thus Communication Skill (CS) is considered as a vital driving force of human behavior in academic area and has received valuable attention in research; look at as a crucial measure for the present, future success of students.

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