



A Study of Expert System for Career Selection: Literature Review

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Abstract— *Expert system uses human knowledge stored inside a computer to solve problems those require human expertise for solving. Knowledge expert system helps to support for making better decision. There is need of career guidance for students at college level. Expert system plays an important role to facilitate decision making, diagnosis of diseases etc. Expert system for career selection can be developed using Fuzzy logic, neural network for guiding students for selecting proper career stream. From the literature review it has found that in Maharashtra comparatively very less research took place on expert system for career selection. Hence there is wide scope in expert system development for career guidance which will assist secondary and higher secondary students in Maharashtra for selecting proper career. Through this paper researcher thrown light on literature review of career selection expert systems. Here for career selection researcher reviewed 43 literatures including 2-conference proceeding, 8-Books, 22-Journals, 1-Report, 5-Thesis, 3-Websites, 2-Encyclopaedia articles and 2-generic articles. Articles referred are from last two decades and majority of them are latest.*

Keywords— *Expert system, Knowledge representation, Rules, Networks, Problem domain, career selection.*

I. INTRODUCTION

Expert system have proven to be effective in a number of problem domains which normally requires human expertise. Expert systems use symbolic knowledge representation in terms of rules, networks or frames. An expert system is a computer program that represents and reasons with knowledge of some specialized subject with a view to solve problems or giving advice. Expert system is used in different sectors like, medical, agriculture, mining, education, industry, etc. Depending upon the use it is designed for specific purpose e.g. in medical and agriculture it is used for disease diagnosis, in education for learning purpose. Career selection is one of many important decisions students take for selection of proper course.

II. OBJECTIVES

- To find the role of expert system
- To know the process of career selection.
- To identify factors affecting career selection.
- To study existing expert systems for career guidance.
- To find the research gap in existing systems.

III. NEED FOR EXPERT SYSTEM

Expert system is a system that uses domain knowledge stored inside a computer to solve problems that require human expertise for solving. An expert system is a computer program that represents and reasons with knowledge of some specialized subject with a view to solve problems or give advice. There are some limitations of human counselor viz; number of expert counselors, availability of human experts at anytime and anywhere, accessibility. It is very difficult to replace human expert, with time human expert knowledge may be damages, its speed and efficiency changes, it costs very high, hence expert system is useful for either to replace or help the human expert (counselors). Hence expert system enable the use of expertise at anytime anywhere, to reduce operational cost by automating a routine task that requires timely human expertise. Today there is N number of choices in front of students for selecting their career path; hence one should assess himself before career selection. Acquiring the knowledge of self assessment and select perfect career is challenging activity. Now a days students take advice of psychologist / counselors for career guidance. As number of counselors is less and acquiring knowledge of career selection is not affordable, hence the use of an expert system for career selection is the best option. An expert system can retain the knowledge of experts and maintain for future reuse.

Prajakta K Kshatriya TY B. Sc. student ended her life by hanging herself at her own home in Sinnar, Nashik district. According to police official Ashok S Jadhav, preliminary investigations revealed that she killed herself after performing badly in her third year graduation examinations. [1]

Rupali Shinde (14), a Std IXth standard student of Maharashtra High School, hanged herself at her house in Thane, According to Sushil G Jawale, investigation officer, Wagle Estate police station, she was below average student. "The cause of the suicide seems to be depression, as she was unable to cope with her studies,".[2]

IV. CAREER SELECTION

Career selection is one of the main important decision for students in determining future plans affecting one's life. Choosing a career in a certain stream defines the future of a student. However, it is difficult for a student to choose a career path at the early age. This decision will impact them throughout their life. Choosing the perfect career is a sure thing for success in life.

Hall (1976) defines career is the individually perceived sequence of attitudes and behaviors associated with work-related experiences and activities over the span of the person's life".

Career is defined by the Oxford English Dictionary as a person's "course or progress through life or a distinct portion of life". Career is understood to relate to a range of aspects of an individual's life, learning and work. The term career is used to describe an occupation or a profession that usually involves special training or formal education, and is considered to be a person's lifework.[3]

Career choice is a developmental process that extends throughout life; it involves series of decisions. In reality career decision is not just a matter of selecting an occupation that is good match with person's characteristics, but it is the lot more complicated process. Good Career planning includes a match between requirements for a job, aptitude interests, personality of the youth and expectations from the parents. Good career planning leads to good career adjustment.[4]

Career choice is a broad opportunities that exists for life long vocations. These vocations are set out in a framework of strategies moving toward personal goals. Fields of vocational, academic, and sociological endeavors are explored for the purpose of satisfying personal, economic, and intellectual goals. [5]

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Career guidance refers to services and activities which assist individuals, of any age and at any point throughout their life, to make educational, training and occupational choices and to manage their careers. Such services may be found in schools, universities and colleges, in the workplace. (Module-I, n.d.)

For career guidance many organizations, consultancies, counsellors are guiding to students for selecting their proper career options. For this purpose they are considering different parameters for guiding students.

V. CAREER SELECTION PROCESS

Career counsellors follow their own methods for giving career guidance to students. It means counsellors considers different factors for assessing student. Some uses aptitude, psychology test, personality test, skill tests, student's background information, IQ, interests, etc., from this information they are guiding the students about career selection options.

Factors affecting career decision making are student's performance in previous examination, parent's expectation, advise of teachers, friends, others, aptitude, interest, IQ, personality, living environment, educational background, skills, gender, location, influence of peer and curriculum content, religious affiliation, social opportunities, emotional rewards, economic benefits, etc., Aptitude and Intellectual abilities are important for career selection, the context in which people live, their personal aptitude, and educational attainment influence while selecting career (Bandura, Barbaranelli, Caprara, &Pastorelli, 2001).

The General Aptitude Test Battery (GATB) profile of occupational aptitudes can be used to determine appropriate career and/or training paths. GATB is a measure of a wide range of aptitudes and is used for occupational selection, rehabilitation, and vocational counseling [7].The GATB, is a professional career aptitude test which measures nine different aptitudes and can be used to help assess the likelihood on how an individual will be successful in specific careers or training programs [8]. GATB is a general mental capability that involves the ability to reason, plan, solve problems, think abstractly, comprehend complex ideas, and learn from experience; to deal with life and its situations appropriately.

One can measure cognitive and perceptual level of students using arithmetic computation, three dimensional space, English vocabulary and arithmetic reasoning subtests [9]. GATB is psychological test and it measures the aptitude level and compares it with occupations based on ability level.[10]

German psychologist L. Wilhelm Stern was the first to coin the term intelligent quotient (IQ), a figure derived from the ratio of mental age to chronological age. Dr. Nafde's Non Verbal Test of Intelligence (N.V.T.I.)is the test used to measure students intelligence and it is tested using four sub tests i.e. analogy, water reflection, series and classification.[11]

Interest inventory by J. Mascaren has this inventory consists of different questions/ items to measure interest in Medicine, Engineering, Commerce, Arts and Fine Arts. It is meant for 14 to 18 year-old boys and girls. The time limit to complete the test is on an average 30 to 35 minutes.[12]

Bell's Adjustment inventory is a test of personality that assesse the individual's adjustment in a variety of situations such as, home, health, emotional and the social context. The test gives the score in the different adjustment dimensions and gives a fair idea of how you are dealing with these situations at your current age and stage in life.[13]

Decision making process for career selection consists of different steps it starts with identifying the decision to be made, then gathering information, identifying alternatives, weigh evidence, choose among alternatives, taking action and finally reviewing decision and consequences. Here for selecting career information related to interests, skills, abilities, values, experience, occupations is necessary to collect. [14]

This article describes components/elements involved in making career decision. These are knowing about self (values, interests, skills, personality and aptitude), knowing about your options (occupations, programs of study and jobs),

knowing how you make decisions and thinking about your decision making. Decision making is a way to form and establish identity. [15]

In Indian educational system students select their career stream after their secondary school (S.S.C.), and hence it is important to make correct decision at this phase. In Maharashtra students especially from backward areas are not getting proper guidance from their parents and environment, so it makes them difficult to take career decisions. And hence SSC is turning point in students life, and for selecting proper stream they need proper guidance from teachers, counsellors, parents etc.,

VI. EXPERT SYSTEMS FOR CAREER SELECTION

Below are few present expert systems used in educational sector, useful for students, teachers, Head of the department for taking career related decision.

➤ **iAdvice:**

iAdvice is a Career Advisory expert system designed by Chathra Hendaheva et al. to guide students for faculty of B.Sc. IT students of Moratuwa University, engaged in their higher education to determine their career paths and to select their course subjects to be in-line with their career goals.[16]. The System consists of three components viz; knowledge base, Inference Engine and user interface. This expert system uses features such as reasoning ability, providing explanations, alternative solutions, uncertainty and probability measures, questioning ability and also forward chaining, backward chaining and rule based inference in designing expert system. This system was divided into two main subsystems i.e. Career known subsystem and Career unknown subsystem. The first subsystem provides advice to students who has specific career goal and second subsystem provides advice to students who is unclear about career objectives. Past examination performance, student preferences and skills, industry alignment with subjects, are the main factors considered by a human expert in providing career guidance.

➤ **PAS**

Post graduate Advisor Expert System (PAS) was proposed and developed by Al-ghamdi et. al. for advising post graduate students of computer science major in King Abdulaziz University (KAU) to select suitable course during their PG programme. This system developed using Wxpython language and Access database. PAS consists of four components viz; DB, Processing unit, user interface and scheduler. Present system is desktop system and author aim to make a statistically study on PAS to determine precision of the system in producing good plans.[17]

➤ **CPSRS**

Career Path Selection Recommendation System (CPSRS) was proposed and developed by Razak, Hashim, Noor, Hazwam, & Halim. This system was developed using fuzzy logic technique. CPSRS was designed for providing direction and guidance to final year students for faculty of computer and mathematical science, University Teknologi MARA (UiTM) students of Malaysia for choosing suitable career. Factors considered for career selection are student's strengths, skills and personality, interest, past academic records. The use of fuzzy logic approach helps students by giving career recommendation based on career test. They used Fuzzy Associate Memory (FAM) as fuzzy inference because FAM will contain the knowledge from an expert that is believed to be able to reach nearly any sort of control objectives. The operator MIN and intersection AND is used as inference rule.[18]

➤ **CACGS**

Computer Assisted Career Guidance System (CACGS) is a career system which helps clients from secondary to post-secondary students of Malaysia. It is a interventions and various print and media-based support resources that are used within organizations to assist individuals in making career decisions".[19]

➤ **ONLINE ADVISOR** is a web-based decision support tool [20], this tool is proposed to help the advisor and student to interact with each other and make the decision for choosing a suite courses. This system can help the advisors to offer the appropriate advices to their students through showing student information, courses that had been taken or not by the student and changes in courses requirement.

➤ **IS A-DVISOR** is a prototype that had been developed as advising expert system in Information System-IS department in Ajman University [21]. This system assess students and their advisors to make academic plan that suits the student. This system is based on knowledge base component and reasoning strategies in its inference engine components, it also based on Object-Oriented (OO) architecture of its database. This system provides students and advisor quick and easy course selection for each semester. This system is standalone system.

➤ **CAM (Career Advisor Model)** - is a model proposed to provide right advice to students. This model is based on machine learning technique and rule based decision support capability. [22]

➤ **CGM- (Career Guidance Model)** - Winston & Lawrence developed expert system model (CGM) for African high school students. Survey was carried out to estimate the level of professional satisfaction with the task and nature of their career and also determined what career practices are carried out in Kenyan high school. It was found that approximately 90% of public high school students in Kenya were not getting reasonable career guidance due to limited resources and time. The proposed model consists of three sections, personality analysis, decision making regarding selecting specific job category (simulation of activity), and Scholastic Aptitude Testing (SAT) for evaluating one's cognitive ability. Personality analysis model created knowledge and rules based on Myers-Briggs Typology Indicator (MBTI). Proposed system was designed using visual basic and Access. [23]

➤ **CMS (Career Master System):** Balogun, Thompson presents development of career master DSS for counsellors to assist students in selecting the right discipline for secondary school leaving students of Nigeria who have problems with their choice of careers as they intend to study at tertiary institutions of their choice. This career master system implemented using Visual Basic. This system is designed for desktop and counsellors, and system recommendation

were based on parameters like ability, skills, Intelligent Quotient, interest, parents and friends influence, preferences, parent occupation and hobbies, past academic performance. For development of this career master system author considers four databases subject, study, pass and course. Author checked this DSS system with career counsellors result, it found that developed system recommendations are correlated with counsellors recommendations. System provide the desktop for the counsellors to enhance the duty of choosing the best and most appropriate discipline for clients. (Balogun, Thompson,& State, 2009)

- **Rule Based DSS:** Muhammad Zaheer Aslam, et al. presents the design and development of a proposed rule based Decision Support System that helps students in selecting the best suitable faculty/major decision while taking admission in *Gomal University*. They designed a model using visual basic for testing and measuring the students capabilities like intelligence, understanding, comprehension, mathematical concepts his/her past academic record, intelligence level. They divided tests into two parts one for testing capabilities and abilities and another for testing intelligence. Capability and ability test consists of 100 questions i.e. 20 questions each for English, Mathematics, Physics, Chemistry, Computer Science / Biology and intelligence test consisting of 50 questions. They applied model resulting into a rule-based decision support system to determine the compatibility of the available faculties/majors in Gomal University. This DSS identify the most suitable faculty or major for the student based on his abilities and capabilities extracted from the test module results. They used CLIPS language to store knowledge base. Rules can be made more customized and more criteria may be added to it for more data mined results. It can be extended to include other universities faculties and majors to be able to serve more students wishing to be enrolled in other universities and make the criterion customized for that university. [25]
- Oladokun, V.O. et.al. developed decision support system for university admission seekers using fuzzy logic. Fuzzy inference system of decision process was developed. Model parameterization was carried out using information from the Nigerian University Admission System. For developing this system student ability, average cut off points, university competitiveness score, choice preference used as input variables, and choice viability as output variable. Different membership functions i.e. ZMf, GaussMf, PiMf, SMf, TrapMf, DsigMf are used. The developed model seeks to match a candidate's ability with course-university combination. The model provides an easy to use tool for assessing the viability of a choice or advising on the level of efforts required to meet the competition associated with a choice. It was concluded that Mamdani based Fuzzy Inference System will be a veritable tool for the university admission choice problem. (Oladokun V O et.al., 2015)
- Saraswathi et.al., proposed an online Expert System for providing guidance to students for the selection of their undergraduate courses after the completion of higher secondary school education. The systems knowledge-base contains the details about the colleges in Pondicherry which is acquired from web pages using pattern matching and jSoup parsing technique and the knowledge-base is constructed automatically based on set of rules without manual efforts. Rules are framed and an inference engine (rule based reasoning) is developed which makes the Expert System. The constructed knowledge-base can be queried with domain related queries and the Expert System provides the most relevant details for the query. For career guidance, Expert system technology seems to be the most successful method of computerization. [26]
- Ari et.al. designed a graphical user interface programme working with fuzzy logic rules for directing students in Germany to their career selection considering various input parameters like interests, abilities, students diploma marks etc. Professional competence is used as output suggesting students for predisposition of occupational groups as a result of 6 input, 25 membership functions and 4050 rules. Students professional competence is evaluated with the help of the program designed with fuzzy logic rules. Additional parameters i.e. student advisor adviser's thoughts, grade point average of previous training, determining test of professional desire, student's thoughts, physical conditions and parents' thoughts are transferred to the system. Designed system was evaluated and its results are more effective and efficient. (Ari et. al, 2009)
- Fekri-Ershadet.al, proposed a rule based expert system for head of the university department to choose the best lecturer for respected course. The proposed system is developed using Clips and is divided into two steps i.e. human experts knowledge is designed as decision tree, and in second step system is evaluated using extracted rules of these decision tree. [28]
- Adawiyah & Ismail proposed a design and development of career guidance system for secondary school students in Malaysia. [19]
- QUING WU investigated and analyzed key criteria on university selection like University ranking, Subject ranking, Completion rate, Location, Accommodation costs, Tuition fees, environment, city culture, facilities, weather, subject, future occupation selection, interest, educational quality, personal preference social awareness of the university and Entry Requirements affecting student's decision while selecting suitable university. DSS was designed for international students coming from china. The system is only a prototype system. The researcher investigated and analyzed key factors affecting international student's decisions when selecting suitable university using *personal interview and questionnaire survey method*. Researcher designed a system named DSS-US using Java programming language. Analytical hierarchy process (AHP) and weighted sum mode (WSM) methods were used to select best suitable University for their *post graduate* study in UK. [29]

VII. FACTORS AFFECTING CAREER SELECTION

- Hirschi identified six common basic phases in the career decision-making process viz; awareness, generating possible career alternatives based on one's own interests, skills, and values through self- and environmental

exploration, reducing the career alternatives to a manageable number for more in-depth exploration, deciding among few alternatives, confirming one’s choice and building a commitment to it, and being firmly decided and committed to a choice. Author presented a six phase model of career decision making (CDM) for secondary students. Authors studied that within the Swiss education system, secondary students have to make a real career choice in grade nine. They didn’t measure the actual knowledge of the world of work or the skills of students in career decision-making which could also be regarded as important aspects of career choice readiness. Here author did not measure the actual knowledge of the world of work or the skills of students in career decision-making, which may be an important parameter of career decision making.[30]

- O. ISSA et.al (2008) identifies that students all over the world are facing problems for decision making in career selection. The choice of career, subjects, and courses of study in schools and of subsequent paths to follow, are always difficult problems facing prospective undergraduates. Often, choosing the right subject combination leading to the right profession can make the difference between enjoying and detesting the career in future. Dedicating oneself to career choices that are unattainable leads to frustration. Author has investigated factors affecting career of UG students in Nigerian library and information science schools. [31]
- Swanson & Found describes constructs necessary for career selection. These constructs are interests, need & values, abilities and skills, personality. Majority of measures incorporate Holland’s topology to measure interest, or there are several measures like strong interest inventory, self -directed search, Campbell interest and skill survey, Kuder career search etc. Kuder skill assessment and ACT’s inventory of work-relevant abilities more likely used for measuring skills and abilities. Myers-Briggs Type indicator and NEO personality inventory can be used for assessing personality construct.[32]

Table I shows factors considered for career selection. From this table it is found that students academic performance,

TABLE I INFLUENCING FACTOR FOR CAREER SELECTION

Factors	(Edwards & Quinter, 2011)[33]	(GRYGO, 2006)[34]	(Wu, 2012)[29]	(Ari, 2009)[27]	(Alias, Norazul, Bin, & Bakar, 2010)[35]	Darren Fizer	(Hendahawa, Dissamayake, Samaraweera, Ruwanpathirana, & Karunananda, 2006b)[36]	(Razak et al., 2014)[18]	(Aslam & Khan, 2011)[25]	Balogun, Thompson, and Siate [34]	(Olamide & Oluwaseun, 2013)[37]	(Borchert, 2002)[5]	(Ghuangene, 2011)[38]	(Shumba & Naong, 2012)[39]	(Fremie, 2014)[40]	(Alexander et al., 2011)[41]	(Degee, n.d.)[42]	(Addison, Antwi, & Amisah, 2014)[43]	(Saleem, Ahmad, & Irfan, 2014)[44]
Ability/ Capability																			
Age																			
Area of residence																			
Attitude	✓						✓												
Availability of jobs	✓																		
Community																			
Counsellors /Advisor		✓		✓			✓								✓				
Environment			✓	✓			✓					✓	✓					✓	
Family Business							✓						✓						
Financial Support /Family Income	✓						✓				✓		✓	✓		✓	✓		✓
Friends Influence		✓					✓			✓			✓	✓		✓	✓		✓
Gender	✓				✓		✓						✓	✓	✓	✓	✓		
Hobbies										✓									
Interest	✓		✓	✓	✓	✓		✓		✓	✓		✓	✓	✓	✓	✓	✓	✓
Industry Alignment with subjects							✓				✓		✓						
IQ									✓	✓									
Job Guaranty					✓														
Learning Experience	✓																		
Location			✓																
Media																			
Opportunity										✓	✓	✓					✓	✓	✓
Outcome													✓						
Expectations																			
Parents Educational Background										✓									✓
Parents Influence		✓		✓	✓	✓				✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Past Academic Performance				✓			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Personality					✓	✓		✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Preference			✓				✓			✓		✓	✓	✓	✓	✓	✓	✓	✓
Prestige	✓																		
Programme					✓														
Self Efficacy													✓						
Self-employment	✓																		
Scholarship					✓														
School Attended	✓	✓	✓							✓	✓								✓
Skills					✓		✓	✓	✓	✓	✓	✓			✓				
Students strength								✓											
Teacher		✓			✓	✓						✓	✓	✓			✓	✓	✓
Tuition Fees			✓																

VIII. RESEARCH GAP

Existing systems for career selection considers few parameters/ factors. These systems were designed considering curriculum of particular university requirement i.e. these systems are useful for selecting courses/ majors of particular university. Everyone can't have access to these systems hence the access is limited and are not generalized systems, thus those are not useful for selecting a general faculty after secondary school. Due to less number of counselors it is not possible to guide all students regarding career selection. In Maharashtra specifically students those are from rural area are unaware about career selection and it is not economically possible to get career selection guidance to decide their career paths, for testing their skills, intelligence, interests etc.

IX. CONCLUSION

From above literature review it is found that expert system is used for guiding students of secondary, higher secondary, graduate for selecting proper career option/stream, major/course in particular university. Different factors affecting career selection are students ability, age, aptitude, area of residence, attitude, availability of jobs, community, counsellors /advisor, course curriculum, environment family business financial support/family income, friends influence, gender, hobbies, interest, industry alignment with subjects, IQ, job guarantee, learning experience, location, life style, opportunity, outcome expectations, parents influence, past academic performance, personality, physical condition, political consideration ,preference, prestige, previous work experience, programme, self-efficacy, self-employment, scholarship, school attended, skills, students strength, teacher, tuition fees etc. All these factors are helpful for students after secondary, higher secondary, graduation courses for selecting stream or programmes in particular university.

Existing expert systems for career selection considers few factors. These systems were designed considering curriculum of particular university requirement i.e. these systems are useful for selecting courses/ majors of particular university. The access to these system are to particular problem only. In Maharashtra specifically students coming from rural area are unaware about career selection and for them it is not economically affordable to take advice from professionals to take decision based on aptitude test. Considering the less availability of career counsellors in rural area and to get ready assistance of career guidance, expert system on web is very good option. Research on design of expert system for career selection in Maharashtra is very limited and hence there is wide scope for research in this field. Researcher has plan to design expert system for career selection.

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