



Career Guidance through TIC-TAC-TOE Game

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ABSTRACT

Many graduates are being qualified year after year in different disciplines that do not have any kind of idea about the career that is most suitable to them. Some of the graduates are suffering due to the bad career choice that they have taken in the absence of proper career guidance system which is based on psychological assessment. The type of career suitable for a graduate student is dependent on the Psychology of a student and therefore the psychology of a graduate must be measured which can be used for determining suitable career that suits the Graduate.

In this paper, the design of Tic-Toc-Toe Game that can be played by a student is presented and it is also shown how psychology of student can be measured considering Intelligence, Learning ability, perseverance, patience and Speed of solving problem etc. while the student plays the game. An expert system is also presented that helps predicting a career that is most suitable to a graduating student

Key words: Expert System, Game Playing, Assessing psychological factors Cognitive model, Career Guidance

1. INTRODUCTION

Many students are graduating year after the years. There are millions of jobs of different jobs available world over which needs certain level expertise and behavior of a person seeking for specific job. A map of available jobs with its related psychological factors is needed so that one can predict a suitable job once physiology of a student is assessed.

A cognitive model can be developed that can be used for developing an expert system which can be used for assessing suitable careers that can be pursued by a student. The cognitive model can be developed considering different Psychological factors that include Patience, speed of solving the problems, intelligence, learning ability, perseverance etc.

A game "TIC-TOC-TOE has been designed and developed in such a way that Psychological factors of a student can be assessed while the student is allowed to play the game a number of times. Different kinds of Jobs and the kind of Psychology required for doing those jobs can be pre-

determined and a repository of the same can be developed and can be made pre-available.

A career guidance system can be developed that is cable of reporting suitable jobs given Psychological factors of the student concerned. The intelligence of a student can be assessed through use of several tests that include IQ tests, reasoning tests, aptitude test etc. Intelligence can also be assessed through game playing which is an interactive method which helps in assessing the Psychological factors while the student is made to participate in a kind of activity.

TIC- TAC-TOE is an intelligent game and it is so effective that it can be used for assessing different psychological factors that include Problem solving ability, Learning speed, perseverance, intelligence and Patience.

The game is designed to be played between the computer and the student. The game can be commenced by either the computer or the student. The current board position is maintained as a 3 X 3 matrix stored internally in the memory. The choice of a square by the student is marked as "X" and the choice of a Square by the computer is marked s "O". The students wins the game if the symbol "X" is marked consecutively either row wise or column wise or diagonally. Computer wins the game if the symbol "O" is marked consecutively either row wise or column wise or diagonally. Nobody wins if any of the column or row or diagonal with a specific symbol in which case the game is concluded to be a draw..

Many students suffer after graduation having chosen a career that is not quite suitable to them or disinterested in the JOB that has been assigned to them. The student must be guided so as to make them choose proper jobs suitable to them. Career Guidance to the students is absolutely required without which the students may land up in wrong choices. A career expert is needed who will be able to counsel and provide the required guidance to the student.

The student must be guide throughout the program of study and make them select the subjects that are most appropriate to the psychology of the students. The students must also be guided to select proper projects that quite match the psychology of the students. Expert system is quite essential that the student should be using throughout the study and attempt the job opportunities floated by the recruiters that are

most suitable to them and only those jobs that match the Psychological abilities of the students.

A cognitive model must be built using which suitable careers to a graduating student can be predicted. Thus the main problem is to be able to assess the psychology of students through game playing and use the psychological factors to predict suitable careers with the help of a cognitive model.

An expert system needs to be designed and developed and make the students play the game by interacting with the computer. The software that implements the game must be built to assess psychological factors of the student. The student must be able to look for the suitable careers once the game playing is over. Thus the Cognitive – Expert system must support the following so that objective providing the career guidance can be provided.

1. Make the student play the TIC-TOC-TOE game and assess the Psychology of the students through the assessment of the Psychological factors.
2. Develop a cognitive model considering various Psychological factors that are related to the game being played.
3. Predict / Assess the careers that are quite suitable to the students
4. Correlate the Psychological factors assessed by the students with academic record of the students and bring out the exceptions so that exceptional patterns can be recognised.

2. RELATED WORK

In literature any methods have been presented that are related to game playing. Many methods have also been presented in the literature for career assessment through different approaches in addition to game playing. In this paper cognitive model based expert system using TIC-TOC-TOE has been presented

Human knowledge that is required to solve different kinds of problems is stored within a computer system and the system as such is called the expert system [1]. Correct predictions and decisions can be taken by using the expert systems. These days the students are quite keen in learning using the computer system. Many of the populations' worlds over are quite inserted in playing games and thereby learn and acquire knowledge in different fields. The students are quite benefitted through computer assisted games for quick learning and career guidance. The students college level especially are keen to know the careers that are best suited to them so that they spend their entire effort in achieving the career goal.

A career counselling system that uses psychometrics has been proposed by George M. Papadourakis *et al* [2]. They have used psychometric parameters that include work environments, work preferences, motive behind the work elements, and personality traits of a person and the sincerity of a person answering the questions that were raised to the respondent of the system.

Careers as such are mostly dependent on the psychological factors of the person seeking a career. Physiological factors will help to assess a person not only the current state of the person but also the future behaviour of the person concerned. Psychological factors as such will help in predicting suitable careers over the entire life span of a person concerned as presented by Herr, Edwin L [3].

One has to make a career plan right before the commencement of the undergraduate program. Career planning requires inputs related to goals of the students, ability to solve the problems, transition from institute to industry as presented by Roessler, Richard T., *et al.* [4].

Many difficulties one has to face while making career decisions as the issues involved are complex to solve as stated by Kelly M. Martincin and Graham B [5].

An expert system has been developed and presented by Drigas, Athanasios *et al.* [6]. The system can be used for evaluating the performance of the students. The output generated by the system can be used to determine jobs that are quite suitable to the students concerned. They have used neuro-fuzzy logic for building the assessment model.

Several types of expert systems are being built considering different input models. Some time multiple expert models that are interlaced needs to be used. These kinds of model portions the problem into multi domains and each domain modelled through a separate expert system. El Haji, Essaid, *et al.* [7] have proposed multi expert system based system through multi-agent based development. Each expert system maintains different rules and inference engine as per the domain requirement.

Selection of undergraduate courses has a direct bearing to the kind of career that can be sought by the students. Saraswathi, S., *et al.* [8] have presented an online expert system that can be used to select the courses that should be chosen having defined the kind of careers chosen by the student concerned. However, the choice of the subjects will go wrong if the students choose a career that is not quite to the Psychology of the students.

The current day students are more interested to seek career guidance through game playing. Thus, the importance of the game playing is increasing enormously. Any lapse on the design and development of the games will defeat the original purpose for which the game is designed and developed. The games must be designed and developed keeping the objectives and goals that must be achieved in relation to career guidance and counselling. The career guidance system should help the students to know about their capabilities and the kind of jobs that suit them.

Most of the games assess the psychological factors quantitatively and not much emphasis is made on the qualitative assessment. Both qualitative and quantitative assessment helps in proper psychological assessment of the students Dunwell *et al.* [9]. Career decisions are most

important and the models that support the decision making must support both quantitative and qualitative assessment of the psychological factors P. P. Jamsandekar., [10].

The students have many options to choose from while entering into XII standard itself. The option chosen by them will lead to pursuing a set of careers that may or may not suit the students. Thus it is important that career options have to be kept in mind while choosing an academic option while entering into XII stand of study. Yen-Ru Shi *et al.* [11] have presented that designing a game must be done keeping in view of student interaction and the kind of qualitative and quantitative assessment that must be made..

Students get quite motivated and get interested to acquire career guidance through game playing. The game will be played by the students again and again due to game playing attraction. The requirement that the game must be played several times will be fulfilled due to the interest that get created among the students for playing games. When a game is played several times, more accurate assessments can be undertaken within the expert model built into the career assessment system, which is the main requirement for proper assessment of suitable careers Robert S. Siegler [12].

A number of papers have been published for mining comparable patterns [13] [14] [15] [16] [17] [18] [19] [20] [21] [22] [23][24][25] having some specified and related attributes which can be used to extract the cognitive tables. However this needs building of huge database by making the students interact with system and the database is built from behind. No such data base is available as on date

The literature survey revealed that no contribution exists that seek to build a cognitive model and expert system using which suitable careers can be predicted. This paper presents a Cognitive-Expert model using which psychological factors are assessed and an expert system is used for predicting suitable careers to the students.

The Tic-Toc-Toe game is developed which can run on any kind of computer system. The software system is designed and developed for capturing psychological factors of a Game playing student.

3. DESIGN OF TIC-TOC-TOE GAMING SYSTEM

Career assessment is the most important and critical issue for deciding once own life. A person who does a job that matches his/her Psychology is bound to succeed and rise to the top most levels that one is aiming to grow. It is important to know about suitable career quite early in the stages of pursuing a career. The system is designed and developed keeping in view of the students playing the game interacting with the machine.

The cognitive model designed and implemented considers capturing psychological factors that include Intelligence, Learning ability, Regularity, Speed of play, Patience and Perseverance of the student while the students plays Tic-Toc

Game, Figure 1 shows the functional modules of the system developed and implemented.

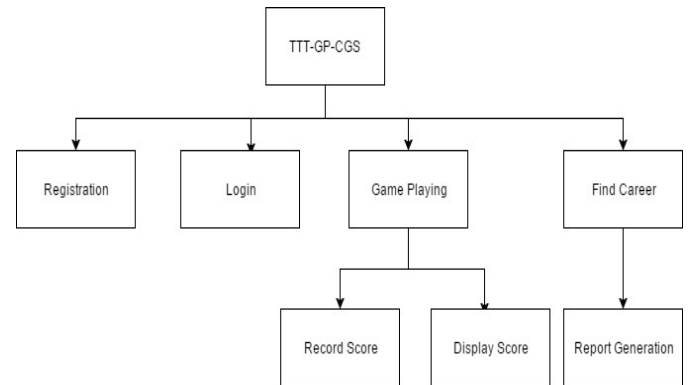


Figure 1: System Architecture of Tic-Toc-Toe game

Two distinct modules relating to game playing and career predictions have designed and developed apart from other modules that ensure authorization and access control.

A student should register by inputting their personnel particulars such as registration number, first name, last name, phone numbers, program of study, study year, CGPA, backlogs, previous credits etc. the student also must register their authorizations related information such user name and password. The details of the students are stored in a database.

The identification particulars of the student are accessed through registration module. The students can play the Tic-Toc-Toe Game after the registration an then completing the proper authorisation process. The student can play the game any number of times in a day. However for proper assessment of the psychological factors it is estimated that the game must be played at least 10 times a day. Lots of data is collected while the game is played by the student which include time of commencement of the game, time of ending the game, number of times the game is played, number of times the game is won and lost, Minimum and maximum time taken to win or lose the game etc.

Different kinds of scores are computed while the game is played. The scores computed are related to average time to win a game, number of games played by the student. Max speed of playing the game, Minimum speed of playing the game etc. The scores are used to map to the qualitative assessment of psychological factors such as intelligence, speed of solving the problems, patience, perseverance, and learning ability.

4. ASSESSING PSYCHOLOGICAL FACTORS

Tic-Tac-Toe game is played several times by a student and data related to many measueremnets such as number of times the game played, amount of time taken for winning or loosing a game etc are computed. The time taken to win a Game is noted and average of the time taken for winning a set of games played over several trails is computed. Several Psychological factors are assessed considering several

measurements that are accrued while the games are played by the students.

Assessing Intelligence

The average time taken by the student to win a game actually shows the intelligence of the students. An expert system is required to categories the intelligence of the students based on the time that the student takes to win a game. The classification of the intelligence of the students based on the time that the students’ takes can be fixed by an experienced expert or through a learning model that can be derived out of data captured and maintained within a data base. An expert engine can be built that mines the data and come out with Intelligence computational model. Table-1 shows the intelligence gradation into discrete qualitative assessment of the the Psychological factor ‘intelligence’.

Table 1: Quantitative and Qualitative assessment of intelligence

S.No.	Average Score(Quantitative)	Qualitative
1.	>=0.45 and above	Very high
2.	>=0.3 & <0.45	High
3.	>=0.2 & <0.3	Moderate
4.	< 0.2	Low

From the average time computed for a student to win a game the qualitative assessment of the factor “Intelligence is computed

Assessing Speed of solving problem

The expert system keeps logging the time taken by a student to play every game that he plays. The system computes average time taken by the student two play a game considering all the games that the student has played and the time taken to complete playing all the games. The average time taken to play the game reflects speed of solving the problem. The average speed of solving the problem is computed in qualitative terms using Table 2. Table 2 can be built through an expert engine or through domain knowledge of an expert in the filed.

Table 2: Speed of Solving Problem –Quantitative- Qualitative Assessment

S. No.	Speed of solving problem(Quantitative)	Qualitative
1.	<= 40 sec/game	Fast
2.	> 40 Sec & <=1 min	Moderate
3.	> 1min & <=2min	Slow
4.	> 2 min	Very Slow

Assessing Patience & Perseverance

The number of times a game is played and the amount of time during which the game is played shows the students perseverance and patience. For a proper assessment to be made, It is recommended that the student paly at least a minimum of 30 games. The number of games played can be used for qualitative assessment of patience and perseverance using Table 3. An expert engine is built to assess the

Psychological factor “patience and perseverance” both qualitatively and quantitatively.

Table 3: Patience & Perseverance - Quantitative to Qualitative conversion table

S. No.	Number of games played (Quantitative)	Qualitative
1.	>=30	Very high
2.	>= 20 & <30	High
3.	>=10 & <20	Moderate
4.	< 10	Low
1.	>=30	Very high

Assessing the Learning ability

To assess learning ability, it is necessary that the student needs to play minimum 50 games. If the number is less than 50 learning ability will not be assessed. The following equation is used to compute the learning ability index(LAI). For assessing Learning ability,

$$\begin{aligned}
 & \text{Learning Ability Index LAI} \\
 & = (\text{Max}(\text{Speed of playing the Game}) \\
 & - \text{Min}(\text{Speed of processing the game}))/5 \\
 & * 1000
 \end{aligned}$$

The learning power of a student can be computed both in quantitative and qualitative terms by using Table 4 which can be either be recommended by an experienced and expert or thorough an expert engine.

Table 4. Learning Ability Index - Quantitative -Qualitative Computations

S. No.	Quantitative	Qualitative
1.	LAI>=6	High
2.	LAI>=3 & LAI<=5	Moderate
3.	LAI<3	Low

5. FINDING SUITABLE CAREERS

Generally a student is chosen for a career based on academic performance and the psychology of the students is ignored. Academic performance of a student is computed based on Grade Point Average (CGPA) and the way a student presents himself / herself during the process of selection. Most of the times while this being case it is found that the student is not quite suitable for the job assigned after being selected as the student does not possess the required psychological behavior that is required for discharging the JOB requirements. It is necessary to consider the Psychological factors along with academic excellence to predict the type of career for which the student is suitable.

Many Jobs exists in the market for each of the discipline. The industries are in a position to explain the kind psychological behavior that the rectorates must exhibit for discharging a JOB as they continuously assess the performance of the recruits after watching their on the job performance. There could however some kind of human error in this case. Collection of the academic, Psychological behavior and on the Job performance of the recruits into a database will help to learn a model that maps the

relationships between careers, Academic performance and Psychological behaviors which can be used for prediction. In the absence of such a model one can depend on a model recommended by Experts in the field. The model recommended by some of the experts is shown in the Table 5. Given the CGPA and qualitative values of the Psychological factors, one can determine the career which suits a student through making search within Table 5.

6. EXPERIMENTATION AND RESULT ANALYSIS

A sample set of students have been selected out of 15000 students present in KLEF university campus. The students have been provided with the workstations to play the game TIC-TOC-TOE game. As the students played the game the expert system computed the scores for each of the Psychological factors that were designed into the system. Using the computed scores the inference engine built into the system fetches the suitable careers and the same are displayed to the student. The Academic performance of the students, the psychological behaviroal scores and the highest career for which the student is suitable is shown in Table 6.

It can be generally observed that if students have good intelligence, they do acquire quite a good academic excellence. This hypothesis in fact has been proved. However, some outliers also have been observed in terms of high intelligent students accruing low academic excellence. It has also been observed in some few cases that the students with low intelligence achieved high CGPA. These kinds of anomalies must be adjusted before career assessments can be made. The scores obtained by the students considering the intelligence related psychological factor and the CGPA are shown in table 7. Figure 1 shows the relationship between the intelligence and CGPA. In Figure 1 Intelligence score is shown on X axis and the CGPA on Y axis.

In the above graph, it is observed that a student, who has high intelligence, has low CGPA. The reason behind this may be that either the student is not having good memory or has no interest in the course concerned.

The outliers must be removed so that accurate assessments can be made. The Graph in Figure 1 can be made to be linear by removing the outliers. The new graph thus achieved is shown in Figure 2. The relationships between the CGPA and the intelligence score have been established. Students having high intelligence have good CGPA and vice versa. Most suitable careers can be predicted in such cases.

In the sample study conducted career assessment of computer science and engineering students has been carried and the jobs for which the students are suitable are predicted.

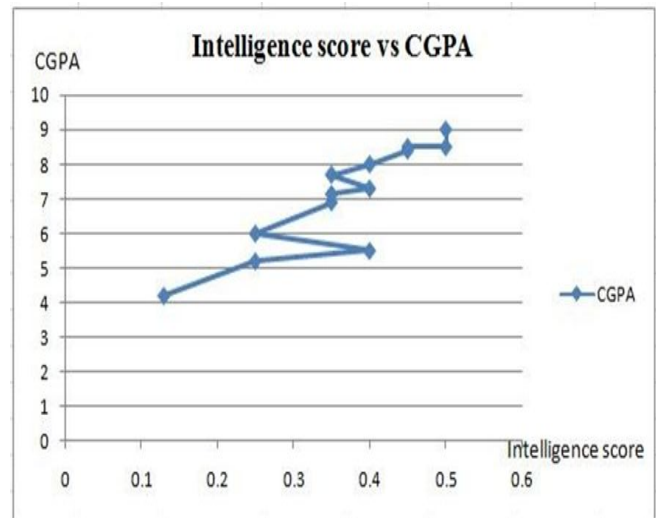


Figure 1: Intelligence score vs CGPA

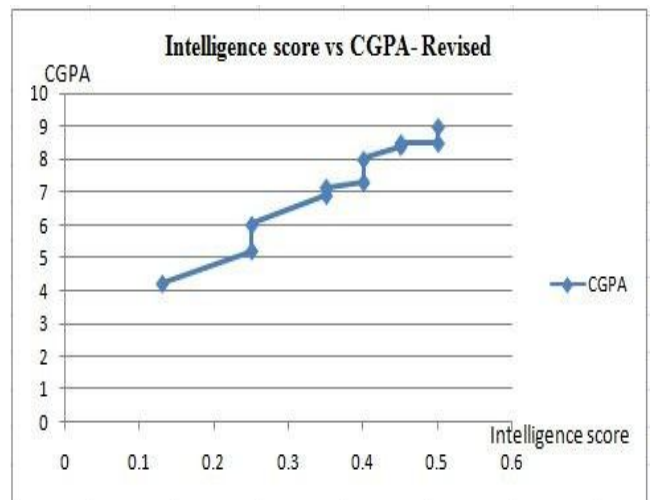


Figure 2: Intelligence score vs CGPA

7. CONCLUSION

All the students these days require career guidance so that the students will make right choices to pursue a suitable career, Career guidance must commence from 12th standard onwards. Psychological factors must be combined with academic achievements to properly predict the suitable jobs to the students, Outliers if any existing in the system must be removed before proceeding with the assessment. The expert based system is more reliable compared other kinds approaches to predict suitable careers due the reasons that the game playing can be undertaken for any number of times and a such there is no specific limit to game playing.

Table 8. Intelligence score and CGPA –Revised

S.No.	Register no.	Intelligence	CGPA
1.	13003463	0.13	4.20
2.	13003567	0.25	5.20
3.	13003566	0.25	6.00
4.	13003368	0.35	6.90
5.	13003200	0.35	7.14
6.	13003301	0.40	7.30
7.	13003082	0.40	8.00
8.	13003161	0.45	8.40
9.	13003111	0.45	8.50
10.	13007237	0.50	8.50
11.	13003025	0.50	9.00

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Table 5: Career VS Required Academic Record and Psychological Factors

S. No.	Career	CGP A	Quality of Psychological Factor			
			Intelligence	Speed of solving problems	Patience and perseverance	Learning Ability (optional)
1	Software Engineer	>= 7.5	Very High	Fast	Moderate	High
2	Software Maintenance Engineer	>= 7.0	High	Moderate	Moderate	Moderate
3	Software Tester	>= 6.5	Moderate	Slow	Moderate	Moderate
4	Marketing Person	>= 6.5	Low	Slow	High	Low
...

Table 6: Student VS Recommended career(s)

S. No.	Registered No.	CGPA	Intelligence	Patience & Perseverance	Learning Ability	Speed of solving problems	Recommended Career
1.	13003111	8.5	Very High	High	High	High	Software Engineer
2.	13003025	9	Very High	High	High	High	Software Engineer
3.	13003200	7.14	High	High	Moderate	Moderate	Software maintenance engineer
4.	13003567	5.2	Moderate	Moderate	Moderate	Slow	Software Tester
							...

Table 7: Intelligence score and CGPA

S. No.	Register no.	Intelligence	CGPA	S. No.	Register no.	Intelligence	CGPA
1.	13003463	0.13	4.20	8.	13003104	0.35	7.7
2.	13003567	0.25	5.20	9.	13003082	0.40	8.0
3.	13003150	0.40	5.50	10.	13003161	0.45	8.4
4.	13003566	0.25	6.00	11.	13003111	0.45	8.5
5.	13003368	0.35	6.90	12.	13007237	0.50	8.5
6.	13003200	0.35	7.14	13.	13003025	0.50	9.0
7.	13003301	0.4	7.3				