

Role of Teachers in Transferring Knowledge and Awareness in Pre-Engineering Students: Qualitative Analysis

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Technical and technological education is one of the most popular programs taught at almost every high school and middle school including pre-engineering program (Blais, 2004). Engineering is one of the prestigious fields of choice for majority of Pakistani students, but the motivation and interest to study is declining day by day which is a matter of concern at both national and international level. The role of significant others was considered important by most researchers and specifically teachers are well acquainted with the problems, challenges and aptitudes of the students. Considering their importance, seven interviews were taken from 4 male and 3 female teachers teaching at pre-engineering level using interview guides. Thematic analysis was done to extract the themes and categories. Students' awareness about field and interest, the barriers they faced during their FSc, their motivation and motivational factors, values, achievement, and other related factors emerged as major themes based upon teacher's opinion.

Keywords: Psychosocial Factors, Qualitative, Academic Satisfaction, Engineering

Introduction

The development in the field of Engineering is highly demanded in all parts of the world. Science, Technology, Engineering, and Mathematics (STEM) fields specially engineering is crucially important field of study and depends on the teamwork, cooperation, life-long learning, and practical implication of the learned generic skills. Solving problems effectively and efficiently is the core of engineering practice and all these skills depends upon the skills of the teachers transferred into the students for practical implications (Passow, & Passow, 2017).

Engineering and technology are the fields that need understanding from a variety of ways to estimate the importance of these fields as they are responsible for the development, understanding the world around, know the worth in comparison with other countries, and also to promote healthy life style. This understanding has to be built among students, teachers, and all the stake holders and they need to promote learning in such technical fields for better outcomes to compete with the outer world (Shanta, 2019).

Mainly the students are not interested in the field of engineering due to

different reasons identified by the researchers (Afsar & Jami, 2020), such as barriers, interest, motivation, achievement, outcome expectancy, mathematical skills etc. through qualitative research. On the basis of Student's focus group discussions, they concluded that genuinely students faced a lot of barriers and issues in their pre-engineering studies, hence, demotivating them, lower their interest, affecting their achievements etc. in the field of engineering. The students need stimulation to encourage them for such fields especially engineering otherwise it will not be possible to make these students opt for these fields. As noted by Ritz (2015), exposure to educational experiences that promote analytical problem solving is beneficial to all students.

Although the relative importance differs for male and female students; females' dispositions that predict STEM career interest are not that different from the males in this study, although females' attribution of their interest in STEM is more strongly tied to the influence of other people such as parents and teachers. There is an implied need to have parents and teachers encourage females who exhibit an early interest in STEM to persist in their focus in a STEM-related career (Charlesworth, & Banaji, 2019; Strachan et al., 2018).

When asked for suggestions for improving STEM education in the United States, there were many ideas that were frequently mentioned including, more hands-on and engaging lessons, more STEM-related (including engineering) courses offered, career education at an earlier age,

making classes more relevant to the real world, and more passionate and qualified teachers. Younger students are thought to benefit most from exposure to scientific inquiry during the naturally curious stages of development, in which they display a natural inclination to the fundamentals of engineering design processes; designing and building things; and taking things apart to see how they work (Conrad et al., 2018).

Researches (e.g., Eya, et al., 2020; Gillespie et al., 2020) indicate that one of the determinants of pursuing STEM as a career is having positive psychosocial factors such as a view of STEM as positive and useful. Different factors according to literature are related to student's interest too, as the domain of Science and Technology are mainly responsible to maintain status of super powers for leading the world (Samal, & Bharati, 2019; Weyland, 2018) so the effectivity of the technological fields is of utmost importance. Factors such as motivation, support from the significant others (parents and teachers mainly), coursework related to the fields, exposure to high quality and experienced teachers boosts students' motivation and help them attain their degrees which according to a study in 2012 was less than 40% (Christensen, Knezek, & Tyler-Wood, 2015).

According to researches (e.g., Hall et al., 2011; Tan & Laswad, 2009) the interest in students is purely determined by psychosocial factors but still the reality and the demands of the fields are very distant to keep up the pace with the needs of the market noted by the Commission on Professionals in Science and Technology

and other researchers(e.g., Amuasi et al.,2020;CPST, 2007;Voulvoulis, &Burgman, 2019).The decline is seen at the post-secondary level although at secondary level, the inductions has been increased a lot in the past two decades (Azzopardi et al., 2019). The decline has given a major setback to the industry and technological developments and has increased the demands of the professionals in technological fields (Aun, &Kok,2019; Consortium of Social Science Associations-COSSA, 2008) and this situation prevails in almost every part of the world (Kuenzi, 2008; Association of American Universities - AAU, 2006).

Teachers were identified to be ill-competent in teaching mathematics for the practical application in real life. Mathematics is the most important field of study for engineering students and the teachers are well aware of this fact still they are not competent enough to teach the students effectively (Cardella, 2008).

Many engineering colleges have the goal of increasing the quality and number of students choosing to pursue engineering, and therefore, are heavily investing in programs that expose pre-collegiate students to engineering. These institutions are involved with summer outreach programs and weekend or fieldtrip opportunities for students to visit engineering campuses, and some curriculum development. Often untapped resource for engineering colleges is through 12th grade technology and pre-engineering teacher training.

Based on the findings from researches, engineering colleges, with the goal of increasing the self-efficacy of engineering students should consider focusing resources on developing 12th grade technology and pre-engineering teachers. Additional recommendations for practice, pedagogical implications, and areas for further research are offered (Rampasso, et.al, 2018; Wu, & Wu, 2020).

Along with the educational environment, teachers, peers, and parents (Sethi, & Scales, 2020; Šimunović, &Babarović, 2020; Гофурова, 2020)play important roles in students' motivation for learning science. One longitudinal study perceived ability in mathematics and science, as well as friends' interest in science had the greatest impact on student's motivation for learning science (Lee & Shute, 2010) and on student's actual career choice (Ikonen et al., 2018). Research on factors affecting the decision to choose a STEM career is still emerging (Ganley et al., 2018; Kugler et al., 2017).

Science and technological studies are actually difficult and not related to reality. Practicality must be incorporated in the STEM education system to link it with reality and career (McCrea, 2010). In majority countries, the education system is not appropriate for the technological studies thus declining interest of the interested students too due to the teaching methodology followed. An examination of contributing factors is needed to understand why students choose STEM majors (Heilbronner, 2011). Researchers are

beginning to more closely study this science identity gap (Barton et al., 2013).

A study (Sahin, & Waxman, 2021) integrated SCCT and previous research on factors closely connected with personal and environmental factors and STEM choice. Several factors that are related to students' persistence in STEM fields, such as (a) the number of courses taken (Gottfried, & Plasman, 2018; Sahin, & Waxman, 2021); (b) early exposure to mathematics and science (Olsson, & Martiny, 2018); (c) mathematics and science curriculum (Firat, 2020; Hassan et al., 2019); (d) advanced level courses in mathematics and science (Bucciarelli, & Kuhn, 2018); (e) STEM clubs and summer camps or internships (Ekmekci et al., 2019; Sahin, & Waxman, 2021); (f) STEM teachers' and parents' expectations (An et al., 2019; Cooc, & Kim, 2021; Šimunović, & Babarović, 2020); (g) opportunities and support students receive (Kirn, & Benson, 2018; National Academies of Sciences, Engineering, and Medicine, 2019); (h) participation to science fairs (Dawes et al., 2015); and (i) teacher quality and diversity (Du et al., 2019; Hutton, 2019).

The researches done previously have assessed the point of views of the students (Afsar & Jami, 2020; Kuechler, McLeod, & Simkin, 2009; Tan & Laswad, 2009), either in retrospection or in future orientation but teachers' perspectives are not assessed to know why students are or are not motivated to complete their degrees in the field of engineering and technology.

Researchers have identified in many ways the importance of teachers in education (Beggs et al., 2008; Kuechler et al., 2009) the impact of their support, the motivation that is responsible for the student's growth, the strategy they follow to engage the students in the course, the quality and exposure they can provide, but the main influential aspect is what does the teachers know of the factors involved in studying pre-engineering and persuasion of the technological field.

Hence, the need to explore teacher's role in student's affective learning is important to know the issues and concerns of the students in teacher's perspective. Teacher's role in promoting engineering related attitude, skills and knowledge. This research study focused on the significance of teacher's role in pre-engineering student's career aspirations.

Objectives

Following are the objectives of the study

1. To explore the role of teachers in transferring knowledge and awareness in pre-engineering students
2. To explore different factors in teachers' perspective that influence pre-engineering students.

Method Sample

Interviews were conducted from teachers ($N=7$; 4 male, 3 female) teaching engineering related subjects (such as mathematics and physics) at pre-engineering levels. Thematic analysis was done to analyze the interviews of the teachers.

Interview guide.

Interview Guide was prepared for teachers with 16 total questions relatively general in nature to avoid suggestibility in the interviews.

Guide was prepared for teachers with 16 total questions relatively general in nature to avoid suggestibility in the interviews. For example, teachers were asked, “*What strengths and weaknesses do you see in students of pre-engineering?*”, and “*What are your personal views about the career choice of students?*”

Procedure

Sample was first selected conveniently and then data acquiring process was initiated through the introduction of the study to the participants in each interview. Purpose of the research was explained to the teachers. The teachers were interviewed individually to attain the objective of the research. Questions were asked from general to specific in the sequence of interview guide.

Result and discussion

This study was a qualitative study based on thematic analysis of interviews with teachers. The interviews were audio recorded and memos were prepared. The

data was transcribed, coded, and analyzed using thematic approach. Thorough scrutiny of the transcriptions helped in generating meaningful themes. Interviews were transcribed by the researcher. Codes were then categorized broadly and then themes were identified following the method described by Creswell (2007). Different themes, categories, and codes which were generated from the interviews of the teachers are described in detail.

Research (e.g. Hall, Dickerson, Batts, Kauffmann, & Bosse, 2011) suggests a strong need for understanding the factors that affect the career considerations at different levels of career choices and also highlights the importance of guidance for the improved career considerations (Malgwi et al., 2005).

Interest of the students

Interest domain was found to be one of the most important variables of the current study. According to the teachers, students at F.Sc. Level were aware of the career choices, they even selected their future institute for studying which was majorly an inspiration from the alumni’s. The old students from the college interacted with the new students to give them awareness and guided them in the admission processes and other career related issues

Table 1

Perspective of Teachers on Interest

| Themes | Categories | Codes |
|--------|------------|--------------------|
| | | Career awareness |
| | | University ranking |
| | | Alumni’s role |

| | | |
|-----------------|----------------------|---|
| Interest | Awareness | Family's role Individual differences |
| | Factors for interest | Updated equipment Liking of the fields Career choice by self Effective teaching Use of technology |

A female teacher teaching physics commented explaining the above factors as,

“Hmara system bohatacha hay is lehazce k hamaray old students atayhain college hum unkoyahan k students ce interact karwatayhain ta k wo kuchseekhsakainapni field kimaloomatlysakain” [Our system is very good in the way that our old students come to college we let them interact with the current students so that they can learn about their field and take information about their fields].

The above comment from the teacher highlights the importance of alumni interaction with the current students where the exchange of ideas and relevant knowledge help the students in getting an idea of their field and nature of the domain they might choose. Such interactions according to teachers are very fruitful for the current students as it is a source of interest and guidance in a right direction.

The interest in literature was related to performance than students' beliefs about the importance of effort or natural abilities and when students are interested in something, they tend to pursue it and excel at it. One of the greatest gifts that parents can give their children is the freedom to explore interests. It can set young people

on a lifelong path of discovery and learning that culminates in a creative, productive life. Parents, teachers, peer groups and relatives' attitude should be positive for better outcome but unfortunately, they have no awareness of subject as well as their financial and psychological support (Ekperi et al., 2019).

In Pakistan, however, this freedom of choice is rarely given to the children; rather choices of the parents are imposed on the children for studying a particular field. This research also identified that students have limited options and freedom of career choices where both students and teachers agreed to it. The lack of interest in the field actually created a hurdle in achievement, lowering their motivation and hence shaking their intentions to persist in the field. Students cannot choose for them not only because they have little freedom but also lack of exposure and awareness about the concerned fields compel them choose the fields their parents choose for them.

The majority of people are not aware about subject, their importance and their scope. Awareness can be in the form

of activity awareness, cultural awareness, social awareness, work place awareness, location awareness and knowledge awareness (Salonen et al., 2018).

For student's interest, parents and teachers were found to be important in the literature too (Rabenberg, 2013; Renninger, & Hidi, 2020; Warne et al., 2019) which was also found to be important by the current study.

Knowledge of the technological field was very limited decreasing the probability of opting engineering field. Parents of the engineering students were also source of awareness. Parents from the background of engineering could give more relevant information to their children and are clear in giving directions. They help their children in understanding different subfields, knowing the worth and scope of each field. Additionally, parents' groups should focus on helping other's parents understand their role in encouraging their children to consider various career options.

Parental attitudes play an important role in encouraging students to consider various career options, including career exploration, gender-typing, and future occupational plans (Halim et al., 2018; Lim & You, 2019).

If parents and teachers fail to support students or guide them in career choices, they might never consider engineering fields as careers. It has been observed that many students in US attempt to choose majors by chance and 23% enter college with undeclared majors (Atuahene, 2021; Sharif et al., 2019). Introducing the fields, guidance and support are also important in choosing

any major at any level especially for engineering fields. So, the teachers and parents are highly involved for building interest in the fields and attracting students in the engineering related fields (Blotnicky et al., 2018; Mohtaret et al., 2019).

Researchers identified positively influencing factors in STEM education among which parental involvement and support has been identified as the biggest positively influencing factor, identified in the current study too, to which both students and teachers agreed. Availability of bilingual education, cultural relevance etc. were considered important in the literature but not in the current research. None of the teachers or students mentioned these factors as important in persistence of STEM education. Interest, self-efficacy, exposure to fields were considered important in the literature as well as our current study (Caspi et al., 2019).

Individual differences exist; some students are interested in studies and others just do it for a degree not knowledge or interest. Some students are interested in specific subject but not the field, some are pursuing the field but are not interested. There are multiple reasons for the choice of subject and career so individually every student is different in many aspects from the other according to teachers teaching at pre-engineering level. The choice of subject actually depends upon the marks obtained by the student at F.Sc. level for which family pressurizes to choose a specific field imposing their priority of field on children. According to a female teacher, teaching mathematics,

“Students jantyhain k unkokonsa career choose karnahyqk social media unkobht idea dysaktihy agar uskasaehehistemal ho, magr chunky parents pressurize kartyhainek field k lea uskiwajacebachyapnay interest wala career choose naheekarpatay. Parents k mutabiqunky number achy hain to engineering ya medical he lenachahea. Jab pre-engineering parh lain tab to medical ki option bhinaheerehti un k pas” [Students know their career choices as social media gives them the idea of their field if used in a right way, but as parents pressurize for a field, students cannot choose their career of interest. According to parents, their marks are good so they must opt engineering or medical. If they study pre-engineering then the option for medical is also eliminated].

A teacher, teaching physics said,

“Bachonko ye bhipatahy k unkokis university ma admission lena hay jese engineering walybachyzeada tar National University of Science and Technology (NUST) ko prefer kartyhainqkzeada tar students ko ranking kabhipatahota hay yadusroncesuntyhain” [Children (Students) know in which university they are going to take admission, like engineering students mostly prefer National University of Science and Technology (NUST) as most of the students knows about the university ranking also or they have heard from others (about that university)].

To pursue career in engineering, the teachers identified their interests in terms of knowledge, awareness, and exposure of the students to that relevant field. They could not relate RIASEC model for interest with

the interest of students, rather they emphasized that to generate interest in a person exposure is the main step where the role of alumni, siblings and parents of the same field were the sources of guidance, awareness and knowledge.

Exposure to field can be achieved by field trips, internships, real time experience, 3D designing displays etc. but teachers identified that updated equipment can actually help them inculcate interest in the students. Being the students of technical fields, they have the right to get acquainted with the technological support and gain knowledge by exploring technology.

Teachers are considered highly important in student’s life. Teachers are more recognized and followed if they have effective teaching methods. Students have faith on the teachers who can help students understand the concepts effectively.

Stimulating interest in the students through different activities and exploration of careers in STEM fields particularly is very important for STEM career considerations otherwise lack of interest and exposure to such fields through STEM related activities can neglect the field and retard the growth. Analytical problem-solving technique can benefit the students all together and in considerations for what is good and bad for them (van Aalderen-Smeets et al., 2019).

Barriers

Achievement depends on the situations faced by the students during their educational tenure. Majority of the students could not reach their set goals due to the hurdles faced by them in their education.

Teachers identified a number of such barriers in students' educational life which limit their growth and achievement. Some of the barriers are generally identified in FSc. Level and which are faced by the students generally in the FSc. Level (e.g., institutional policies, cramming, family pressures etc.) and some are specific to pre-engineering only (e.g., lack of interest, lack of practicality, lack of practical exposure etc.).

Gender differences have been reported by the teachers as girls chose pre-medical and boys mostly opted for pre-engineering because of the stereotypically defined feminine and masculine fields. Teachers also identified that students of medical are much clearer in scope of the study, vision and directions due to lack of exposure to the fields of engineering. However, in both genders there is a lack of particular aim in life which is a serious

concern and students needs to be counseled timely. A female teacher from IMCG college teaching mathematics commented;

“Larkiyān to jāti he pre-medical mā hain, pre-engineering mā bhṭkām koi atihainlarkian. Wajashaid ye hay k doctors kojantyhain un k sath interaction hay, khudnahee to family mā ce koi jātahogamagar engineer ghargharnahee jātayharkisi k sath interaction naheehotaunka, family mā ce koi ho to phirunkomalumatbhihotihain” [Girls opt for pre-medical, they rarely opt for pre-engineering. The reason could be that doctors are known and interacted with indirectly through their family if they do not directly visit them otherwise. But engineers do not go door to door; they do not have a high interaction with the society. If a family member is in engineering field, then they (student) might know about the field].

Table 2

Perception of Barriers in Studying at Pre-Engineering Level as Psychosocial Factor as Per Teachers, Teaching at F.Sc. Level.

| Themes | Categories | Codes |
|-----------------|-------------------------------------|--|
| Barriers | Barriers from Family | Stereotypes Family Pressure |
| | Personal Factors as Barriers | Gender Understanding of different Subjects Attitude towards studying engineering Lack of Aim Lack of Interest Cramming/Memory Issues Language Barrier Lower Grades Study Routine Lack of Practicality of the content taught |

| | |
|------------------------------|--|
| Institutional Factors | Choice of Institute Institutional Policies Lack of Practical Exposure Career Counseling |
| Teaching Factors | Lack of Effective Guidance Teaching Inefficacy Teaching Methodology |
| Course and Curriculum | Outdated Irrelevant Less Practical/Theoretical value |

Literature suggests that despite girls having a positive disposition toward science (if not higher than boys), girls aged 10-13 are much less likely to aspire to careers in science (Archer et al., 2015; DeWitt, & Archer, 2015). A study of 6,000 students completed in 2012 indicated that by the end of high school, the odds of being interested in a STEM career are 2.9 times higher for males than for females (Sadler, et al., 2012).

Young women believe that science and technology are not relevant to their future career goals (Lent et al., 2018). Girls tend to prefer to learn in a more social context and need to see connections between school assignments and the real world. Formal role models are also an important factor that is often missing for girls in STEM areas (Hutton, 2019).

Family pressure for career choice is also considered as barrier in the students' career and achievement. The teachers argued that if the students are interested in a particular subject they had to get counseled and choose what they are good at and interested in. However, in Pakistani

culture, parents are the decision makers of their children, not knowing their caliber, interest, skills required to pursue the career. They opted subjects and fields for their children which may land their children into problems. Teachers added that a stereotype exists in the perception of parents that only prestigious fields are medical, engineering and IT and only they are recognized. Hence, parents want their children to be in these fields.

A male teacher from IMCB teaching physics said,

“Parents kay maslyzeadahainunko medical engineering IT kapatahy bus k yahee fields hainjinkipehchan hay to bachonkozabardastiinhi ma dal detyhain” [Parents are having more problems; they only know about medical engineering and IT that only these fields are recognized so they force their children to opt for these fields].

High school students (from different backgrounds, including Asians from India and China) with mean ages 14.6 were assessed to find the influential factors which were peers with same interest, relative of the field, influence of a teacher, and a counselor

(or a teacher knowing different career options in the school level) were identified to be influencers for opting a particular career (Almircar et al., 2020). Researches in the past (Hall et al., 2011; Keller & Whiston, 2008) also noticed that children regard the choices of their parents and they were their major influencers in past and in the recent literature (Halim et al., 2018; Sharif et al., 2019) too. The current study also supports the verdict of parents being the major influencers of their children in pursuing a field and career aspirations.

Some shortcomings of the institute can also make the students suffer in their education e.g., institutes lack the surveillance of the students, lack of practical exposure of the field, lack of practicality as there are no proper laboratory facilities, attendance is not taken into serious considerations which promotes bunking attitudes of the students, non-serious attitudes towards teachers and lectures hence leading them to failure or direct them towards academics.

According to researches, there is a need of meaningful engagement of students in the field of engineering to find and promote interest in the field which needs qualified teachers (Bowen et al., 2019) which is a major barrier at pre-engineering levels as the teachers' exposure is too limited and the qualification is just a degree attained with ineffective strategies (Almircar et al., 2020). Unluckily, this wasn't reported by the teachers in the barriers faced by the students. Some of teaching related factors were identified by few teachers as mentioned in the table e.g.,

lack of effective guidance by the teachers, inefficacy (in general), and methodology for teaching were reported to be ineffective.

For some students the difficulty faced is the choice of institute. Although majority of the students are aware of the ranking and the choices for their institutes, but they may not get admission there and had to choose another institute which is difficult for them. A mathematics teacher explained in the following way,

“Bachonko counseling kibhtzarurathyqkkuch to jantyhain k unkokiakarna hay magrbaazbachokona field ka idea hota hay na universities ka to mushkil ho jatahyunk lea bht” [Students need counseling because some know what they are going to do but some others do not have the idea of the field nor the universities, so it becomes very difficult for them (to choose their field and university)].

Some teachers do not have the capability of teaching effectively although they are educated and have the qualification for teaching. Effective guidance may not be provided by the teachers or counselors may not be available which makes the students suffer by taking wrong decisions and are confused in career choices.

The outdated curriculum, lack of career counseling, cramming of the material, lack of practicality of the content taught, all serve as barriers that cause hindrance in the normal path of education towards success. According to the teachers, the course content is outdated, a huge difference exists between the curriculum taught at intermediate traditional educational system in Pakistan and A-levels which must be

minimized to make the curriculum as effective as it is for the A-level students. Practicality of course content is mentioned in several ways by the teachers, such as practical orientation, exposure, and laboratory practical are all lacking effectiveness and needs to be updated and upgraded which was also supported by the literature (e.g., Avrithi&Kok, 2019).

Counselors hold key roles in guiding the students besides parents and teachers but the problem again is that the counselors either do not have enough exposure of the fields (Rottinghauset al., 2018), or the students do not consider seeking help from the counselors in their career considerations (Cabell, &Gnilka, 2021).

Barriers in the educational system are so many but literature highlighted some of the important aspects in STEM education that are responsible for the under preparedness of STEM students which are, overrepresentation of unqualified teachers, limited opportunity for advanced placement courses, teachers’ low expectations from students especially from

minority groups (e.g., Girls) etc. (Moorning, 2018).

Pakistan is, unfortunately, one of the countries that lag behind in providing essential technical skills to the students of technical fields. It has been, though, successful in up-gradation of higher education. A lot needs to be done to bring school and college education up to the mark. Higher secondary education needs specific focus as this stage marks transitional phase of a child from adolescence to early adulthood at 16-18; hence significant changes in child's overall personality (Mahmood, Khattak, Haq, &Umair, 2018).

Motivation

The importance of motivation in success and achievement was highlighted in the interviews of teachers. Motivation has a vital influence in one’s life but motivating a student to study is not always easy. Demotivating factors include self-finance. It reduces the motivation to study knowing that they will easily get admissions in engineering colleges and universities on self-finance owing to economic support from families

Table 3

Perception of Motivation as Psychosocial Factors as Per Teachers, Teaching at F.Sc. Level.

| Themes | Categories | Codes |
|------------|----------------------|--|
| | Demotivating factors | Self-finance Ineffective teaching Poor equipment Parental pressures |
| Motivation | Extrinsic Motivation | Role of Alumni Career Counseling |

Visits to Universities
Discussion with Subject Experts
Technology Orientation and Updates

Students don't care about their grades if they know they can get admissions in universities to pursue their educational career. Same happens if their teachers don't teach effectively, hence, the students gets de-motivated. Poor research or lab equipment can also be a contributor of de-motivation as they cannot see things happening in real life and just have an abstract theoretical concept of the topics taught at the pre-engineering level. A teacher of physics from OPF said,

“Bachonko demotivate karnaasaanhymagr motivate karny k lea bhtmehnatchahea institute k level pebhteachers k level pebhi students k level pebhi or zahir hay gharkitarafce” [It is very easy to de-motivate students but it requires a lot of effort to motivate them on institutional level, teacher's level, student's level and obviously on from family].

Referring to motivation, teacher said that it is difficult to motivate the students but demotivating them is really easy because of their families. They may not be supportive enough to let their children excel in the field they have chosen. The major contributors of motivation are the institutes in which the students are studying, the teachers who teach them, parents and students themselves. Motivation is considered an important factor in studying engineering by the students and teachers.

Bellová et al., (2021) has argued that attitudes towards natural science have increased the recognition of the importance and economic utility of scientific knowledge. The Economist Intelligence Unit, (2014) reported that the estimate graduate unemployment rate in Pakistan is 28%. In South Asia unemployment rate is high among art and business students then the medical and engineering students which make parents to force and motivate their children to opt for natural sciences such as engineering and medical primarily. But according to teachers, students are not motivated to study because of variety of options in public and private institutes to pursue their careers. They can secure admissions easily in any institute to study the subject they want to study provided their parents belong to high-middle socio-economic status.

Mostly the factors of motivation identified by the teachers are extrinsic in nature and intrinsic motivation was not identified. The main focus was on the gains that are extrinsic in nature. The teachers notified that these factors either contribute to motivating factors or they are needed to motivate the students of pre-engineering.

There is a vital role and influence of alumni in motivating the students through interaction and knowledge sharing. Visiting universities, discussion with the subject experts,

technology orientation and updates, and career counseling were all considered to be motivational factors for the students according to teachers. All these could be done through the academic channels.

Teacher’s role in motivating students was also considered important, ineffective teaching or failure to motivate students is main factors of demotivation in students. The institutes where there are poor facilities, inefficient laboratory equipment, and absence of laboratory facilities can cause demotivation in students to learn science majors. These factors ultimately act as barriers in the student’s education system and teachers specifically mentioned them.

Values

Value here refers to what is expected from the field as an outcome. Value could be both intrinsic and extrinsic like in motivation.

Motivation is rarely present in the students, they imitate their cousins, and siblings etc. and get admissions. The only motivation is getting a job and value assigned with engineering profession.

Table 4

Perception of Values as Psychosocial Factors as Per Teachers, Teaching at F.Sc. Level.

| Themes | Categories | Codes |
|--------|---------------|--------------------------|
| Values | Prestige | Highly prestigious |
| | Opportunistic | Better job opportunities |
| | | Bright future |

Prestige, better job opportunities, and financial security in a renowned field, are the values that according to teachers are considerable for students. Comment from a male teacher of mathematics is,

“Parents kolagtahy financial security in fields ma hyjese medical or engineering or wahicheezbachon k dmagh ma bhi dal di jai hay k izzat or shohratinhi ma hay” [Parents think that financial security is in these fields of medical and engineering and this thinking is transferred in the minds of the students too that respect and fame are in these fields].

Katz et al., (2018) confirmed that students at high school level are not independent, and prefer their parent’s choice for them and more than half parents want their children study in natural sciences (specially in medical or in engineering).

Pasha and Siddiqui (2020) described that engineering and medical are considered as the most worthwhile professions due to which natural science subjects are precursors and rural students consider it ideal for better future career and to increase socio-economic status whereas urban students are enforced by the society

and parents to take on scientific attitudes to adjust in the modern society. The same has been described by the students and teachers that engineering has been considered the most prestigious field along with medical which guarantees job, prestige, money and change in status.

Social cognitive career theory also declares that the value or outcome expectancy mediates the role of career interest and academic interest. The worth of value or outcome expectancy is also studied by researchers (such as Perkins Coppola,

2019). Earning potential has been the indicator of persuasion in the field (Slaton et al., 2019) which is reflected in the current study as financial security and opportunity in future.

Academic criteria

Teachers said that mathematics, problem solving and similar skills like creativity, alertness, intellect, and interest are the basic skills required in every domain of engineering and problem solving as well as creativity are the skills that must be present in every individual whatever the field they are from

Table 5

Perception of Academic Achievement as Psychosocial Factors as Per Teachers, Teaching at F.Sc. Level.

| Themes | Categories | Codes |
|-----------------------------|---------------------------|-------------|
| Achievement Criteria | Subjects | Mathematics |
| | | Physics |
| | | Chemistry |
| | | Computer |
| | | English |
| | Skills based achievements | Creative |
| | | Alert |
| | | Intellect |
| | | Interest |
| | | Motivation |

For persistence in engineering field, teachers identified mathematics, physics, chemistry, and English as important subjects which have been reported by the teachers teaching at FSc. level. But the subjects like mathematics and physics has been reported frequently to be among the most important

ones (Al-Mutawah, & Fateel, 2018; Alsamadani, 2017; López-Fernández, Ezquerro,, Rodríguez, Porter, & Lapuerta, 2019; Mariamah, Ratnah, Katimah, Rahman, & Haris, 2021) which in this research is also approved.

English is not a major field in engineering career but as medium of instructions in educational domain, it is very important. The reason was that in Pakistan students are from different backgrounds and their mother languages are different. Their primary concern in lower education levels (like matriculation and below was to focus on Urdu language primarily which is a national language and English is a tertiary language for them. That is the reason that most students are not comfortable with the medium of study. Admission tests have a particular proportion of English as criteria for passing admission test so for that matter, it is considered important. A physics teacher commented,

“Bacha jis marzi field ma jaye us k lea interest or motivated ho to achieve kartahy. Specifically engineering k lea to zahirhy math, physics zaruri hain” [Student choosing any field needs interest and motivation for achievement. Specifically for engineering math and physics are necessary].

A female teacher from IMCG teaching physics said,

“Engineerig ma lagtahy k physics, maths bht zaruri hay magrmujhy lagtahy k chemistry chemical engineerig walon k lea shaidze adazaruri hay, computer software k lea zaruri hay or English to medium hy studies ka ye to important hay he” [In engineering it seems that physics and math are much necessary but, in my opinion, chemistry may be more important for chemical engineering, computer for software engineers and English is a medium of study so it is obviously important].

Administrative Factors

A nation's overall position and its standing in the comity of nations are, to a large extent, determined by the standards of its educational system. Since education is a means for the development of personality and character, it is not merely about gaining knowledge and mastering science and technology and control of information; it is also concerned with the nation's belief system, culture and civilization, and values. Education represents, simultaneously, a nation's past, present, and future. Today, even developed countries are worried with respect to the situation of education and their students' poor performances in the subjects of science and mathematics.

Educational factors were discussed earlier in many ways in different themes as it is very important consideration according to teachers and some factors are highlighted in different ways. Practicality and practical exposure are valued and considered important in many ways as explained earlier. Practicality is important as it can help in conceptual understanding. A real time exposure is provided to the students helping them in achieving high grades in FSc. as well.

A different attitude prevailed in the past where education from colleges was taken seriously but now students bunk their classes, involve in different non-academic activities etc. which is basically the reason for increase in the number of academies and shortening of attendance in the

colleges. It is now trending more to get admission in the colleges as well as academies. The students go to the college just for recreational purposes and join academies to study their respective courses.

Education was considered as gaining a reservoir of knowledge, experience and skills but the attitude has been changed so much. The focus of students is just on gaining grades and achieving high without understanding the practical orientation of different courses they study.

The teachers identified that they have short duration for course coverage so individual attention is possibly not given to students. Only content of the courses is covered because students have to appear in board exams. Proper discussion over the topics is not incorporated in the teaching methods which is a major lacking. Practical application of the content covered and incorporating new developments in the fields and trending advancements makes the course more effective and interesting. Otherwise, the course is too outdated and ineffective as it lacks behind the advancement in technology and science.

Students lack concentration and attention in different education related domains and to engage them in such tasks and education is a big challenge. Media and technology have changed the trends of education and students are more interested in gaining attraction, making money and recreational activities. In such scenarios, the students must have to be engaged in

practical side of education for more insight and interest.

Specialized course should be offered for pre-engineering students to get an orientation of the field. The courses that are taught to pre-engineering are ineffective as it does not give the conceptual understanding and orientation. Introduction of specialized courses and content means that it may contain the knowledge of different fields and domains which clarifies what we do in a specialized field. Then the students will also be clear about their career selection and major subject selection. These courses or contents require more specialized teachers for which trainings might be helpful in improving teaching strategies and implementation of the specialized courses.

The teachers mentioned that in some educational institutes, a proper forum for teacher's training is maintained through workshops and sessions for the teachers but unfortunately it is not offered in many institutes.

According to Pakistani literature, there are a lot of problems for example, access to education of locals to the educational facilities, and lack of equal opportunities to different sects, genders and geographically located people. Relevance of the course content to Pakistani culture, values and needs, requirement of trained teachers to promote education, educational system and syllabi being static or frozen and changing very slowly are some dimensions explored in the literature (Ahmad, 2014; Ahmad, Rauf, Rashid, Rehman, & Salam,

2013; Akram, Kamran, & Ahmad, 2020; Aziz, Bloom, Humair, Jimenez, Rosenberg, & Sathar, 2014; Farooq, & Kai, 2017; Mahboob, 2017; Rashid, & Mukhtar, 2012; Shahzad, 2019; Zafar, & Ali, 2018).

Students achieve high grades by rote memorization or unfair means but the skills and potentials are rarely found in them when they enter practical fields, which is a major dilemma of the educational system in most parts of Pakistan (Khalid & Khan, 2006).

In such an advanced technological society, a wide gap has been identified in what is taught and what actually need to be

practiced. With the development of the technology, the courses must be updated to compete with the demands of the situation. Specialized courses, according to teachers can also help students acquire the updated knowledge of the course.

This study also identified such factors among which lack of practicality, teachers' qualification, and outdated syllabus were regarded as the most prevailing factors in educational institutes that restrained the students of pre-engineering from achieving high and securing a sound future in engineering career.

Table 6

Perception of Administrative Factors as Psychosocial Factors as Per Teachers, Teaching at F.Sc. Level.

| Themes | Categories | Codes |
|-------------------------------|---------------------|---|
| Administrative factors | Practicality | Practical importance |
| | | Conceptual understanding |
| | | Real time exposure |
| | Education Scenario | Achievement of grades |
| | | Attitudinal change towards acquiring education/knowledge |
| | | Policy of institutes for attendance and examinations etc. |
| | | Teaching efficacy |
| | Outdated curriculum | Time shortage |
| | | Content coverage |
| | | Teachers' trainings |
| | | Too old and ineffective |
| | | New educational trends |
| | | Need for specialized courses |

Part IV. Conclusion of the qualitative data from teachers of pre-engineering students.

All of these factors proposed by teachers identified important factors and issues in the career path of engineering. Teachers suggested that counseling is an important field and must be part of the mainstream for the decision making and career choices. Parents should be counseled to make them understand the importance of career choice. Knowing the strengths and weaknesses, students can better opt for themselves what is best suited for them.

This qualitative analysis of the interviews helped us identify factors based on Social Cognitive Career Theory (SCCT) such as barriers, support system, and other demographic characteristics.

Strategies, policies and suggestions from the teachers helped us identify the barriers that could be minimized to help students achieve their goals in the field of engineering.

The analysis suggested different aspects of the problems that influence the students' intension for persistence in the next level of their education. The flaws and barriers identified are curriculum, awareness, scope, difference in the semester and annual system, selection criteria, and teacher' competencies which actually affect the achievement of the students.

Ethical considerations

Ethical codes given by American Counseling Association approved by ACA Governing

Counseling (2014) for psychological research with career aspirations and career studies were followed in the research.

Limitations and suggestions

The major limitation of the study was lack of diversity in the sample, which hampers the generalizability of the research findings. Most of the sample was taken from the Colleges of Rawalpindi, and Islamabad. Hence a bigger sample taken from the general population of Pakistan can contribute a lot in overcoming this limitation. Proportionate sample of both genders could not be identified for the study.

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