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The Factors Driving Career Planning and Mentoring in Four Year UG Engineering Education using ML Techniques

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Abstract: Career Planning is a continuous process of evaluating individual career goals through self-assessment, market research and objectively meeting the goals through continuous learning. In the context of Industry 4.0, career planning is not just limited to working professionals, but also plays a major role for the professional engineering students. Mentoring becomes a solid supporting prop to reach these goals systematically. It requires a philosophy, proper design of methodology, and organization structure. This study explores various factors driving career planning and mentoring in Four year UG Engineering Education. In this context, authors conducted literature survey and student's survey on 171 students to understand various factors, skill levels needed in designing career planning model and proposed mentoring model using Machine Learning Techniques (k-Means Clustering Algorithm). Further, authors surveyed 1525 students to understand career aspirations, designed Center for Career Planning organization and experimenting this model in a leading private group engineering college.

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Keywords: Career Planning; Under Graduation Student Career Options; Skills for Engineering Students; Mentoring; Machine Learning.

1. Introduction

Career Planning provides a direction, identifies the strengths and weaknesses, skills and knowledge, in order to achieve the career goals. According to Schermerhorn et al.,(2005), "Career planning is a process of systematically matching career goals and individual capabilities with opportunities for their fulfilment". Career planning includes two important phases- Assessment (aspirations and skills) and Development (analysing the opportunities and alignment to the opportunities). This process would be successful when there is an action plan and periodic reviews. This is where mentoring plays a major role. In conjunction with proper mentoring, career planning creates a profound impact in reaching the career goals. Contradictory to the popular perception, Career Planning is not just applicable to employees, but it also important for UG Engineering students. The under graduate curriculum is adopting internships, job oriented skill training programs, electives, multi-disciplinary courses, campus recruitment programs, etc. Hence, it is important to identify various factors driving career planning and mentoring in UG professional courses.

This paper is structured as follows. Section 2 discusses the literature survey. Section 3 presents the methodology and results for factors driving career planning. Section 4 presents the proposed clustering model for UG Engineering Students. Section 5 presents the threats to validity. Section 6 presents the conclusion

2. Literature Survey

In this section, we present the literature survey conducted in order to identify factors driving career planning. The best and perfect career choice plays major role in student's life (Alberts et al., 2003). This step ensures better employability and job satisfaction in long term (Jainani, 2018). Career is an application of a person's cognition and capabilities and provides basis for developing business networks (Redman and Wilkinson, 2001).

Career planning is the process to pursue his/her growth objectives in conformity with his/her expertise in the area, capabilities and aims (Bayraktaroğlu, 2011). Career choice is influenced by 2 factors- social factors (family, environment, social bonds, etc.) and psychological factors (perception, cognitive intentions, beliefs, ideas, personality and assessments, etc.) (Özen, 2011).

Career should improve standard of living, cultural environment, his family experiences, guidance and expectation provided and pertinent to particular field (Cavus et al., 2015) and (Muraguri, 2011). Another study states that Employment opportunities and learning experiences have major influence (Edwards and Quinter, 2012). According to Hewitt, few intrinsic reasons like passion, parent's choice, social prestige, job opportunities, income factors play major role in career planning (Hewitt, 2010). Influential people may play an important role for selection of any career path among youth (Wildman et al., 2001). Academic performance also plays major role in career planning (Schermerhorn et al., 2005). Dominant family business influences the career choice esp. in selecting particular field (Fizer, 2013). According to Perrone et al., (2001),"There is a difference between the choice of male and female in selecting the career choice".

A research was conducted to investigate the factors that influence the career choice in UG and PG Business students. The most influencing factor is "interest in the subject", which has direct linkage with personality type. This study also proposes the importance of student counselling sessions and other interventions to improve the results. Career choice is partially influenced by social class, financial resources, affordability and future employability" (Ahmed et al., 2017) and (Kerka, 2000).

3. Methodology and Results

In this section, we present the methodology adopted and results of the survey process. Based on the literature survey and expert opinions (industry, academia, recruiters and parents), we identified important factors of the career planning and mentoring.

We have adopted the survey method of quantitative research by designing a structured instrument (questionnaire) which was to be answered by the UG students, chosen from different backgrounds and geographical locations. Total number of participants are 175 students across various Engineering Colleges.

3.1 Survey Results

Student's segmentation involves dividing a student base into groups of individuals based on certain traits they share. We divided survey questions into following four types of segmentation models.

1. Demographic Segmentation Model: Gender, Year of Study, Parent's Income Group, Sibling's Position, Department,

2. Geographical Segmentation Model: State, Current Stay (Hostel/Day Scholar)

3. Psychographic Segmentation Model: Goals, Constraints Level to pursue goals, Commitment Level, Working in Social Projects, Natural Skills, Type of person (Creative, Leader, Follower, Context Dependent), Personality Qualities

4. Technographic Segmentation Model: Academic Performance, Group Discussion Performance, IT Skills Readiness, Domain Readiness, Communication (Oral and Written), Presentation Skills, Prototype Making Skills, Business Pitch Skills, Aptitude, Technical Projects, Mentor Availability.

The following section presents survey results & analysis.

1. Gender Analysis:

Fig. 1: Male vs. Female

As part of the survey, male and female ratio (48% and 52%) is almost equal, which brings un-bias in the decisions.

2. Year Wise Student's Participation

Further, we analysed year wise student's participation by gender.

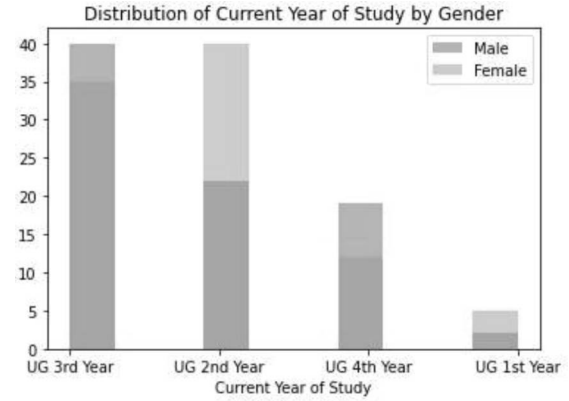

Fig. 2 : Year wise Student's Participation by Gender

We have 43% participation from UG 3rd Year, 35% from UG 2nd Year, 16% from UG 4th Year, 5% from UG 1st Year with almost equal gender ratio. This kind of participation shows the maturity of the students who are ready to plan their career (majority participants are from 3rd and 2nd Year).

3. Location

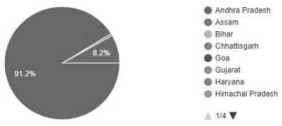

Fig.3 : Student Location

Majority of the participants are from Andhra Pradesh (91%) and Telangana Regions (8%).

4. Parents Occupational Position

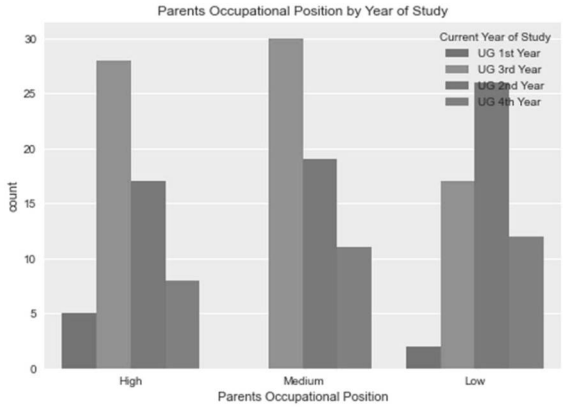

Fig.4:Parent's Occupational Position by Year of Study

We categorized survey participants into three groups (High, Medium, and Low) based on their parent's occupational position. We surveyed parent's occupation and made a heuristic approach in the categorization. We observed that majority of the participants belong to Medium and High class families.

We observed more male participants are from financially constrained families as showed in Fig.5.

Fig. 5 : Parent's Occupational Position by Gender

5. Siblings Support / Occupation

We understand that ordinal position of siblings, age spacing, and gender composition has huge impact in terms of identity development as well as career development in traditional family setting. It is also studied that there are variations of parenting across sibling's birth order. In order to study this, we collected sibling's occupational or current status as showed in Fig. 6. Many participants are having

student siblings. This promotes competitive spirit in the home environment but less of sibling mentoring support.

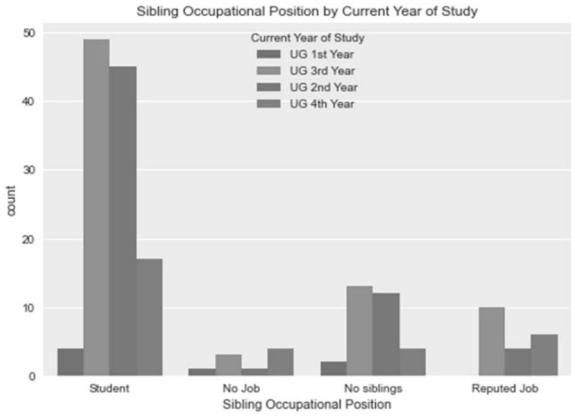

Fig.6:Sibling's Occupational Position by Year of Study

Female participants are having more student siblings than male as shown in Fig.7.

Fig. 7. Sibling's Occupational Position by Gender

6. College Type

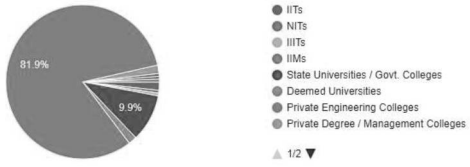

Fig. 8. College Type

Majority of the participants are from Private Engineering Colleges with 82%, Govt. State Engineering Colleges (10%), Deemed Universities (2%), IITs (2%), NITs (1%).

7. Stay during College

We observed that 58% students are day scholars and 37% are hostellers. This becomes good distributed sample for finding career influences.

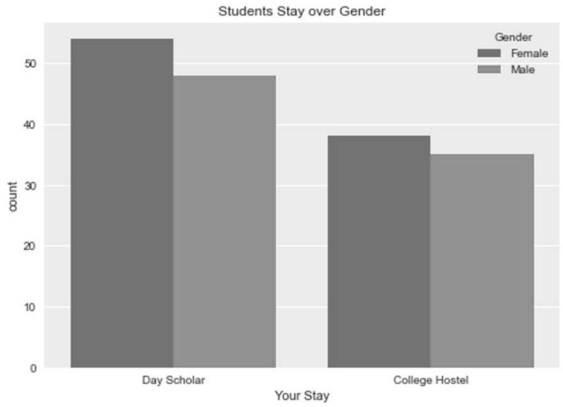

Fig.9: Stay during Education

We also observed that there is no significant difference between genders over stay preference. This signifies the equal opportunity.

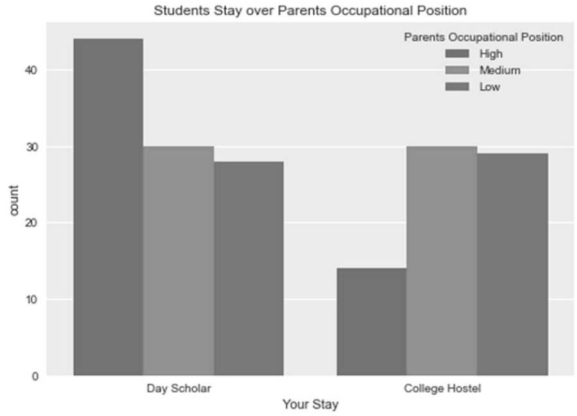

Fig.10: Stay during Education

It is observed that more number of day scholars with high & medium parental financial position

8. Engineering Branch

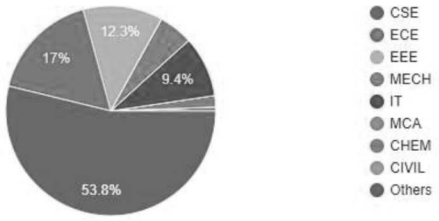

Fig. 11 : Engineering Branch

We found that 53% are from CSE, 17% are from ECE, 12% from EEE, 5% from Mech, 10% from IT and others 2%. It is reflecting current market preference.

Table 1: Academics survey questions using the qualitative approach.

9. Student Goals

We requested participants to select goals. 44% opted GATE/Core Engineering, 14% Opted GRE, 11% opted for Civil Services/Competitive, 21% opted for IT/Software Jobs, 4% for CAT/GMAT / Management, 5% to start their own start up, and 1% for creative jobs. UG Engineering students have exhibited mixed aspirations contrary to engineering allied jobs only.

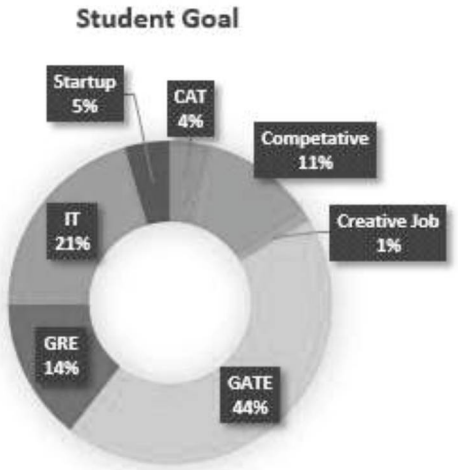

Fig. 11: Proffered Goals

The aspirations are having influence over parent's occupational position. Students from varied backgrounds are having different type of goals. Lower financial background students are aspiring more of competitive exams than upper financial background as shown in Fig.12. This is quite understandable that lower financial background students look for better stability and low risk options. Upper financial background students aspired more for GRE than middle and lower background students. Middle class background students are aspiring more for IT jobs.

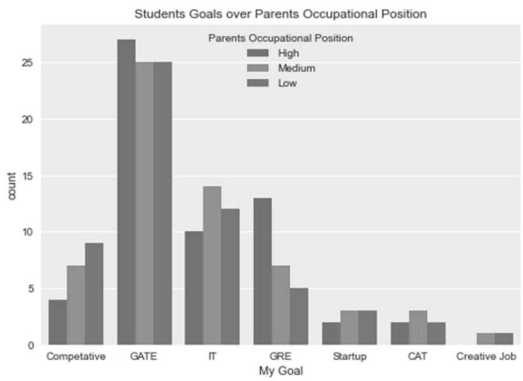

Fig. 12 : Proffered Goals over Parents Position

10. Financial and Social Constraints

63% of participants mentioned, "I have financial/social constraints but still want to pursue my interest at any cost". 35% mentioned, "I don't have financial/social constraints but intact with goals". It shows that most of the students wish to fulfil their goals in spite of their background.

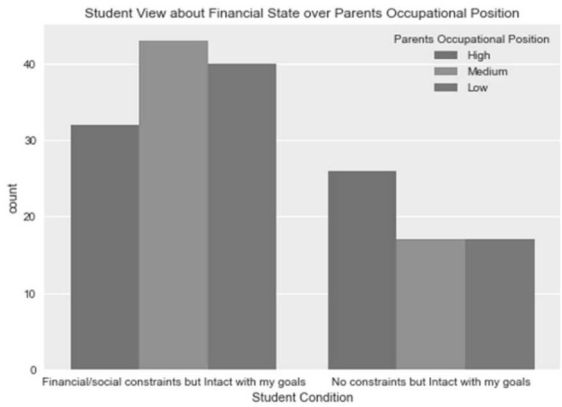

Fig. 13 : Financial and Social Constraints over Parent's Occupational Position

We corroborated this data with parent's occupational position. The data is matching as shown in Fig.13.

11. Academic Performance

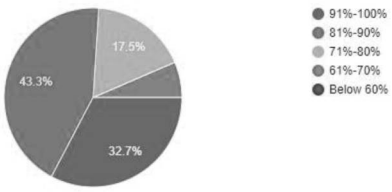

Fig. 14 : Academic Performance (+12 to UG)

This sample presents that most of the participants are academically serious.

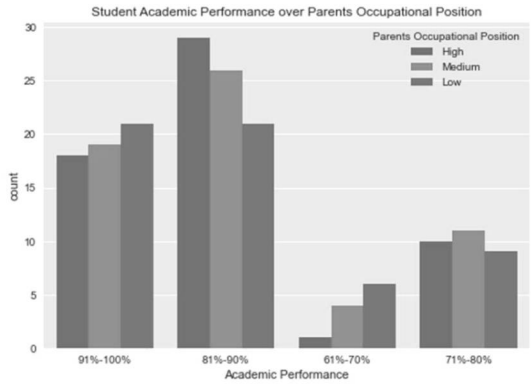

Fig.15 : Academic Performance over Parent's Position

Parent's position has no major bearing on overall academic performance. However, the students from lower and middle class background fared high in 91%-100% bracket as shown in Fig.15.

Similarly, Gender has no major significance in overall academic performance except in 91%-100% bracket where girls outperformed boys as shown Fig.16.

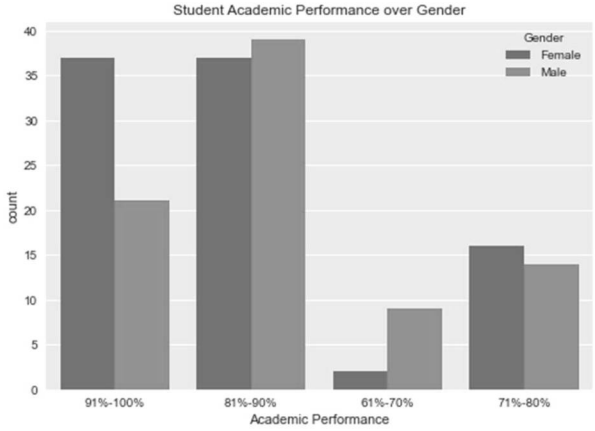

Fig.16: Academic Performance over Gender

12.Commitment

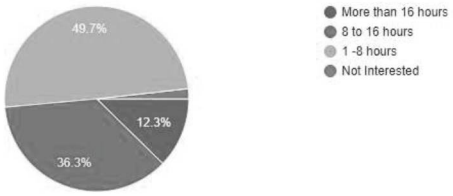

Fig. 17 : Time Commitment

50% of the participants are committed to keep 1-8 hours (outside the college hours) towards their goal. 36% committed for 8-16 hours outside the college hours. 12% committed for keeping more than 16 hours outside the college hours. This sample exhibited to keep extra effort towards their goals.

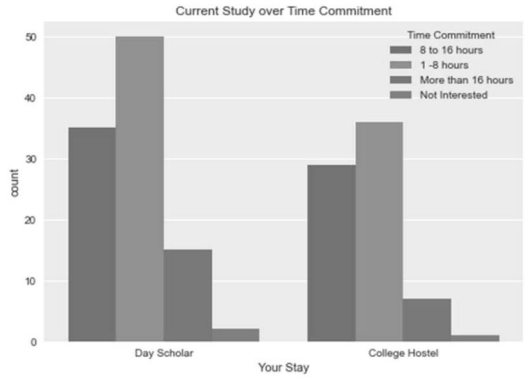

Fig. 18 : Student Stay over Time Commitment

Surprisingly, day scholars committed for extra hours to pursue the goals as shown Fig.18.

13.IT Technologies Readiness

93% of the sample mentioned that they have basic programming knowledge. 4% of the participants mentioned that they have competitive coding knowledge. 2% of them having animation knowledge and 1% mentioned that they do not have any IT exposure. This sample depicts the familiarity with IT skills. Third year students are highly familiar with IT systems.

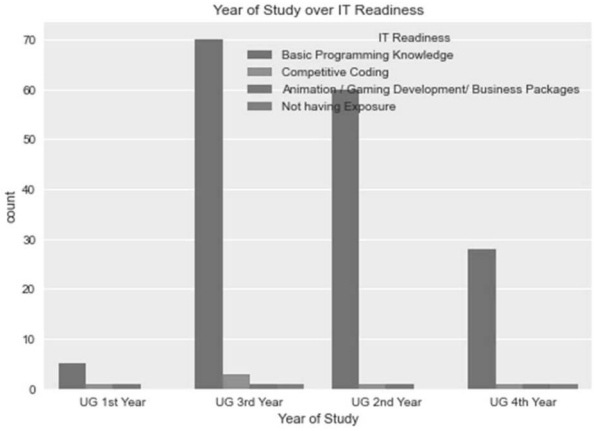

Fig. 19 : IT Readiness

14.Domain/ Subject Readiness

We surveyed Subject or Domain Readiness (e.g. Knowledge in e-commerce, retail, HR, Finance, Engineering -Manufacturing Process, Energy, Agriculture, Healthcare, Chemical, Supply chain, Instrumentation, Civil Engineering, Economics, etc.). 67% are having college level basic understanding of their subject. Only 33% participants are confident at expert level.

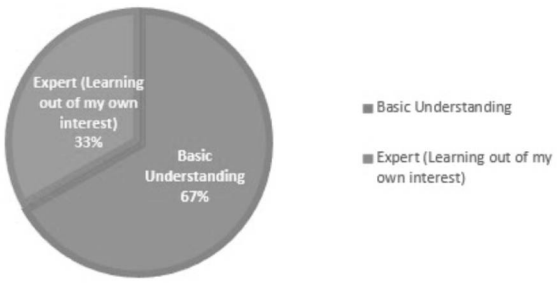

Fig. 20 : Domain / Subject Readiness

15.Communication Skills (Oral)

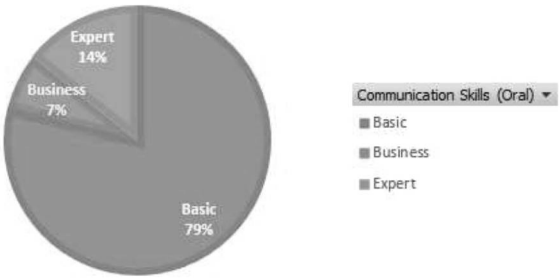

Fig. 21 : Communication Skills (Oral)

79% of the students are having basic oral communication. 14% are having expert level communication. 7% are having business communication skills.

16.Communication Skills (Written)

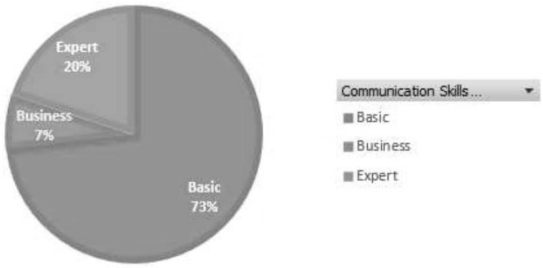

Fig. 22 : Communication Skills (Written)

73% of the participants are having basic written communication. 20% are having expert level written communication. 7% are having business written communication skills.

17.Presentation Skills

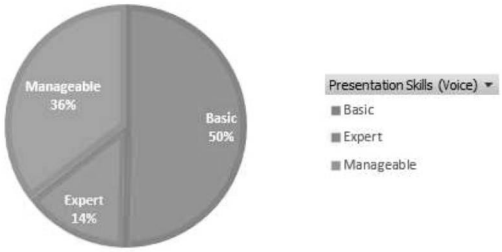

Fig. 23 : Presentation Skills

50% of the students are holding basic presentation skills, 36% are with manageable level and 14% with expert level.

18.Report / Article Preparation Skills

Fig. 24 : Report / Article Preparation Skills

46% of the sample holds basic preparation skills, 32% manageable, and 22% with expert level.

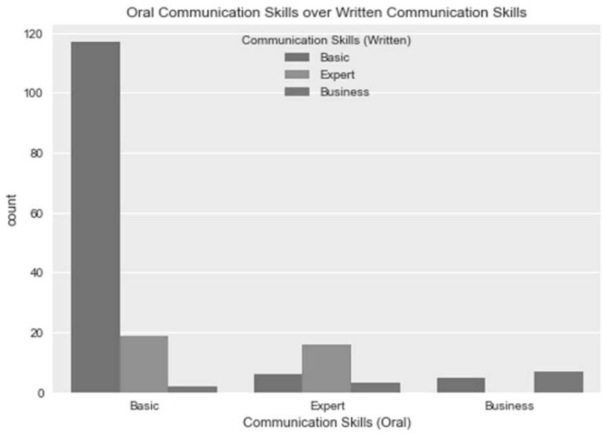

Fig. 25: Communication Skills Oral over Written Skills

We observed that majority of the sample possess basic level oral & written communication skills as shown in Fig.25.

19.Prototype or Model Making Skills

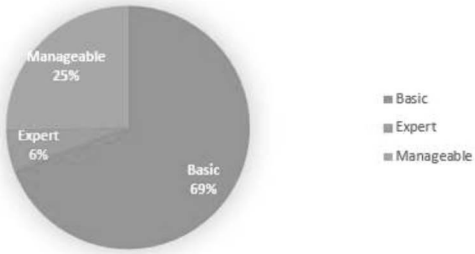

Fig. 26 : Prototype or Model Making Skills

69% of the students are having basic prototype making skill, 25% of them at manageable level and 7% with expert level. This shows that many students are lagging on model making skills.

20.Participation in Business Pitch Competitions

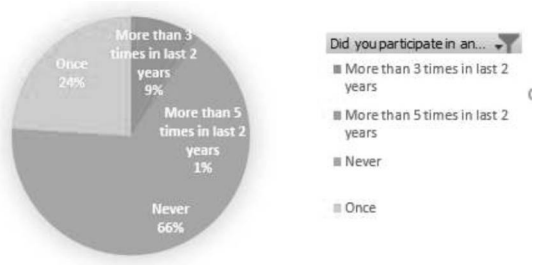

Fig. 27 : Participation in Business Pitch Competitions

We observed that 66% sample never participated in business pitch competitions. 24% participated once. 9% twice in the last 2 years. Participation in competitive challenges and business pitch competitions is highly critical for presentation and idea development skills. It helps in entrepreneurial career planning.

21.Level of Logical Reasoning and Aptitude in Competitive Exams (e.g. NTSE, Olympiad, KVPY, Competitive Exams)

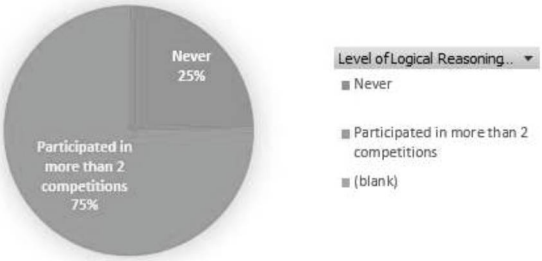

Fig. 28: Participation in Competitive Exams

75% participated more than twice in the last 2 years and 25% never participated. There is a need for better participation.

22.Working Experience in Social Projects

Fig. 29 : Participation in Social Projects

53% participated in single social project. 18% participated in three projects and 29% are not having any experience. Participation in Social projects increases the level of problem identification, design thinking and solution development with respective to business viability, technical feasibility and human desirability.

23.Working Experience in Technical / Business Projects

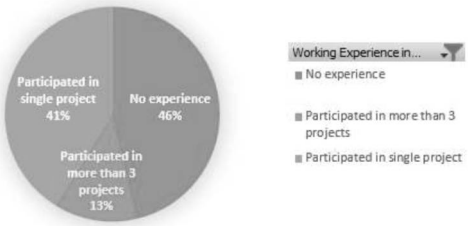

Fig. 30 : Participation in Technical / Business Projects

41% mentioned that they participated in Technical /Business Projects and 46% do not have any experience. Technical or business projects increase the awareness towards financial mapping, investments, usability, productivity etc.

24.Natural Skills

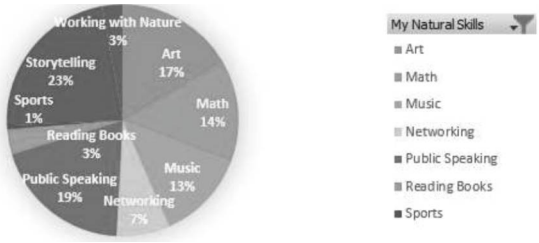

Fig. 31: Student Natural Skills

14% claimed Math or Logic skills, 23% with storytelling, 19% public speaking, 17% Art, 13% Music, 7% Networking skills, 3% Naturalistic Intelligence, 3% with Book Reading, 1% with sports. This spread is completely varied. Each individual is

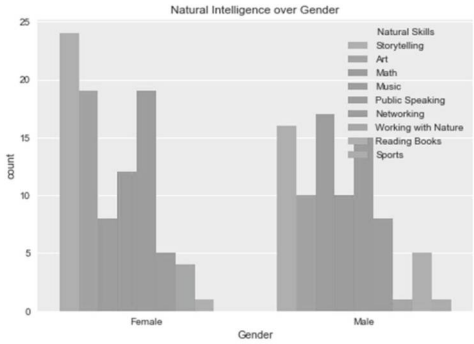

Fig. 32 : Natural Intelligence over Gender

born with certain intelligence. If this is included in the career-planning, job satisfaction is increased.

Female Participants claim more storytelling, art, public speaking compared to male participants. Male participants claim more math-logic intelligence compared their female counterparts as shown in Fig.32.

25. Which type are you?

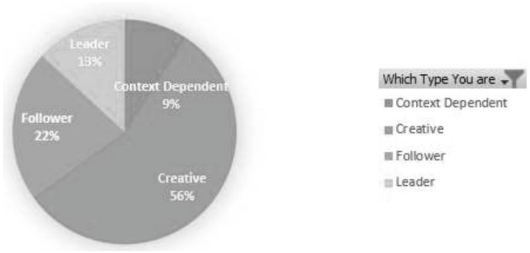

Fig. 33 : Type of the Personality

56% of the participants claimed of creative type, 13% of them are of leadership type, 22% of them are follower type, 9% are of context dependent type. Sample is perfectly mixed with all type of personalities.

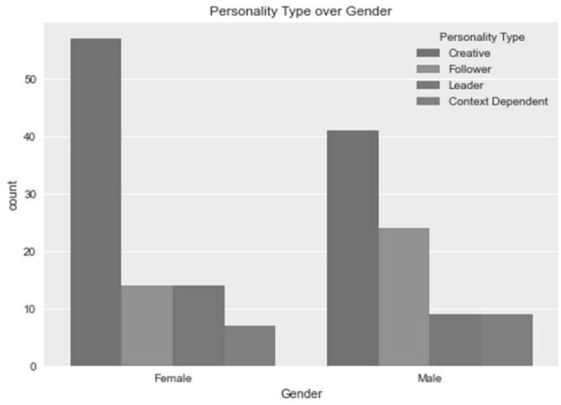

Fig. 34 : Type of the Personality over Gender

Female participants are more of creative type compared to male counterparts.

26. Which quality (s) describes me

Fig. 35 : Quality Description

78% of participants claimed adaptable to situation, 8% achievement orientation, 2% empathetic, 2% optimistic life, 2% pessimistic, 3% self-confident, and 3% teamwork. This sample has completely mixed portfolio. Both genders claim similar qualities as shown in Fig.36

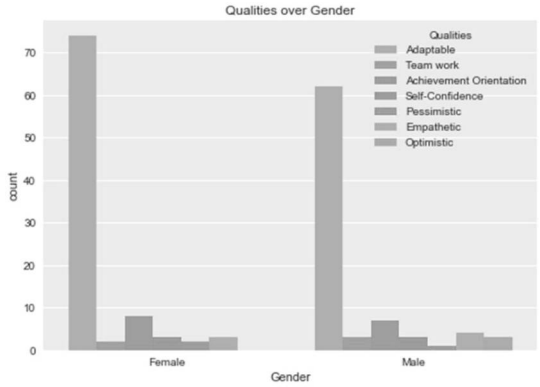

Fig. 36 : Quality Description over Gender

27. Mentor Availability

Fig. 37 : Mentor Availability

73% of them do not have mentor for their career planning and development. This situation demands the need for mentoring and counselling. Both female and male are in a similar composition in terms of lack of mentor for their career planning.

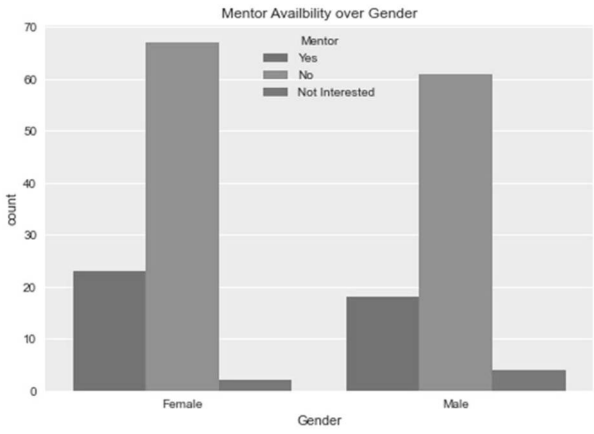

Fig. 38 : Mentor Availability over Gender

3.2Mentoring through Clustering Methods

The term mentoring means that the support given by the more experienced person for the growth and learning of another. As per the Smith (2007) "a particular mode of learning wherein the mentor not only supports the mentee, but also challenges them productively so that progress is made". According to Cox (2005), Mentors, in the traditional sense of the term, are usually people in leadership roles or are people whom the mentee aspires to be like.

A study was made on the importance of Mentoring. The students appreciated the role played by mentors. It is observed that mentor helped mentee in terms of feedback. The mentor acts as a change agent, collaborates, and helps through cognitive coaching. The aspect of change refers not only to the classroom practice but also to the development of an overall professional culture (Mpofu and Chimhenga, 2016).

Before assigning mentor, we need to cluster similar students so that instruction becomes more effective. We used k-Means Clustering Algorithm to cluster the participants (Xiaoliang et al., 2020). We made 4 clusters as showed below.

k-means clustering (Number of classes = 4):

Variable	Observations	Minimum	Maximum	Mean	Std. devia
Which one of the following situations describes yo	168	1.000	5.000	3.048	1.443
Your Average Academic Performance (+2 to till date	168	2.000	5.000	4.042	0.871
How many hours you would like to spend per week	168	1.000	5.000	3.583	0.777
I have an opportunity to participate in a formal Gro	168	1.000	5.000	2.887	1.599
My IT Readiness(Skill set that I possess)	168	1.000	5.000	2.571	1.596
My Subject or Domain Readiness (e.g. Knowledge in	168	1.000	5.000	3.571	1.119
Communication Skills (Oral)	168	1.000	5.000	1.750	1.430
Communication Skills (Written)	168	1.000	5.000	1.976	1.608
Presentation Skills (Voice)	168	1.000	5.000	2.369	1.454
Article / Report / Presentation Making (using ppt / e	168	1.000	5.000	2.524	1.582
Prototype or Model Making Skills	168	1.000	5.000	1.714	1.164
Did you participate in an Idea presentation or 3 pitc	168	1.000	5.000	1.446	0.756
Level of Logical Reasoning and Aptitude in Competi	168	1.000	5.000	3.048	1.434
Working Experience in Social Projects	168	0.000	5.000	1.482	1.153
Working Experience in Technical / 3 Projects	168	0.000	5.000	1.315	0.942

Fig. 39 : Summary Statistics

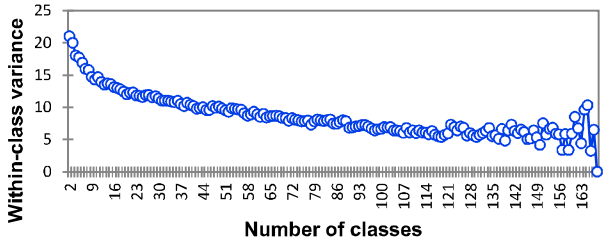

Fig. 40 : Evolution of Variances

Iteration	Within-class variance	Trace(W)	ln(Determinant(W))	Wilks' Lambda
0	25.203	4133.225	79.924	0.743
1	20.255	3321.833	77.777	0.087
2	19.008	3117.362	77.456	0.063
3	18.423	3021.443	76.997	0.040
4	18.058	2961.554	76.625	0.027
5	18.037	2958.147	76.584	0.026

Fig. 41 : Statistics for Each Iteration

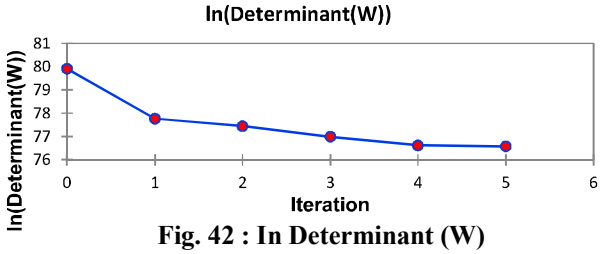

Fig. 42 : In Determinant (W)

	Absolute	Percent
Within-class	18.022	71.38%
Between-classes	7.226	28.62%
Total	25.248	100.00%

Fig. 43 : Variance decomposition for the optimal classification

	1	2	3	4
1	0	3.597	5.327	4.089
2	3.597	0	5.278	3.059
3	5.327	5.278	0	5.707
4	4.089	3.059	5.707	0

Fig. 44 : Distances between the class centroids

As showed in Table 1, Class 1 has 34 Participants, Class 2 has Participants, Class 3 has 38 Participants, Class 4 has 36 Participants.

Table 1 : Results by Class

Class	1	2	3	4
Objects	34	60	38	36
Sum of weights	34	60	38	36
Within-class variance	17.6	14.6	26.7	14.8
Minimum distance to centroid	2.04	1.7	3.2	1.9
Average distance to centroid	4.003	3.7	5.01	3.7
Maximum distance to centroid	7.1	5.4	6.9	5.8

This method is useful to create like-minded groups.

4. Proposed Clustering Model for UG Engineering

Further, authors propose following organization structure using clustering model for career planning.

This is designed after multiple interviews with Industry personnel, academicians, students over a period of 3 years.

Second Year UG Engineering is the right time for making the career plan. It is observed that if a student takes any career decision in the First Year, it is called as "Patriotic Decision" as the decision carries a lot of emotions. If student takes any career decision in the Third Year, it is called as "Pricking Decision" as student has less time to plan and prepare. If student takes any career decision in the Fourth Year, it is called as "Paralytic Decision" as student has no time to plan and prepare. Hence, if student takes any career decision in the Second Year, it is called as "Perfect Decision" as student gets sufficient time to plan and prepare.

Based on the student's wish, Intellectual Quotient, Emotional Quotient, and Social Quotient levels, the following model can be executed.

Heads-On			Hands-On			Hearts-On		
Engineering Domain			Finishing School			Management-Innovation-Entreprenership		
GATE ESE	Core Company	GRE TOEFL IELTS	IT	ITES/ KPO	Non-IT/MSME	CAT GMAT	CIVILS / Competitive Exams	Startup/ Family Business

Fig. 45 : Student Career Aspiration vis-v-vis Wish-Fulfilment Plan

Industry 4.0 is threatening traditional job systems, skills and educational needs. It is compelling huge change in education institutions in the form of Education 4.0. Education 4.0 complaint institutions are expected to have administrators, teachers, trainers, researchers, counsellors, mentors, advisors and inspirers. Job is not limited to knowledge sharing but also to inspire the student, give an opportunity to set a goal, identify the skill needs and meticulously plan for fulfilment of the student's wish.

Progressive institutions, proactively setting up Centre for Career Planning which cater to the needs of students with diversified background. Few may be having high intelligent quotient, few good emotional quotient, few good social quotient, few with creativity and business acumen. This composition is varied in every student. Each student is designed for certain job. Institutions have to honour and respect this kind of intelligence composition. Each student is having different aspirations. Mentors need to map both aspects meticulously and mentor students accordingly. Mentor's job is to identify the student competencies and intelligence composition, collect aspirations and make a customized plan for every student and facilitate the same. This is huge new age strategic and operational requirement.

Broadly, Institutional level Centre for Career Planning should have 3 verticals- Heads On, Hands On and Hearts On. Each vertical is critical in its function, role in the society and providing equal opportunity to all types of students.

1. "Heads On Vertical" caters to the needs of GATE, ESE, CORE JOB and GRE where deep theoretical engineering understanding or research orientation is required.

2. "Hands On Vertical" works towards needs of IT, ITES, KPO, RPO Opportunities where it caters to the needs of programming skills, domain skills, language skills and other Finishing School skills

3. "Hearts On Vertical" broadly caters to the needs of CAT/GMAT, Civil Services and Other Competitive Examinations, Start-up and Family Business Opportunities where individual requires leadership capabilities, managing teams, managing risks, financial management, business execution capabilities etc.

4.1 Pilot & Methodology

Based on this model, it is experimented in the one of the leading private engineering group colleges. Students were given orientation towards Heads On, Hands On and Hearts On options. A survey has been conducted for all students of second year to state their personal career choice and vertical which they would like to be attached to. Students completed this survey on their own, in free & fair fashion. Students shared constructive suggestions to support this process. A total of 1525 students participated in this survey across 4 group colleges. Survey Period- Oct 2018.

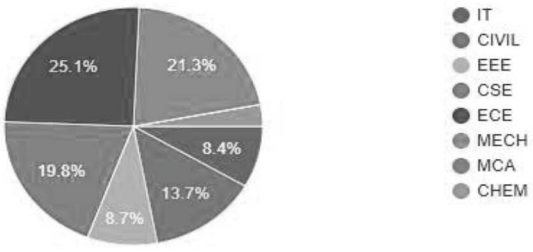

Fig. 46 : Dept. wise Student Career Aspirations

Fig. 47 : Heads On vs. Hands On vs. Hearts On

It is observed that more than 78% opted for Hands On vertical. The following Figures 48, 49, and 50 details further break up of Heads On, Hands On and Hearts On.

Fig. 48 : Heads On (GATE vs. Core Job vs. GRE)

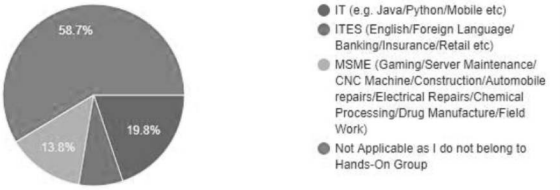

Fig. 49 : Hands On (IT vs. ITES vs. MSME Type)

Fig. 50: Hearts On(CAT vs. Civil Services Vs.Start-up)

4.2 Interventions and Impact

After clustering students according to these verticals, mentors were assigned to students. Institution has roped in training partners to provide external guidance and training. This model is in operation for more than 2 years. Students are getting mentored to full-fill their career wish. More than 12 start-ups were incubated so far. More than 15 student patents were published. Students are trained for GATE and mentored by experts. More than 60% students already got placed in various IT companies. Civil Services training is getting imparted to more than 60 students. More than 50 students are getting trained in CAT.

5. Threats to Validity

While designing this model, we attempted to survey students from one region. It is desired to increase the sample size across multiple regions so that feasibility accuracy can be improved. Mentoring is 4 years process in UG Engineering Education. This kind of projects need lot of time to measure the impact. Proper results can be published only after ascertaining results from few outgoing batches.

6. Conclusions

A large portion of our life is spent in achieving career goals. A well-designed career plan is important which provides a roadmap for the student's future. It helps in multiple means. Student gets an opportunity to leverage strengths, develop confidence, and helps to invest time and skills in a way that is emotionally satisfying. Self-assessment plays major role in career planning. Mentoring helps to improve the leadership skills, opportunity to learn from the mentors, and finally improves the student's chance for success. Mentoring through clustering methods create like-minded groups. This creates peer-learning environment. While segmenting students, it is important to consider demographic, geographical, psychographic and Technographic aspects. However, assigning right mentor at right time is a herculean task for large institutions where student population is huge with diversified aspirations, level of absorption and skills in the limited 3-year window. Machine learning techniques like k-Means clustering algorithm can help to cluster the similar set of students. This process helps in making instruction effective. Clustering survey questions should be customized according to year of study and type of need. The number of clusters can determined based on the availability of mentors and quality of mentoring. In this survey, institution is a tier-2 type with medium student population size. Hence, number of clusters (4 in this case) is sufficient. However, in large University cases, we should go with more number of clusters. Proactively, progressive institutions should set up Centre for Career Planning, adopt mentor-training programs and mentor students according to intelligent, emotional, and social quotients.

References

[1] Schermerhorn, J R, Hunt, J. G. and Osborn, R N. (2005) Organizational Behavior, 9, Wiley Publications

[2] Jainani, K.. (2018) Analyzing Factors influencing Career decisions of Youth for higher Education.MANTHAN: Journal of Commerce and Management, Volume 5, Special Issue

[3] Ahmed,K.A., Sharif,N. and Ahmad,N. (2017)Factors Influencing Students' Career Choices: Empirical Evidence from Business Students, Journal of Southeast Asian Research, Volume 2017, Article ID 718849, 15 pages, DOI: 10.5171/2017.718849

[4] Redman, T. and Wilkinson, A. (2001) Contemporary Human Resources Management, NewYork: Financial Times Prentice Hall.

[5] Bayraktaroğlu, S.. (2011) İnsan Kaynakları Yönetimi. 4. Baskı. Sakarya: SakaryaYayıncılık

[6] Özen, Y.. (2011) Kişisel Sorumluluk Bağlamında Kariyer Seçimini Etkileyen Sosyal Psikolojik Faktörler. Eğitim ve İnsani Bilimler Dergisi, 2(3), 81-96.

[7] Cavus, Geri and Turgunbayeva (2015) 'Factors Affecting the Career Plans of University Students after Graduation', International Journal of Humanities and Social Science. 5, No. 5.

[8] Muraguri J.M. (2011) 'Factors influencing degree choices among female undergraduate students at the University of Nairobi – a case study of the 2010/2011 cohort', unpublished MA research project, University of NairobI

[9] Edwards, K., & Quinter, M. (2012) Factors influencing students career choices among secondaryschool students in Kisumu municipality, Kenya. Journal of Emerging Trends in EducationalResearch and Policy Studies, 2(2), 81-87.

[10] Hewitt, J. (2010) 'Factors influencing Career choice'. Retrieved on 15/02/2010 fromwww.ehow.co

[11] Wildman, M & Torres, M. Robert (2001). Factors identified when selecting a major inAgriculture, Journal of Agricultural Education 42(2), 46-55

[12] Fizer (2013). Factors affecting career choices of college students enrolled in agriculture. aresearch paper presented for the master of science in agriculture and natural resources degree. TheUniversity of Tennessee, Martin. Retrived Fromhttp://www.academia.edu/download/50361832/Fizer_Research_Project_Final.pdf.

[13] Alberts, C., Mbalo, N. L. & Ackermann, C. J. (2003) 'Adolescents' Perceptions of the Relevance of Domains of Identity Formation: A South African Cross-Cultural Study'. Journal of Youth and Adolescence, 32 (3), 169-184.

[14] Kerka, S. (2000) 'Career choice, gender, race and class'. Eric cleaning house on adult career and vocational education Columbus. ED 421641.

[15] Perrone, K. M., Sedlacek, E. W. & Alexander, M. C. (2001) Gender and ethnic differences incareer goal attainment. Career Development Quarterly, 50(2), 168-178.

[16] Smith (2007) "Interconnectedness of the roles of mentors and mentees in pre-service teacher education in ro.ecu.edu.com.

[17] Cox, E.. (2005) For better, for worse: The matching process in formal mentoring schemes. Mentoring and Tutoring, 13(3), 403-414.

[18] Mpofu,J. and Chimhenga, S.(2016)The Importance of Mentoring: Findings from Students Doing Post Graduate Diploma in Education at Zimbabwe Open University, Bulawayo Region, IOSR Journal of Research & Method in Education, Volume 6, Issue 3 Ver. I (May. - Jun. 2016), PP 27-31

[19] Xiaoliang,Z., Yulin,H., Jin,Y., Qin,H., Azhar,M., and Huang,J.H. (2020) "A Robust k-Means Clustering Algorithm Based on Observation Point Mechanism", Complexity, vol. 2020, Article ID 3650926, 11 pages,. https://doi.org/10.1155/2020/3650926