An Interpretive Phenomenological Analysis of Career Choice in Science: Evidence from Malaysian Undergraduates

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Background of Study

> "An unfulfilled vocation drains the color from a man's entire existence"
> (De Balzac, 2008)

Melodramatic but true nonetheless, French novelist Balzac had aptly portrayed the ramifications of a frustrating career path on an individual's quality of life. Yet, the attainment of a successful and satisfying career reclines very much in an individual's own definition and perception. As a general belief, there are two main elements to career success. The first, extrinsic success, is objective and usually an observable element like salary while the second, intrinsic success stems from subjective reaction to one's career (Ng, Eby, Sorensen & Feldman, 2005). The apparent desirability of salary, prestige and status have posited extrinsic success as the focus of employers and employees alike, thus contributing to the misconceived equation of career success and satisfaction solely with high extrinsic factors. This belief was refuted by Ng et al. (2005) in a report of low sample size weighted correlations of salary and promotion with career satisfaction respectively. Owing to this, vocational research have begun to shift attention to the perceptions and feelings of one's career, which is essentially the core of subjective career success and how these may consequently impinge upon career decision-making.

As important as it may be, intrinsic career success which hinges on the subjective experience and emotions of an individual are predisposed to the milieu of ambiguity and obscurity in its pursuit. As increasing emphasis is placed on attaining both extrinsic and intrinsic success and satisfaction, the formation of one's career choice in the recent times has also taken on an equally complicated path. While a career encompasses the unfolding sequence of a person's work experiences over time and across multiple jobs, organisations and occupations, crucial formation of a career identity begins long before the commencement of the first job (Arthur, Hall & Lawrence, 1989). It transpires in adolescence as they begin to discover a variety of new subjects, knowledge and interests. Career identity gradually crystallise as individuals explore and attempt different occupational interests, tasks and planning in consideration of a future career (Super, 1990 as cited in Rogers & Creed, 2011). During this process which extends till adulthood, individuals alight upon a host of factors that influence their decision-making, hence shaping their ultimate career choice.

Social Cognitive Career Theory

A core theory of reference in career development, the Social Cognitive Career Theory maintains that decisions preceding academic and career-relevant choices and subsequent performance and persistence in educational and occupational fields are framed by an assembly of person and environmental variables (Lent, Brown & Hackett, 1994). According to the theory, four cognitive-person variables: self-efficacy beliefs, outcome expectations, interests and goals work individually and in concert with contextual barriers and support to facilitate or hinder progress towards career goals (Lent, et. al, 1994). More precisely, self-efficacy acts in tandem with outcome expectations to mold one's area or subject of interest which eventually inspires academic and career goals. This in turn determines the implementation of specific actions that lead to performance and goal attainment. Throughout this progression,

background influences including emotional, financial support, cultural and gender role socialisation provide the setting for an individual's learning experiences. On the other hand, more direct influences such as network contacts, structural barriers and opportunities affect the career plans at critical choice junctures.

Self-efficacy, which is one's judgment about his or her own capabilities to organise and execute courses of action has been associated with increased levels of career planning and career exploration in high school students (Rogers & Creed, 2011) while *outcome expectations* that incorporate one's personal beliefs about physical, social and self-evaluative outcomes of undertaking a particular path has also been linked to academic goals and interest of certain academic majors such as engineering and biological sciences (Byars-Winston, Estrada, Howard, Davis & Zalapa, 2010).

The Salience of Work

An individual's attainment of intrinsic success pivots firmly on the importance and significance of an occupation to him or herself, which may vary in different characters. The background and contextual elements that profiles one's salience of work is important as it further determines the nature of motivation which drives his or her tenacity for achievement in the chosen field. Social-cultural expectations including gender role socialisation and available role models have been found to strongly influence an individual's perspective not only on work, but in other aspects of life and these in turn determine how they may prioritise one choice over another.

Conventional female roles for example, uphold the expectation of females in supporting family and household matters primarily. As illustrated in Stoner, Hartman and Arora (1991), managerial women who maintain this traditional view of high family role salience experienced highest levels of family-work conflict when putting in long hours at work. Regardless of whether it is work passion, work-life balance, attractive income or social-cultural expectations, decisions will be made with precedence to the aspect which one holds most salient.

Context of Study: Science as a Career Choice in Malaysia

Based on the UN Millennium report (2010), the scientific, technological, engineering and mathematics (STEM) workforce are among the most critical resources for economic transformation. As countries move towards knowledge-based societies, government interventions are geared towards influencing program choice in order to meet national needs (Kember, Ho & Hong 2010). In the developed nations and rising economies such as United States and Asian countries, the higher education institutions are seen to play a vital role in supplying the required human capital through producing competent graduates who can be a catalyst to drive new sources of domestic growth and attract foreign direct investment.

While there has been a strong emphasis in promoting the undertaking of science and technology (S&T) as a career path for university students, there has been a notable trend of decline in the number of graduates and workforce in this field. In Malaysia, the country's aspiration of attaining a high-income economy that is innovation-led, sustainable and provides good quality of life for its citizens has brought forth a pressing concern owing to reports of decreasing enrolment of S&T undergraduates,

low percentage of graduates and reduced workers pursuing an S&T career (Lai & Yap, 2004; Ibrahim, 2012). Vocational research across the globe has attributed this worrying trend to perceived difficulty and stress in academic courses, social barriers, and poor self-efficacy beliefs among students (Inda, Rodríguez, & Peña, 2013; Oon & Subramaniam, 2013). In view of these findings, this research aims to delve into the emotions, perceptions and career choice intentions of Malaysian S&T undergraduates in anticipation of reviving the nation's economic transformation. Specifically, this study aims to understand how individuals make sense of their personal experiences in science as an educational pursuit and potential career choice.

Method

Participants

A purposive sample of 23 science undergraduates from public and private universities in Malaysia were interviewed for the study. The sample consisted of 12 females and 11 males. Twelve participants were Chinese, eight were Malays and three were Indians. Most participants were in the final year of their undergraduate course while others had recently completed their degree. A profile of the participants is summarised in the table below.

Table 1: Profile of Interview Participants

Participant	Gender	Ethnicity	Public/Private university	Course of study	Years of study	Career choice
P1	Female	Chinese	Private	Biotechnology	4	Job in Science or teacher
P2	Female	Chinese	Private	Biotechnology	4	Job in Science or Business
P3	Female	Chinese	Public	Product Development Technology	3	Marketing role in Science company
P4	Female	Malay	Public	Actuarial and financial mathematics	3	Finance/Risk management field or Postgraduate studies to Academia
P5	Female	Chinese	Private	Biotechnology	4	Postgraduate studies to Academia or job in Genetics field
P6	Male	Chinese	Private	Biotechnology	4	Postgraduate studies to Academia or job in Wastewater field
P7	Female	Chinese	Private	Biotechnology	4	Postgraduate studies to Academia

P8	Female	Chinese	Private	Biotechnology	4	Job in Banking or business
P9	Male	Chinese	Private	Biotechnology	4	Marketing role in science company
P10	Male	Malay	Private	Electrical Engineering	4	Postgraduate studies to Academia or Job in Machine maintenance
P11	Female	Malay	Private	Electrical and Computer Systems	4	Postgraduate studies to Academia
P12	Female	Indian	Public	Microbiology	3	Postgraduate studies to Academia
P13	Male	Chinese	Public	Microbiology	3	Postgraduate studies to Academia or R&D in Corporate
P14	Male	Chinese	Public	Microbiology	3	Research and Development in Corporate
P15	Male	Malay	Public	Pure Chemistry	3	Postgraduate studies to Academia
P16	Male	Chinese	Public	Biochemistry	3	Postgraduate studies to Academia
P17	Male	Malay	Public	Physics	3	Postgraduate studies to Industry
P18	Female	Chinese	Public	Chemical engineering	3	Professional Engineer
P19	Male	Indian	Public	Biochemistry	3	Research and Development in Corporate
P20	Male	Malay	Public	Material Science	3	Postgraduate studies to Academia or R&D
P21	Female	Malay	Public	Material Science	3	Project manager/Planning or Postgraduate studies to Academia
P22	Male	Malay	Public	Pure physics	3	Postgraduate studies to Academia
P23	Female	Indian	Public	Pure Chemistry	3	Postgraduate studies to Academia

Procedure

The phenomenological research approach was employed for this study. The purpose of phenomenology is to describe and understand the essence of lived experiences of individuals who have experienced a particular phenomenon (Lichtman, 2006). The current study examines the feelings and perceptions of science undergraduates about their subject and career intentions ensuing their social, cultural, familial and individual experience and emotions throughout their childhood and education. Interview sessions were conducted for approximately 40 minutes to an hour comprising of questions regarding initial contact with science, source of interests, perceived barriers and supports, role models and academic and career intentions. While specific interview questions were prepared, the actual session followed a conversational style, allowing the researcher to adapt the sequence or phrasing of the questions for a natural flow.

Results

From the preliminary data analysis, four major themes were identified: 'Science as fantasy and discovery', 'Science as a default choice', 'Science as a reality or illusion', and 'Science as a transit, crossroad or destination'. Each theme shall be discussed with accompanying excerpts taken from the transcribed interviews.

Theme 1: Science as Fantasy and Discovery

During the course of the interview, all participants mentioned feelings of attraction and fascination during their initial contact with science during childhood. Their curiosity in the subject was triggered by a few notable medium of influences including family, school and media. At home, interaction with older siblings and relatives provided opportunity to observe and learn about scientific applications and technology. In school, enrichment programs such as science fairs, competitions, workshops and laboratory experiments introduced participants to the universality of science in naturally occurring phenomenon. Specifically, participants sustained their interest via engaging media tools including educational television programmes, sci-fi movies, scientific articles and magazines.

> *During my childhood, actually I play with my brother, he used to show me, we play with the water hose, used to, at that time I don't know he blow or what. The water coming down from the basin, like from higher to lower, like keep going flow. So I keep thinking, how does he doing that? So that is the first, something that triggered. I'm so impressed (Participant 20, Male, Material Science undergraduate)*

> *Actually begin with one competition I took part when I was 12 years old, it's a national program, they arrange a junior science competition, each school comes out with few teams and each team will carry out some experiments to show some kind of invention in science. It is significant one because it allows us to think in many different ways, there is no definite concept, you always can be skeptical. That is why science can be always be hypothesised.*

I don't like to follow something blindly. Actually that competition makes me aware of this. (Participant 12, Female, Microbiology undergraduate)

From primary to lower secondary, science classes and activities were general in nature, thus it was not till upper secondary did participants form a stronger passion for science that was then segregated into three subjects; Biology, Chemistry and Physics. The undertaking of (all or either of) these subjects enabled participants to garner more knowledge in their chosen field of science. Mainly, participants noted feelings of inspiration and motivation to consider a career in a related science field due to a positive experience with the subject and teacher.

Just a small part of my textbook and then I feel very interested why just a few of cells that can develop into a plant or maybe an organism. So this developed my interest and then I plan to continue my future study in Biotechnology. (Participant 2, Female, Biotech undergraduate)
The main interest came when I was in form 4. Because my form 4 lecturer for biology. She is a fantastic lady. She is the one who instill the love in biology. I scored really well. Thanks to her. She is the main reason that I choose biochemistry. We study about the chemical reactions in our body. (Participant 19, Male, Biochemistry undergraduate)

Theme 2: Science as default choice

At the point of transition between lower secondary to upper secondary, participants had to make a choice between science or art stream. The participants mainly chose science for two reasons; first being the social perception of science as the "superior" option which fit for only good and smart students; second being the advantage of science that allows broader career options in the future. They indicated that it was mostly parents, relatives and the school itself that regarded science stream in better light, thus reinforcing their selection of the science stream. In some cases, participants were not even given the opportunity to decide, instead, they were required to enter the science stream after obtaining good results in their examinations. While most participants did not personally feel that art stream was inferior to science, some admitted that they were not exposed to any subjects in that field, hence prefer to remain in their comfort zone by opting for science stream.

Let's say you are a science stream student, after SPM is easier to enter art stream, but if you are from art stream you are stuck and cannot change the course anymore. That's why I go into a science stream. (Participant 3, Female, Product Development Technology undergraduate)

I guess I wasn't much expose to business that's why I choose science, is like my only choice. (Participant 5, Female, Biotech undergraduate)

The second thing is that my parents, they support us to go to science. Because parents have perspective that science student are cleverer as compared to art student. They always see science student as the good student, smart student, art student is a bad student, stupid student. (Participant 7, Female, Biotech undergraduate)

Theme 3: Science as reality or illusion

Contrary to the fun and exciting nature of science from childhood till secondary education, participants begin to express an apprehension for the subject during their tertiary education. They felt a significant difference in difficulty of science subjects between secondary and tertiary education. Specifically, their experience with the subject in the latter involved difficult syllabus, repetitive laboratory work, and strict deadlines. This experience led to precursory feelings of uncertainty and contemplation if science was indeed a suitable path for them to advance their careers in.

> *There seems to be a very large gap between Form Five and foundation so I was kind of struggling for chemistry. It was very hectic in the way I feel that I didn't spend the amount of time that is needed for my family members because all of our time is already given to finish up the assignments. That is one of the regrets during my degree. I really didn't wanted to do anymore (Participant 1, Female, Biotech undergraduate)*

> *Actually start from the first year I realised that the most obvious part is that I thought I could answer all the question but came out the result is not the result that I want. Is not the bad but still I wish, I target for higher result. I actually experienced dilemma of whether I should continue. I just realised is not that easy and that time, of course I will feel very sad. (Participant 7, Female, Biotech undergraduate)*

Furthermore, those that had undergone their practical training or internship in the industry did not seem to feel any better about their career prospects in the industry. Instead, they envisioned that a career in the science industry involves a modest salary scale, repetitive tasks, long working hours and demanding work tasks. Based on the reality check via the brief internship episode, these individuals seemed to experience a sense of indecisiveness and personal struggle in determining their future career plans.

> *You would not feel it that strong, you know that the salary is not high, the career prospect wasn't that good. Only when you go through your internship, you realised that these are all true. (Participant 13, Male, Microbiology undergraduate)*

> *I did not like the working environment, is very hectic. They do a lot of stuffs and each person is assigned to like super a lot of jobs. It's pretty disappointing. You can learn a lot but I just don't like the environment and working hours. I like flexible working hour like in (postgraduate) research. (Participant 5, Female, Biotech undergraduate)*

However, a number of participants who were from pure science courses reported positive experiences in their final year project or an internship experience working in research laboratories in an academic setting. These individuals possessed a high self-esteem for being part of an important research project with their academic supervisors and these undergraduates valued the autonomy to carry out the investigative tasks and possessed a strong sense of ownership in their project work.

While Applied Chemistry have to go for internship, the Pure Chemistry need to work inside University X with a supervisor. You know from the internship that my friends experience, you become a labour worker. You make coffee you get photocopies. This is true, in my labs I feel like one of the scientist that really do science for living. The supervisor respect me as a scientist, in my opinion. (Participant 15, Male, Pure Chemistry undergraduate).

I did my internship in University Y. Actually I was trained as a trainee research assistant. I have been working with Prof XXX, he is also microbiologist. The experience was like they never restricted me, they encourage us to test out our own hypotheses. So, in that case, I enjoy. I extended my internship as well. (Participant 12, Female, Microbiology undergraduate).

Theme 4: Science as transit, crossroad or destination

As the participants were in the final year of studies or had just completed their course, we asked them to share with us their plans for future careers or their current thoughts in future endeavors. While their interest lies in science, some participants were also considering occupations in the business sector or entrepreneurial endeavour which is seemingly more rewarding than science careers in the lab doing research and development. There were also a few participants who preferred non-research roles in science-based organisations such as marketing personnel or consultants where they would be able to meet clients and still be able to apply their scientific knowledge.

I am going to marketing department, for a food company so is also related to food [technology]. I start to consider marketing because it still has very good connection with R&D department and I can travel a lot. I get to meet a lot of people and not just cooped up. I like the job that keep on changing every day and keep on thinking so even though you may be hectic but I think is enjoyable (Participant 3, Female, Product Development Technology undergraduate)

I would like to work in a wastewater related field. I will do the best in advising the client how they should manage their waste in terms of waste management. Second I feel that I can actually be part of the effort in the reducing waste or managing sustainability. (Participant 6, Male, Biotech undergraduate).

A majority of participants (15 participants) were considering an academic career path in the higher education or as school teachers which is perceived as a meaningful pursuit for the betterment of the society. Out of these 15 participants, there were a few individuals who were driven by sheer passion in science, and they are determined to remain progressive in the field through the pursuit of higher degrees. In this regard, salary seems to be a secondary factor of consideration for these individuals.

If I don't have any pure passion for my career, I don't think it will work out for me because I will get tension. I won't think about the salary, the salary is not my cup of tea that I will go for salary. Money we can gain in many other ways, we can go into share and other things like investment. (Participant 23, Female, Pure chemistry undergraduate).

Well, if you really love science. You don't really pursue the money, the money will come to you. You know being in science it is about giving, it is not about taking, that is what I believe. So, if you are in the science field to have a lot of money, you have the wrong purpose. (Participant 15, Male, Pure chemistry undergraduate).

Understandably, other participants were feeling ambivalent about their next step, mostly citing difficulty in getting a job or a challenging journey ahead as barriers to pursue their career in science. They believed that as fresh graduates in the science field, their knowledge and experience was not sufficient to secure a research position in the industry which necessitated postgraduate qualifications. Furthermore, even if they did manage to obtain a job, the starting salary was significantly lower than that of a fresh graduate in business or arts sector. These obstacles combined with a keen interest for the science field has thus left participants at a crossroad on their career plans, and postgraduate studies are seen as a point of transit for future careers in the industry or in the academia which is perceived to offer better salaries.

It is hard to get a job with my degree in science. It is hard to get into industry and research. Employers will be more impressed with Masters. (Participant 22, Male, Pure physics undergraduate).

When you only have a degree in this field, the pay is not very high. Like fresh grad is like RM2000. So I think if I continue study, I work as research assistant, also get RM1800. (Participant 16, Male, Biochemistry undergraduate)

That time (during secondary school) I thought science very noble job or what. Then I also thought that the salary is very high. But you want to get a high salary for science field right, you need to study very high level, like PhD. (Participant 14, Male, Microbiology undergraduate).

While sharing on their career considerations, a significant pattern can be observed among these Generation Y participants that they value work-life balance regardless of gender. For Participant 21, he was very decisive in an academic career which is perceived to provide a more enabling environment for work-life balance that will be important for him as the head of the family. For a few female participants in the Engineering degree, they tend to prefer a career in academia during the later part of their career as it avails them the opportunities to spend more time with their families.

Someday I have my own family, someday I have to take care of my own family, especially if you are a man. We have to balance time between work and family. My father ask we what do I expect from the next generation and he made comparison. For me it is a very deep message. I study not for my own future, it is for the next generation. (Participant 20, Male, Material Science undergraduate).

If I want to work as an engineer, after I settle down it would be quite difficult to accompany my family. That is one of my concern that is why I was thinking about doing PhD, so that I can go to lecture but not my first choice. (Participant 18, Female, Chemical Engineering undergraduate).

Discussion, Implications and Conclusion

The results gathered lends support to the Social Cognitive Career Theory by demonstrating the footprints of self-efficacy and outcome expectations on participants' persistence in the science field. The perception of science as an advantageous selection that will equip participants with not only an extensive range of future career choices but also a socially approved and respected path has strongly influenced one's intention to pursue a career in science. Most participants had alluded to this perception during secondary education as they proceeded to enroll in science stream after obtaining the required results. Interestingly, we note a bi-directional relationship between self-efficacy and outcome expectations in that the positive viewpoint of science drives one to choose the science stream while being accepted into science enhances one's self-esteem as they are associated with the "preferred" option. The role of self-efficacy is further reinforced during tertiary education when participants reported difficulties in coping with academic workload, hence experiencing reservations about pursuing a career in the field. This corroborated with findings from Byars-Winston and Fouad (2008) in that maths or science self-efficacy directly predicted outcome expectations while maths/science interest exhibited a direct relationship to goals.

The phenomenological approach used in the present study also drew focus to how their experiences with science influences one's subsequent decision-making and career intentions. In the theme 'Science as fantasy and discovery', participants' descriptions were more emotion-laden, citing feelings of wonder and fascination upon initial exposure to scientific knowledge and applications. In line with findings from Oon and Subramaniam (2013), laboratory work, enrichment programs such as talks and competitions, and good teachers were reported to trigger feelings of excitement and inspiration, thus encouraging interest for science subjects. These positive emotional experiences were observed to be highly instrumental in steering participants to plan their future path and ambition in the science field. More importantly, these emotions are deep-rooted and enduring, maintaining a strong hold in participants to pursue a career in science even as they discover unpleasant aspects of the field. A majority of participants were passionate to remain in science, opting only for different roles within the field to improve their prospects.

While all participants share a common interest for the science field, their intention to maintain science as a career choice is derived from individual factors of motivation. Looking into the long-term future, male participants for example, tend to place more emphasis on monetary reward in their career consideration. Unfortunately, the perception of a modest income associated with a career in science leaves them in predicament in deciding their future career options. Female participants, on the other hand, in anticipation of the traditional gender role of managing household and family aspects held preference for a career that

would be family-friendly in terms of flexible hours and a moderate workload. They believe this can be attainable by pursuing the academic route as a lecturer. Yet, as an immediate concern, a significant number of participants cite passion and significance of work as a crucial factor. In line with recent reports of the 'Generation Y' or 'Millennial' work trend, the findings of this study seem to suggest that this new generation of science students view their career as a course of exploring their passion, obtaining fulfilment rather than purely focusing on financial security (Seager, 2014). Although salary does feature as a salient factor, work-life balance also emerged as a strong predictor in the career choices of this future workforce.

In essence, the present study has provided a processual view of individuals' lived experiences with science and technology from their childhood, their educational experiences and perceived self-efficacy which shape their career motivations and aspirations. Specifically, we are able to impart valuable insight on the perceived barriers to undergraduates' intentions of pursuing science as a field of study and as a career choice. The main deterrent to choosing a career in science prevails in the nominal salary received in return for tedious hours and workload, which is highly demotivating when compared to an equivalent position in the business or arts sector.

There was also an expressed concern for the lack of job opportunities for fresh graduates in the R&D sector as preferences are usually given to those with higher degrees. The internship programs of final year undergraduates also deserve serious attention as these encounters contribute towards the formation of one's impression towards a science career and hence, his or her decision in future career paths. Strong partnership is indeed necessary between the universities and corporations to ensure that mental and emotional support is provided and meaningful learning experiences take place during this period of internship engagement. While it is important for policy makers and researchers to encourage an upward trend towards the enrolment and completion of undergraduates in STEM courses, our findings highlight the complex interplay of factors which impact upon student entry and persistence towards a science career. Further research of a longitudinal study in nature would be useful to track the experiences of science undergraduates throughout their first few years of work to assess their quality of life and career satisfaction based on the choices they made.

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