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Factors that Influence Chemistry Students to Choose a Chemistry-Related Career, their Relationship and the Gender Effect

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Abstract

Following the decline in recent years in the number of students studying chemistry in institutions of higher education, research on choosing a career in chemistry is needed. In general, a career choice stems from various factors, including, among others, personal environmental and behavioral aspects. The purpose of this study is to examine the factors affecting the choice of careers in chemistry among students who are in their final year of studies of a first degree in chemistry in Israel. The study is based on several theories, including a theory that discusses the factors in career choices arising from the structure of personality, self-perception, environmental influences, and the social and cultural context in which a person lives and the Social Cognitive Career Theory (SCCT), which refers to self-efficacy factors. Badura's theory (1986) refers to factors in decisions making as a combination of the influence of external, personal, and behavioral factors and the SCCT applies those on career choices. In this study we focused on the personal, environmental, and behavioral factors under the SCTT theory to try to find specific factors that influence chemistry students in choosing a career in chemistry in Israel. This theory also shows how personal variables affect career development processes. In other words, career barriers (such as insecurity, self-esteem) may prevent a path from being chosen even if there is a high level of self-efficacy. Research on Science, Technology, Engineering, and Mathematics career choice have suggested a wide range of factors that influence one's choice. For example, learning, and career choices are mainly influenced by STEM interest and also by circle of close people, family and close friends (Nuget, 2015). Another example is internal motivation, that stems from a successful experience, identity involvement, and perseverance. In addition, studies have examined the predictability of a career choice by the level of research skills and self-efficacy, to predict student aspirations for research careers. Chemistry, as part of the STEM disciplines, is known as a difficult field because it is intangible and difficult to grasp, requires great investment, patience and perseverance.

Research on the choice of careers in chemistry have found that the most important factors in choosing a career in chemistry are early chemical education, academic expectations that will provide good preparation for the labor market, encouragement from family and friends, and academic staff. The expectation of academic education as a factor of preparing for the workforce after completing a degree was expressed in a study that examined the skills students acquired, such as teamwork, thinking and problem solving, time management, laboratory working and communication skills, organizational skills and independent learning skills, as well as additional skills they would like to acquire. This study found that employers also look for graduates with the same skills.

In addition, there was a difference between gender in choosing a career in chemistry. The source of variance between the genders can be derived from a difference in one of the following factors: culture, exposure, and variability in self-efficacy, role model with greater influence among women as well as home and family factors.

Considering this, the main objective of this study is to examine the factors influencing chemistry students in choosing a career in chemistry, the relationship between the factors and the influence of gender. More specifically, this goal was examined using the following sub-questions:

1. What factors influence a chemistry career choice among undergraduate chemistry students who are in their final year of studies?

2. Is there a gender difference in the factors in choosing a career in chemistry?

   2.1 Is there a gender difference in the composition of factors in choosing a career in chemistry?

   2.2 Is there a gender difference in the factors in choosing a career in chemistry on a personal theme?

   2.3 Is there a gender difference in the factors in choosing a career in chemistry on an environmental theme?

3. To what extent is there a connection between the various factors in choosing a career in chemistry among the study participants?

It is important to note that this study is part of a broader study examining the research questions of four different populations related to the world of chemistry, including: industrial chemists, academic chemists, chemistry teachers in first and second careers, and students. The present study focused on the population of students who are about to graduate and receive a first degree in chemistry at various universities in Israel.

The study involved 54 chemistry students from five different universities in Israel, of which 37 were women (68.5%) and 17 men (31.5%). Most of the participants belonged to the Jewish sector (78%). The chemistry students were asked to fill out questionnaires and volunteer for a personal interview. The questionnaire included questions from the professional literature: the questionnaire on professional identity assessment, self-efficacy questionnaire, the environmental effect questionnaire, and a professional decision-making questionnaire.

In response to the first research question that examined the factors in the choice of careers in chemistry among undergraduate chemistry students who are in their final year of studies, the findings of the quantitative study indicate that there are six key factors in choosing a career in chemistry that are divided into two themes, a personal theme and an environmental theme. On the personal theme, it was found that the factor task-oriented self-efficacy, is higher than the other two factors. In the environmental theme, external motivation which is influenced by reward, status, and prestige, as well as factor

family and a higher educational framework are higher than the factor external motivation influenced by teachers and lecturers.

It was also found that there are certain factors within the themes that differ. For example, external motivation affected by reward, status, and prestige, and the factor family and educational framework were found to have more influence than the self-efficacy factors related to careers and achievement in the sciences. The behavioral theme investigated by personal interviews yielded three categories: a. *Lack of acceptance for parallel STEM subjects*, b. *Early exposure to chemistry*, c. *Options and limitations encountered by the student in the process of admission to studies and during studies*.

As for the third research question, we found positive correlations between the factors in the personal theme, the factors in the environmental theme and the factors of the two themes together. This indicates the effect of the factors at each end separately, as well as the effect of one of the factors on the other. For example, a positive correlation was found between *self-efficacy – scientific achievements in chemistry*, and *self-efficacy - task-oriented*. In the environmental them there is a correlation between an external *motivation influenced by reward, status and prestige* factor and an external *motivation influenced by teachers and teachers* factor and by a *family a framework of studies* factor.

The second research question examined whether there is a gender difference in the factors involved in choosing a career in chemistry on three levels: the existence of gender differences in the composition of the factors, the existence of gender differences in the personal theme, and the existence of gender differences in the environmental theme. In response to a question that examined whether there is a gender difference in the composition of factors in choosing a career in chemistry, the pattern of findings indicates that between genders, there was no significant difference between the personal theme and the environmental theme, but there is a trade that the personal theme is higher than the environmental theme.

In addition, the findings indicate that among women there is a significant difference according to the composition of the six factors: *self-efficacy task-oriented* factor, *external motivation factor influenced by reward, status and prestige* factor and *family and educational framework* factor were significantly higher than the other three factors. In addition, the factor of *self-efficacy chemistry scientific achievement* and the factor *self-confidence in career* are significantly higher than the factor *external motivation influenced by teachers and lecturers*. On the other hand, no significant significance was found among men.

In response to the research question that examined whether there is a gender difference in the factors that influence the choice of career in chemistry on the personal level, no significant differences were found in the personal implication factors according to the gender affiliation of the participants.

In examining the predictability of factors in choosing a career in chemistry using the gender variable and personal background variables, as well as factors in choosing a career in environmental chemistry, it was found that the gender variable is a clear predictor of the self-efficacy factor in scientific achievements in chemistry whereby among men a factor of *self-efficacy scientific achievements in chemistry* gains is significantly higher foe men than for women.

Finally, in response to a question in a study that examined whether there is a gender difference in the factors influencing career choices in environmental chemistry, there were no significant differences in environmental determinants according to the gender belonging of the participants.

In examining the predictability of factors in choosing a career in chemistry in the environmental theme by means of the gender variable and other personal background variables, as well as by factors in choosing a career in chemistry on the personal theme, It was found that the gender variable is a clear predictor of the factor family and educational framework according to which the level of family and educational framework is higher among women than men.

In addition, it should be noted that the personal implication of *self-efficacy scientific achievement in chemistry* was found to be a clear predictor of two environmental factors. It was found that the level of factor of *self-efficacy scientific achievement in chemistry* is higher than the level of factor *external motivation influenced by reward status and prestige* and the level of factors *family and educational framework*.

As for the correlations between personal and environmental themes, it appears that there is a positive and significant correlation between the level of the factors *self-efficacy – scientific achievements in chemistry* and the level of *self-efficacy task-oriented* to the level of the three factors in the environmental theme. These findings are in line with Bandura's (1991) social cognitive theory that ability and achievement affect self-efficacy and self-confidence, while being influenced by status and prestige compensation (Nuget, 2015).

This study showed that the factors in choosing a career in chemistry correspond to those in the professional literature, moreover the study distinguishes between self-efficacy in the content of chemistry/science and a more general academic ability (task-oriented competence). In addition, there is an influence of environmental factors on the personal factors and vice versa, as described in cognitive social theory. The study shows that it is possible to predict the effect of each factor on its own, personally or in the environment. In addition, personal factors can be predicted by environmental factors and vice versa. Which indicates that there is interaction between the factors and that gender influences the factors in choosing a career. The study shows that career choice is also influenced by the interaction of the factors and dependence on the time the decisions are made, as noted by Holland (1997). This study emphasizes the importance of understanding the

factors in choosing a career in order to be able to act to encourage career choices in this field at the university and afterwards.