ISSN 2347 - 3983
Volume 7, No. 11 November 2019
International Journal of Emerging Trends in Engineering Research
Available Online at http://www.warse.org/IJETER/static/pdf/file/ijeter347112019.pdf
https://doi.org/10.30534/ijeter/2019/347112019

Development of a Comprehensive and Integrated Expert System for Career Assessment based on Cognitive models

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ABSTRACT

Every student assessed on which type of job he/she is suitable to avoid misfit in careers. For every student, predicting the right career is essential. An expert system is designed to investigate and find an appropriate job for every student. Here, the student needs to play several games provided by the expert system like Tic-Tac-Toe, 8-puzzle, Sudoku, Sokoban, etc. Based on the performance of the student in all these games, the levels of psychological factors such as intelligence, memory power, patience, etc., are assessed by the expert system. With this, a cognitive model of the student-built. Concerned with each game, the expert system maintains a list of jobs and the corresponding minimum levels of psychological factors that are needed by the student to perform that job successfully. Concerning each game, the expert system predicts some suitable jobs for a student by mapping the cognitive model of the student-generated through that particular game, with the list of jobs. Considering the performance of the student who played different games, the expert system generates a comprehensive report. Then, the student can make his/her career choice to get a suitable and stress-less job. This expert system is very much useful for an individual student, counselors, placement cell of an institution/university, and also for job recruiters of any industry.

Key words: An expert system, cognitive model, Game playing, career assessment, Assessing psychological factors, intelligence, patience, perseverance, memory power, learning ability, speed of problem-solving, logical thinking, planning ability, Decision Making, Speed of recollection, decrypting knowledge.

1. INTRODUCTION

1.1 Career Assessment

Career assessment undertaken for discovering the talents and the skills of students, Career assessments sketched. Some ways to evaluate a student are Aptitude, IQ tests, Reasoning students built by expert systems. In this cognitive model, psychological elements like patience & perseverance, speed of solving problems, learning ability, intelligence, etc., are measured quantitatively. Psychological factors of the student determined through playing the game(s) with the expert system. With this test, the inclinations in job type and career of a student measured.

1.2 Why assess Psychological factors

Psychological factors are symbolizing to the workings of the mind or psyche. Evaluating the psychological elements of student grades in finding his/her best appropriate job type. Career assessment is a vital task in a students' education life. A student will be capable of selecting significant subjects and courses during his studies to nominate the perfect career line based on the career recommended by the expert system. Career assessment is chiefly needed for final grade students to realize what type of professions they are appropriate from the software industry. Therefore, the expert system required to evaluate the psychological factors of a student, such as patience and perseverance, speed of solving the problem, intelligence, etc.

1.3 Cognitive Model

In a computerized model, human problem solving and mental processing simulated by a cognitive model. Such a model can be used to predict human behavior or performance on chores similar to the ones sculpted and improve human-computer interaction.

1.4 Expert System

An expert system is best for career prediction to evaluate the psychological factors viz. logical thinking, learning ability, decision making, patience, and perseverance, etc. Student can solve puzzles to assess his/her psychological factors to predict a suitable career(s).

2. LITERATURE SURVEY

2.1 Expert System

An expert system is an automated software into which the knowledge of human beings relating to problem-solving stored. The expert system stored in a computer system in many sectors for assessment and prediction. Several contributions presented in the literature about building expert systems as automated solutions.

An expert system built by Abdur Rashid Khan et al. [1] for assessing the performance of academicians. They have used fuzzy logic for creating the expert system

A career counseling system developed by Essaid EL HAJI, et al. [2] based a combination of multiple expert methods invoked through Multiple agents which are individual software components that provide the cognition rules required for decision making

A detailed and comprehensive survey conducted by Haider Khalaf et al. [3] for finding the expert systems presented in the literature. They have focussed on online expert systems, which can be accessed by students for taking guidance on career selection.

A TIC-TOC-TOE game developed by Prakash et al. [4], built with an expert system and a cognitive model for evaluating the state of the students concerning several psychological elements, which include. Speed of problem-solving, patience and perseverance, learning ability, intelligence, etc. The expert system used for predicting suitable careers for the students. A questioner designed to contain the questions that administrated on the students, the questioners are keyed into the system and based on the answers provided by the students and expert system built. The questioners include questions that exhibit the psychological behavior of the students

Bouaiachi et al. [5] presented an expert system that provides academic consultations to the students. A porotype development is carried based on the proposed expert system, and the students are made to use the system for the selection of the institutions and the Majors that they should pursue.

An expert system used to asses the memory power of the students presented by Dr. J.K.R Sastry et al. [6]. The memory power is assessed based on the ability to recollect pictures, words, names, faces, and objects which are displayed for 20 seconds and then take the inputs from the students about what they have seen. Scores are allotted based on the extent of recollection expressed by the students. A relationship between the Memory power and academic CGPA established, and they have proved that the CGPA of a student is directly related to memory power.

A Tic-Tac-Toe game was developed by Chandra Prakash et al. [7] for assessing the psychology of the students. The assessed psychological factors combined with the Academic credentials, especially the CGPA. Through the game, intelligence, speed of problem-solving, learning ability and patience, and perseverance computed. The scores to measure the level of the factors calculated by using four different metrics that include low, moderate, high, and very high. An expert system built that finds the level of psychology required for handling a specific career. The model is used to predict suitable carers based on the psychological scores computed for a student who is made to play the game.

2.2 Cognitive Model

A cognitive model developed by Emily AP Haigh [8] for assessing the psychological disorders of human beings. The model is designed based on the fundamental principles of psychology.

An Analytical study carried by Chandra Prakash et al. [9] and conclude that game playing is the best approach for assessing the psychology of students. They have also proposed a generic expert system used for different purposes, especially for determining the psychology of the students. The expert system is developed based on a cognitive model that models various psychological factors.

A critical study on the applicability of various games for assessing the psychology of the students was carried by Chandra Prakash et al. [10] with a primary focus on developing an expert system based on cognitive models for assessing the suitability of specific careers to selected students.

2.3 Career Assessment

An expert system helps to predict suitable jobs proposed by Manisha et al.,[11]. The expert system built based on the weaknesses and strengths of the students. Domain knowledge from the experts collected and developed an expert system based on the received inputs. They have used classifier based machine learning techniques for classifying the various psychological factors into many career streams. The method used for predicting the matching of careers to the level of the psychology of the students.

An expert system called iAdvice was presented by Chathra et al. [12] for advising the undergraduates in the process of selection of career paths that can be selected. The system

also is developed to encourage the students in the variety of subjects required for choosing a career path.

Career assessment based on the cognitive models and expert systems is absolutely for determining suitable career paths scientifically. Out of all psychological factors, the memory of a student pays a significant role in succeeding in a chosen career. An expert system and a cognitive model presented by Chandra Prakash et al. [13][14] that help predicting the suitable jobs of the students.

Game-based career assistance if far superior to a computer-assisted career guidance system, as presented by Yen-Ru Shi et al. [15]. Primarily the game based career selection system is more suitable when it comes to the students. The students are more motivated and are willing to play games and then take career guidance. They have presented a game based career guidance system which can be used for career planning by the students

A study conducted which is aimed to find the semantic suitability information for solving NLP based applications. An expert system was presented, which is based on semantic information and was found to be very close to effective decision making Gurevych et al. [16]. ANKI BENGTSSON argued [17] a career guidance policy is required that written down keeping given creating a competitive workforce in addition to being an entrepreneur or a responsible citizen.

Several expert models developed for assessing Psychological factors of a student's playing different games that include crypt arithmetic, Sudoku, Sokoban, memory power, etc. [20][21][22][23][24][25][26][27]. Most of the models built around human judgments for building expert models. The expert model mined from experiential data stored in a database.

3. DESIGNING INTEGRATED COMPREHENSIVE COGNITIVE AND CAREER ASSESSMENT MODEL

Several Games designed and developed to assess the psychological factors of students and using the scores obtained for each of the factor Careers suitable to the students predicated. Each game is different, and a game assesses certain psychological factors. Some of the Psychological Factors evaluated by more than one game. Each game, when played by students, might lead to predicting a different career. There should be a composite model that combines the scores obtained for each of the factors through a specific game playing so that realistic career predication achieved.

A composite data model developed that integrates the outcomes achieved by playing each of the Games. The scores assessed for each of the psychological factors, its qualitative assessment, careers predicated for a student modeled into an integrated database.

Table 1, to Table 16 primarily models a repository of psychological factors, metrics for measuring the factors, relationships between the psychological factors and the metrics, list of games that can be played, list of careers that can be pursued and also the mental requirements for each of the job. The database design includes the metrics which are used to compute the score of each of the Psychological Factors. Every game designer after calculates scores relating to psychological factors, updates the details into a centralized database. The database system is designed to stores the performance of the students every time a game played at a specific level.

A central query system designed for predicting suitable careers to the student, considering the combined performance of the students collected and stored in a centralized database while the students play specific games. The details of the centralized query system presented in this paper.

Each student must register with the system by providing the details like name, registration number, branch, year of admission, present year of the program, CGPA (or) percentage, etc. so that he/she is allowed to play games

A student has to login to the system by providing an appropriate password so that the operation can recognize him/her as an authorized member.

The student will select one game at a time, and he/she has to complete that game — a brief description of each given below.

N-coin game

In this game, four identical coins are given, out of which three are exact coins of the same weight, and one coin is a fake coin whose weight may be either less or more than the precise coin. The task is to identify the false coin and also specify whether it is lighter or heavier using 3 or 4 weighings. Similarly, this game played with five coins, six coins, seven coins, and eight coins

8-puzzle Game

N 8-puzzle will have three rows and three columns. The puzzle consists of 8 tiles and one space in which the titles moved. Start state and goal state of the puzzle provided. The

problem can be solved by moving the tiles one by one in a single space and does achieving the goal state. [18].

Memory game

A student's memory power assessed in this game. The student has to match the given objects to the corresponding classes. The recollection of objects shown in a picture can also be used to evaluate the memory power of a student. Face recognition is another way to estimate the memory power of a student. The system displays some facial pictures to the student, and the student has to identify those faces among a collection of faces [6].

Sudoku game

Sudoku is a logic-based, combinatorial number-placement puzzle. The objective is to fill a 9×9 grid with digits so that each column, each row, and each of the nine 3×3 sub-grids that compose the network contain all of the numbers from 1 to 9, [9].

Sokoban Game

Sokoban is a game played on a board of squares, in which the player pushes the boxes around in a warehouse, trying to get them to storage positions.[10]

Crypt arithmetic Game

A crypt arithmetic puzzle is a type of mathematical game consisting of mathematical equations among unknown numbers, whose digits are represented by letters (English alphabets). The goal is to identify the value of each letter. The comparison is typically an essential operation of arithmetic, such as addition, subtraction, multiplication. [19]

Tic-Tac-Toe

A game in which two players X and O, who take turns marking the spaces in a 3×3 grid. The player who succeeds in placing three of their marks in a horizontal, vertical, or diagonal row is the winner. In this game provided by the expert system, the first player is a student, and the second player is an expert system [7].

4. GAME PLAYING, ASSESSING PSYCHOLOGICAL FACTORS AND CAREER PREDICTION

Once the login process completed, the student is allowed to interact with the system. Student needs to select a game and start playing. When a student completes a set, depending on the performance of the student in that game, the cognitive model built, and lists of jobs suitable for the students are displayed. After playing all the games, the expert system provides a comprehensive report on the most suitable careers for the student

Each student plays a game multiple times with his/her credentials, and the scores stored in a database. The counts relating to psychological factors assessed through a cognitive model of a student. Suppose he/she plays a game like the N-coin puzzle in the list of games displayed; they evaluated for the psychological element, including logical thinking, patience, and perseverance and learning ability, etc. These are the most critical factors that can influence a person's occupational choice.

By using a computer expert system in place of a human system, a career assessment performed. By using such computer technology, many tools established for assessing student performance. Based on this, some psychological factors evaluated. Depending on this, the computer can suggest decent career guidance for the student. Computer-based career guidance systems are proved to be most appropriate in giving the best career support in all the ways as it uses a way to store and update the files, and also it is used for searching the previous data. It also provides interaction among computers and users. These computer-based career guidance systems assist students in choosing appropriate jobs instead of making incorrect decisions.

Career guidance is also crucial when students need to opt for their undergraduate courses. The online expert system has a knowledge base that is used to give suggestions for the students to select their classes used for their future careers. By designing a game, which is helpful in career planning, will become more successful than a computer-assisted career guidance system. This game-based career planning will be more useful for the students to know the interests of students. With this, they choose the career that suits them. The games intended for career counseling purpose designed with clear objectives and goals. Based on this, the player will take the results of the match earnestly for planning their career. The career assessment game implemented with the user interface, which is user-friendly, and the concept of career selection is known to all age group people. It will provide a flawless career planning for all students of diverse age groups. In the game-based career assessment system, it should provide information on their capabilities, which assists them in finding their interests and appropriate career path.

5. INVESTIGATIONS AND FINDINGS

5.1 Psychological Factors from each Game

Each game measures different psychological factors. Table 17 shows games, and the psychological factors derived from

each match. 'yes' is represented by'1' and 'no' is represented by'0'.

From Table 17 It is seen that using the same game several Psychological Factors assessed, and a psychological factor can be assessed using several games. For example, the Psychological factor "Intelligent" determined through 8 Puzzle game, TIC-TOC-TOE game, Crypto Arithmetic game, Sudoku game, and Sokoban game. Each of the games might asses a student to have a different level of Psychology considering a specific factor.

5.2 Comprehensive Job Predication Method-1

The prediction of the expert system for a Software Engineer job represented as Numerator/Denominator. The denominator in the score indicates the number of games played by the candidate, and the numerator indicates the prediction count for that job. Table 18 shows the prediction of the suitability of a student for a specific JOB based on the prediction of the relevance of a student for that Job

For example, In Table 17, the total score of a student with registration number 101 is 2/2, which indicates that the candidate has played two games out of which two games predicted that he/she is suitable for a software engineer job. The total score of a student with registration number 102 is 3/3, which indicates that the candidate has played three games out of which three games predicted that he/she is suitable for a software engineer job. Hence, the student with registration number 102 is ideal for that job. The authors recommend that students have to play as many games as possible so that the denominator value increases, and the prediction will become more probable and precise. The prediction score when computed is equal to 1 indicates perfect suitability of the student for that Jon. The integrated database queried generates Table 18 the contents of stored in a two-dimensional array.

5.2 Comprehensive Job Predication Method-2

For a specific psychological factor, the student gets a score S for having Played a particular Game i.

Sij = Score computed by a Game for a game I and a Factor j.

Each game is of specified complexity. While some games are easy to play, some other games are complicated. The combined effect weighed considering the games played by a student; it is necessary to assign weights to the game. The weights are assigned by human experts or intelligent calculated using a cognitive model.

Table 19 shows the weights assigned to the games based on their complexity by human experts.

Table 19: Weighting the game based on the complexity of the Game

S.No.	Games	Weighting factor (W)
1.	Tic-Tac-Toe	1
2.	Memory Game	2
3.	8-Puzzle	3
4.	N-Coin	3
5.	Crypt arithmetic	4
6.	Sudoku	5
7.	Sokoban	5

One can see from Table 19 that while TIC-TOC-TOE assigned a weight 1 Sudoku game assigned with a weight of 5.

The total score computed as follows.

m = Number of different games, i= i^{th} game

n = Number of Psychological Factors, j = j^{th} factor

The numerator (N)= $\sum_{i=1}^{i=m} \sum_{j=1}^{j=n} (S_{ij} * W_i)$

Denominator (D)= $\sum_{i=0}^{i=n} W_i$

Combined SCORE for specific Psychological factor = Numerator (N) / Denominator (D)

Where S_{ij} represents, the combined score obtained by a student considering all the games played concerning a specific Psychological factor, and w_i represents weight assigned to a specific game

The student is assessed to be suitable for a specific Job when a specific game played. Table 20 shows the prediction of a student suitable for a specific job when a specific game played and the kind of combined score required for being suitable for a specific job.

From Table 20, the combined score obtained by the student considering the weight assigned to a game. If the predictive score = 1 implies that the student is suitable for that specific job, said with confidence.

The suitability of the student for a specific job can be assessed based on the combined score. From Table 20, one can see that all the students are suitable for software jobs as they all get a combined score =1. However, one concludes that student 103 is ideal as more numerator and denominator of the combined rating obtained.

6. CONCLUSION

To predict a good career(s) for a student, the psychological factors of the student also play a significant role along with their academic scores. There are several conventional assessment tests like IQ tests, aptitude and reasoning tests, etc. which are used conventionally to evaluate some of the psychological factors of a student. The authors proposed a new way to assess the psychological elements of a student using game playing. Generally, students show more interest in playing a game rather than writing exams. An Expert system designed that provides many games like eight puzzle game, Tic-Tac-Toe, Sudoku, etc. A student has to play some of these games so that the expert system can evaluate the psychological factors, build a cognitive model of the student, and predicts an appropriate career(s) for the student. The expert system maintains a list of software career(s) in the software industry. This list extended while considering jobs in other disciplines. The expert system provides scope to extend the list of games in future.

ACKNOWLEDGEMENTS

This research work is part of the research project titled "Development of an expert system for student career assessment based on cognitive models" funded by Department of Science and Technology - Cognitive Science Research Initiative scheme(CSRI) (Sanction order No SR/CSRI/129/2014(G)) of Government of India. The PI of the project is Dr. V. Chandra Prakash. The CO-PI of the project is Dr. J.K.R. Sastry. Koneru Lakshmaiah Education Foundation provides the infrastructure for the project.

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Table 1: Student-Registration-Tab

Attribute name	Attribute Description	Type of Attribute	Constraints
RegstNum	Student registration number	Char	PK
FirstName	First Name	Char	
MiddleName	Middle Name	Char	
LastName	Last Name	Char	
Branch	Major	Char	
YearOfAdmission	Year of admission	Numeric	
YearOfProgram	Year of Program	Numeric	
CGPA	Cumulative Grade Point Average	Decimal	
NumberOfBackLogs	Number of Backlogs	Numeric	
UserName	User name	Char	
UserPassword	User Password	Char	

Table 2: Games-Registry-Tab

Attribute name	Attribute Description	Type of Attribute	Constraints
GameCode	Code of the Game	Char	PK
GameDesc	Description of the Game	Char	

Table 3 :Game Codes

Game Serial	Game Code	Game Description
1.	TICTOCTOE	Tic Toc Toe game
2.	8PUZZLE	8 Puzzle game
3.	SUDOKU	Sudoku Game
4.	SOKOBAN	Sokoban game
5.	CRYPTAPT	Crypto Arithmetic game
6.	MEMASSES	Memory Assessment Game
7.	NCOIN	N Coin Game
8.	MULTIGAME	Multi Game Integration
9.	MAGICSQUARE	Magic Square Game

Table 4: Psychological-Factors-Tab

Attribute name	Attribute Description	Type of Attribute	Constraints
PSYFACTCODE	Code of the Psychological Factor	Char	PK
PSYFACTDESC	Psychological Factor Descriptions	Char	

Table 5: Psychological Factor Codes

Game Serial	Psychological Factor Code	Psychological Factor Description
1.	MEMRECL	Memory Recollection Ability
2.	PROBSOLVABILITY	Problem Solving Ability
3.	INTELLIGENCE	Intelligence
4.	PERSISTENCE	Persistence Level
5.	PERSEVERENCE	Perseverance Level
6.	LOGREASONING	Logical Reasoning Ability

Table 6 : Psychological-Measurement-Types-Tab

Attribute name	Attribute Description	Type of Attribute	Constraints
PSYFACTMESCODE	Psychological Factor Measurement Code	Char	PK
PSYFACTMESDESC	Psychological Factor Measurement Dec	Char	

Table 7: Psychological Factor Measurement code Codes

Game Serial	Psychological Factor Measurement Code	Psychological Factor Description
1.	PSYPALYCOUNT	Number of times the count is pales
2.	PSYGAMETIME	Amount of time taken to play the Game
3.	PSYSUCEEDCOUNT	Number of times the game is played and won
4.	PSYLOSTCOUNT	Number of times the Game is played and Lost

Table 8 : Game-Psy-Relation-Tab

Attribute name	Attribute Description	Type of Attribute	Constraints
GAMECODE	Code of the Game	Char	PK, FK
PSYFACTCODE	Code of Psychological Factor	Char	PK, FK

Table 9 : Psy-Measurement-Relation-Tab

Attribute name	Attribute Description	Type of Attribute	Constraints
PSYFCATCODE	Code of the Psychological Factor	Char	PK, FK
PSYFACTMESCODE	Code of Psychological Measurement	Char	PK, FK

Table 10 : Quality-Assess-Code-Tab

Attribute name	Attribute Description	Type of Attribute	Constraints
QUALASSESCODE	Quality Assessment Code	Char	PK
QUALASSESDEC	Quality Assessment Code Description	Char	

Table 11: Table Quality Assessment Codes

Game Serial	Psychological Factor Measurement Code	Psychological Factor Description
1.	LOW	Low Value
2.	AVERAGE	Average Value
3.	FAST	Fast Speed
4.	MODERATE	Moderate Speed
5.	SLOW	Slow Speed
6.	HIGH	High Speed
7.	VERYHIGH	Very High Speed
8.	VERYSLOW	Very slow Speed

Table 12 : Cognitive-Model-Table

Attribute name	Attribute Description	Type of Attribute	Constraints
PSYFCATCODE	Code of the Psychological Factor	Char	PK, FK
PSYFACTMESCODE	Code of Psychological Measurement	Char	PK, FK
MESSERIAL	Psychological Factor Measurement serial	Num	PK
STARTVALUE	Start Value of the Measurements	Decimal	
ENDVALUE	End value of the measurement	Decimal	
QUALITYASSCODE	Quality Assessment Code	Char	FK

Table 13 : Career-Code-Tab

Attribute name	Attribute Description	Type of Attribute	Constraints
CAREERCODE	Career Code	Char	PK
CAREERCODEDEC	Career Code Description	Char	

Table 14: Career Codes

Game Serial	Career Code	Career Code Description
1.	SOFTENGR	Software Engineer
2.	MNTENGR	Maintenance Engineer
3.	SOFTTESTER	Software tester
4.	DESIGNER	Designer
5.	ANALYST	Analyst
6.	DEVELOPER	Developer
7.	ARCHITECT	Architect

Table 15 : Career-Psy-Rel-tab

Attribute name	Attribute Description	Type of Attribute	Constraints
CAREERCODE	Career Code	Char	PK, FK
PSYFACTCODE	Psychological Factor Code	Char	PK, FK
QUALASSESCODE	Quality Assessment code	Char	PK, FK

Table 16 : Career-Psy-Rel-tab

Attribute name	Attribute Description	Type of Attribute	Constraints
STDREGSTNUM	Student registration Number	Char	PK, FK
GAMECODE	Game Played Code	Char	PK, FK
DATE-PLAYED	Date on which the Game is Played	Date	PK
TIME-PLAYED	Time at which the time played	Time	PK
PSYFCATCODE	Psychological Factor Assessed	Char	PK, FK
PSYFCATSCORE	Score of the Assessed Psychological factor	Num	

Table 17: Psychological factors derived from each game:

Psychological Factor Assessed	8-Puzzle	Tic-Tac-Toe	Crypt-Arithmetic	Sudoku	Memory game	Sokoban	N-Coin
Intelligence	1	1	1	1	0	1	0
Planning Ability	1	0	0	0	0	1	0
Problem Solving ability	1	1	1	1	0	1	0
Patience & Perseverance	1	1	1	1	0	1	1
Learning Ability	0	1	1	1	0	1	1
Logical Thinking	0	0	0	1	0	1	1
Decision Making	0	0	0	1	0	1	0
Memory Power	0	0	0	0	1	0	0
Speed of recollection	0	0	0	0	1	0	0

Table: 18: Job Prediction based Multi-Game Playing

Reg. No.	Jobs predicted	Games played							Prediction Score
		Game-1	Game - 2	Game - 3	Game - 4	Game - 5	Game -6	Game -7	Method 1
101	Software Engineer	1	1	*	*	*	*	*	2/2
	Tester	1	1	*	*	*	*	*	2/2
	Maintenance Engineer	1	1	*	*	*	*	*	2/2
	Marketing Person	1	1	*	*	*	*	*	2/2
102	Software Engineer	*	*	1	1	1	*	*	3/3
	Tester	*	*	0	0	1	*	*	1/3
	Maintenance Engineer	*	*	1	1	1	*	*	3/3
	Marketing Person	*	*	0	1	0	*	*	1/3
103	Software Engineer	*	*	*	*	1	1	1	3/3
	Tester	*	*	*	*	0	1	0	1/3
	Maintenance Engineer	*	*	*	*	1	0	1	2/3
	Marketing Person	*	*	*	*	0	0	1	1/3

Table 20 : Job Prediction based Multi-Game Playing

Reg. No.	Jobs predicted	Games played							Prediction Score
		Game-1	Game - 2	Game - 3	Game - 4	Game - 5	Game -6	Game -7	Method 2 (N/D)
101	Software Engineer	1	1	*	*	*	*	*	3/3
	Tester	1	1	*	*	*	*	*	3/3
	Maintenance Engineer	1	1	*	*	*	*	*	3/3
	Marketing Person	1	1	*	*	*	*	*	3/3
102	Software Engineer	*	*	1	1	1	*	*	10/10
	Tester	*	*	0	0	1	*	*	4/10
	Maintenance Engineer	*	*	1	1	1	*	*	10/10
	Marketing Person	*	*	0	1	0	*	*	3/10
103	Software Engineer	*	*	*	*	1	1	1	14/14
	Tester	*	*	*	*	0	1	0	5/14
	Maintenance Engineer	*	*	*	*	1	0	1	9/14
	Marketing Person	*	*	*	*	0	0	1	5/14