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WOMEN'S CAREER DECISION MAKING AND INTEREST IN ENGINEERING: A QUALITATIVE ANALYSIS OF INFLUENTIAL PERSONAL AND CONTEXTUAL FACTORS

ABSTRACT

The aim of the paper was to better understand the influence of personal and contextual factors on women's career decision making and interest in undergraduate engineering students. On the basis of Social Cognitive Career Theory and utilising a qualitative approach, nine interviews were conducted with women undergraduates at a university in Northern Italy. The results reveal four major aspects: a) the women's interest in engineering is cultivated by different contextual factors in the same way across multiple cultures; b) self-efficacy affects their interest in engineering; c) this interest is nurtured by internal and external recognition; d) their career decision making is determined by an interdependence of personal and contextual factors. The paper contributes to promoting cultural changes in engineering fields. Some practical implications for education professionals and policy makers were also reported.

Keywords: *women's career decision making, self-efficacy, social cognitive career theory, environmental engineering education, recognition*

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KARIERNO ODLOČANJE IN ZANIMANJE ŠTUDENTK NA PODROČJU INŽENIRSTVA: KVALITATIVNA ANALIZA VPLIVA OSEBNIH IN KONTEKSTUALNIH DEJAVNIKOV – POVZETEK

Cilj analize je bil bolje razumeti vpliv, ki ga imajo osebni in kontekstualni dejavniki na karierno odločanje in zanimanje žensk za študij inženirstva. Na podlagi socialno kognitivne karierne teorije in ob uporabi kvalitativnega pristopa je bilo izvedenih devet intervjujev z dodiplomskimi študentkami na univerzi v severni Italiji. Rezultati kažejo na štiri glavne vidike: a) zanimanje za inženirstvo pri študentkah na enak način kultivirajo kontekstualni dejavniki v različnih kulturah; b) na njihovo zanimanje za področje inženirstva vpliva občutek samoučinkovitosti; c) to zanimanje krepi notranje in zunanje priznavanje; d) na njihovo karierno odločanje vplivajo tako osebni kot kontekstualni dejavniki. Članek spodbuja h kulturnim spremembam na področju inženirstva ter poroča o praktičnih ugotovitvah za izvajalce izobraževanj in oblikovalce politik.

Ključne besede: *karierno odločanje žensk, samoučinkovitost, socialno kognitivna karierna teorija, študijski program okoljsko inženirstvo, priznavanje*

INTRODUCTION

Promoting initiatives and actions to retain or recruit students in Science, Technology, Engineering, and Mathematics (STEM) fields has become a priority in many countries (OECD, 2017) to drive innovation, with a corresponding impact on the economy and labour market. Although STEM disciplines have attractive levels of employment and earnings, they still attract a small number of students. Further, gender equality has made very little progress in these male-dominated fields. Women represent fewer than 20% of entrants into tertiary level computer science programs in OECD countries and only around 18% of engineering entrants (OECD, 2017). They dominate in other more feminized fields such as health and welfare but remain significantly underrepresented in STEM studies. Engineering is one of the most male-dominated professions, and the few women who have engineering careers face gendered stereotypes and cultures, which make launching and sustaining such a career difficult. According to Makarem and Wang's (2020) research, women take up 14.5% of architectural and engineering occupations and 11% of civil engineering occupations in the US. In Australia, women account for 12.4% of employment in engineering and in the European Union, they represent approximately 40% of employment in science and engineering, with steady increases. Globally, women tend to feel stalled in STEM occupations and plan to leave these careers due to gender bias, isolation, hostile masculine cultures, inadequate feedback, a lack of mentors and sponsors, and the challenges of gendered organisational structure, culture, and management. The limited access of women to masculinized fields perpetuates the occupational segregation of women and men (Avolio et al., 2020).

SOCIAL COGNITIVE CAREER THEORY

Social Cognitive Career Theory (SCCT), the framework of reference for the data collected, was developed by Lent et al. (1994) on the basis of Bandura's (1989) social cognitive theory, according to which there is a triadic reciprocity among three components: personal attributes (cognitive, affective, physical), external environmental factors, and behaviours. Within this triad, the constructs of human agency (the ability to behave actively and intentionally in the context to generate a change) and self-efficacy (the beliefs of people regarding their effectiveness in managing events through their choices and decisions) express themselves.

SCCT aimed to explain the interconnection between personal and contextual variables that can affect human agency in relation to career development. According to SCCT, people exercise their personal agency on the basis of three social cognitive mechanisms that have an important role in the career development process: self-efficacy, outcome expectations, and personal goals (Brown & Lent, 2019). Self-efficacy refers to the perceived capabilities for learning or performing actions at expected levels (Bandura, 1989). It affects people's vocational interests and their career goals. Outcome expectations are connected to people's beliefs regarding the consequences of activity engagement. Goals represent the personal intentions to take part in an activity or achieve a certain level of performance (Brown & Lent, 2019). However, personal variables such as gender, race/ethnicity, or age and contextual factors (barriers and support) can affect self-efficacy, interests, goals, and outcome expectations. According to SCCT, contextual barriers (obstacles) and supports related to economic and emotional resources, career role models, presence of gender stereotypes, are social and financial variables that can facilitate or impede the formation and pursuit of an individual's career choices (Lent & Brown, 2013). Social and familial support plays an important role in people's career understanding (aspirations) and decision-making behaviour. In fact, people who receive social and familial support, such as opportunities to engage with certain tasks and role model exposure, encouragement in one's chosen goal, can develop a positive attitude toward the difficulties encountered in their life, improving their self-efficacy (Lent et al., 1994).

Within the SCCT, the components that better fit with this study are: cognitive-personal factors such as self-efficacy and outcome expectations; contextual factors such as familial influence and learning experiences.

Personal Factors: Self-Efficacy and Outcome Expectations

Self-efficacy is the perception that people have of their capabilities to succeed in different activities. For example, if a woman believes in her ability to succeed in a STEM career, she will be more likely to pursue one. Self-efficacy is an important variable of people's career choice (Lent et al., 1994). The more people's self-efficacy increases, the less they perceive obstacles or avoid challenging experiences. In this perspective, self-efficacy represents the central mechanism of personal agency (Bandura, 1989). It affects young people's career choices and positively predicts their career outcome expectations in specific fields that

are related to personal beliefs about probable outcomes in terms of anticipating certain results (e.g., money, social recognition and approval, self-satisfaction). It was identified as an important component for understanding women's career development in STEM fields because it affects women's vocational behaviour and career decision making (McKinney et al., 2021).

Contextual Factors: Families and Learning Experiences

Lent et al. (1994) considered two groups of contextual variables for career development on the basis of their proximity: (a) "more distal, background influences" (p. 170) that precede and contribute in shaping interests (e.g., opportunities, role model exposure; support; cultural and gender role); and (b) "proximal influences" (personal network/relationships, discrimination, stereotypes). This last group includes the family as an ever-present variable because it plays an important role throughout people's academic and career development.

According to SCCT, when people perceive difficulties and barriers in their context, they are less willing to transform their goals into actions. For example, daughters in families holding traditional views of women's roles as caretakers, not professionals, might hesitate to articulate their career goals or seek out a non-traditional career.

Learning experiences shape self-efficacy beliefs, but they do not occur in isolation. For example, people's learning environment can provide the relevant activities for developing career interests through direct and vicarious experiences, but the way they live and interpret the learning experiences is influenced by distal background variables (e.g., educational background, family). In fact, educational and family background are the basis on which the new learning experiences are built, influencing interests and self-efficacy (Ferry et al., 2000). Proximal variables (e.g., teachers, peers) play an additional role in people's critical choices and in shaping their self-efficacy beliefs (Lent et al., 1994).

THE PURPOSE OF THE STUDY

The purpose of this study was to understand what factors influenced international and domestic students' decisions to pursue engineering. Specifically, the study aimed to examine personal and contextual factors through the lens of SCCT since behavioural and organisational perspectives are the most common lenses through which women's career experiences are studied (Makarem & Wang, 2020).

This study addressed the following research questions:

- (I) *What is the impact of personal and contextual factors on the career interests of undergraduate women across multiple cultures?*
- (II) *How are the internal and external recognition of women students related to engineering career decision making?*

METHODOLOGY

This study was developed according to qualitative descriptive research (Sandelowski, 2010) since it was designed to carry out an in-depth analysis and understanding of those factors that influence women students' careers and interests. The descriptive design allowed us to conduct the analysis by staying close to the data and avoiding significant inference interpretations. A qualitative descriptive (QD) design was considered the most appropriate as it recognises the subjective nature of the different experiences that participants have. QD research generates data that describe the "who, what, and where of events or experiences" from a subjective perspective (Kim et al., 2017, p. 23).

Study Context

This study was conceived during a faculty development program of a university in Northern Italy, when a partnership between faculty members and researchers of the Education and Engineering Departments was established based on a common interest in gender issues. Specifically, the idea was born when a member of the engineering faculty described the paucity of women students of different cultures in her master's course on Environmental Engineering that she has delivered completely in English since 2007.

Due to the international context of the course (50% students come from non-EU countries), students benefit from collaboration with many other professional groups such as agronomists, biologists, doctors, and economists. Compared to other engineering courses, where women represent 20% of the student body on average, in this course, about 45% of the enrolled students have on average been women over the past three years.

Participants

The participants volunteered their involvement in the study when the professor of the Environmental Engineering course presented the project during one of her lessons. The selection criteria included being a domestic or international woman student in the course and willingness to participate in the interviewing process. Nine students meeting the criteria were voluntarily recruited and interviewed (56% of the women, 22% of the total students in class). The purposive sample represented different countries or various regions of Italy (Table 1). Despite the small number of participants, their different cultures helped researchers to collect perspectives belonging to various countries.

Data Collection

This study was carried out through semi-structured interviews during the autumn of 2019. After ascertaining the students' availability for taking part in the study, the interviews were scheduled and conducted in a private office on the university campus. The interview guide was developed based on theoretical frameworks of career development to investigate the following dimensions: family and cultural context of life, educational background, career interests, and outcome/career expectations. It was used as a dynamic

Table 1
Participants

Country	N. st.	Age and pseudonym	Characteristics of High school	Bachelor's course	Parents' professional role And other role models	Why at an Italian university
Brazil	1	25 (Sofie)	Public school (not very good)	Environmental Engineering	Father: civil engineer Mother: artist A woman civil engineer, who ran a lot of environmental projects in her country.	It was suggested by Brazilian course coordinator. She had an Italian scholarship.
Germany	1	24 (Vanessa)	Gymnasium that gives access to university (in Cologne)	Civil and Environmental Engineering (in Hamburg)	Both teachers (education for students with special needs). A Gymnasium Maths teacher.	Agreement between the two universities in Italy and Hamburg. She had an Italian scholarship.
Iran	1	32 (Helen)	School for talented students (very strict)	Agriculture Water Engineering	Not very well educated. A woman cousin is an engineer. Other relatives are pharmacists.	Less expensive compared to other countries. She had an Italian scholarship
North of Italy	1	23 (Sally)	Scientific Lyceum	Environmental Engineering	Father: computer programmer Mother: doctor Aunt, uncle, and grandfather are engineers. Grandmother was a Maths teacher.	She lives in the North of Italy with her family.
South of Italy	1	23 (Lisa)	Scientific Lyceum	Environmental Engineering	Father: worker Mother: teacher Teachers of scientific subjects (Maths, Physics, Science).	The opportunity to gain a master's degree in the English language at a good university.

Country	N. st.	Age and pseudonym	Characteristics of High school	Bachelor's course	Parents' professional role And other role models	Why at an Italian university
Centre of Italy	1	23 (Anna)	Classic Lyceum	Mechanical Engineering	Both public administrative officers. A cousin is an engineer. A teacher of maths.	Her boyfriend is studying Physics at the same university.
Russia	1	26 (Mary)	General school: balance between humanities and science subjects	Two bachelors' degrees: Engineering and Economics	Parents are both engineers.	Inspired by the university's history and scientists who studied at the Italian university. She had an Italian scholarship.
Argentina	1	24 (Laura)	Scientific Lyceum (near Treviso)	Environmental Engineering	Father: electrical engineer in Italy Mother: teacher Her brother is an engineer. Her boyfriend is an engineering student.	Engineering at the Italian university is famous. She had an Italian scholarship.
Turkey	1	24 (Nicole)	Public school (not very good)	Engineering at Technical University (Ankara)	Father: has an internet café and works there with computers Mother: works in social services (the protection of women) One woman friend with the same passion for scientific subjects.	An agreement between the two universities. She had an Italian scholarship.

and flexible tool that gave participants the opportunity to reflect on their experience and to share the meaning of their stories with the researchers.

The interviews ranged from 1 to 1½ hours; sometimes follow-up prompts were used to encourage the interviewee to expand on her thoughts concerning a specific question. The interviews were audiotaped with the participants' informed consent, and later transcribed

verbatim¹ as electronic documents. The data were stored in password-protected files in a secure location.

Data Analysis

The interviews were transcribed verbatim as electronic documents, and the content analysis was conducted using Atlas.ti.07 software. The qualitative content analysis allowed us to interpret the participants' experiences using the theoretical lens of SCCT. The analysis was carried out through multiple readings and interpretations of the raw data. At the beginning, three authors analysed a single transcript with the same approach and coded it separately. Then the authors compared, discussed and modified the codes. After these phases, two of us coded the other transcripts using the same method. At the end the codes were organised into themes relevant to the research questions.

FINDINGS

The purpose of this qualitative study was to examine the factors influencing women's career decision making of undergraduate engineering students (some pseudonyms were used). Interviews were conducted with nine students of different cultures attending the Environmental Engineering master's degree course at a university in Northern Italy. The final themes that emerged from our analysis were related to personal and contextual factors, and to internal and external recognition (Table 2).

Table 2

The Emerged Themes, the Research Questions, and the Relative Theories of Interpretation

Number of themes	Description of themes and subthemes	Research Questions	Theory of interpretation
1	Personal Determinants for women seeking engineering careers: Abilities; and Commitment	How do personal and contextual factors develop engineering educational career interest among women students of different cultures?	Social Cognitive Career Theory
2	Engineering interest is cultivated by multiple variables: 1) Family modelling and support; 2) Significant learning experiences, and 3) Society culture		
3	Women students' career decision making is influenced by perceptions of: Internal (efficacy, self-beliefs) External recognition	How are internal and external recognition of women students related to engineering career decision making?	

Personal Abilities and Commitment Are Determinants for Being an Engineer

1 The statements from the three Italian students, "Sally", "Lisa" and "Anna", have been translated from Italian into English. The other interviews were conducted in English and the students are cited verbatim.

Although abilities can be considered as individuals' potential, their transformation into relevant career skills requires personal commitment. In fact, commitment as "one's determination to reach a goal" (Locke & Latham, 1990, p. 125), motivates people to implement goal-oriented actions that nurture their abilities, interests and career choice.

Abilities

The participants recognised that careers in the engineering field require a belief in their own ability to be successful. One student provided accounts of a personal awareness of her abilities and determination for considering engineering as a profession: "I think I have the ability in all the mathematical subjects. I'm good and... I don't know, I think it's something that I like to do" (Laura).

Engineering is perceived as a challenging learning field, but the students seem to not let it discourage them because they recognise themselves as talented and able to deal with stress and demanding tasks. In fact, abilities appear as aspects attributed to an elite group of students which the participants implicitly feel they belong to, as "Helen", "Lisa" and "Vanessa" explained:

If you get a high mark, you can go to the best university and study electrical engineering, mechanical engineering or something like this. [...] [T]here is a choice, but you have to be so talented to get this. (Helen)

I have a degree in engineering and they [people] look at me [...]. For me, it seems a natural thing. [...] One friend of mine said: 'I can't, I wouldn't be able to study mathematics, physics ...', so I think that some women set some limits that they do not have. (Lisa)

[...] I actually like math a lot. And that I find it easy to understand all the things that are happening in the lectures, while most of my friends didn't really understand math. (Vanessa)

Commitment

The participants considered the engineering field a demanding area of study. They recognised that engineering careers require hard work and commitment. Specifically, the students said: "To be an engineer you have to study hard, but I think engineering, with engineering I can create and study, and develop things and have a better place on earth" (Mary). "Yeah, I'm able to do that [engineering], because even if it will be too difficult and too stressful, it's something that's more or less easy because you like what you are doing" (Laura). All these statements appear also as a tacit recognition of their abilities and indirectly as a belief in their capacity and evidence of their self-efficacy.

Engineering Interest

Engineering Interest is cultivated by multiple variables: 1) Family Modelling and Support, 2) Significant Learning Experiences, and 3) Society Culture.

Family Modelling and Support

The findings showed that families have influenced the students' career choice and self-efficacy both directly and indirectly. Most of the participants received direct parental encouragement and persuasion that they could be successful in engineering. Some students felt that they were fortunate to have received this kind of family support despite the traditional culture of their own countries, according to one participant who noted, "women are for marriage and men for getting money" (Helen). Most of the participants identified a relative who explicitly encouraged them to choose a career in engineering. The direct impact of the family was declared by "Jessica", who stated: "[...] my sister actually, graduated from the physical gravitation department, but she directed me: 'You can choose engineering, because the job opportunities are higher in engineering.'" And "Nicole" added: "My mother told me that it is a hard chance to find a job with a higher salary and like [sic] to stay at the job for long years, I think that was the main reason."

A father's passion for real problem solving within the family was another direct effect on "Laura's" choice. She recalled:

[My father] is always focused on the mechanics that I don't like too much. Maybe the thing that he really likes is to solve the problems and understand how the things work. I think it was important for me, because yeah, I like it too.

"Helen's" statement showed the indirect influence of her relatives' professional roles: "I have a cousin; she is studying chemical engineering; it is so great [...]. We are really close to each other. Our discussions, sometimes, inspired me."

A family's educational expectations also influenced the students' learning and career choices because their families respected their children's choices even if they did not match their parents' desires:

My parents are not so strict, so I choose everything by myself [...]; my mother said, 'you have to be successful, in whichever way you want'. [...] [P]robably the freedom of the choice was the best thing for me. (Helen)

The students' family-modelling, their references to their relatives' engineering professions, impacted the students' choices indirectly because of their constant exposure to particular environments and discourse, which was a strong inspiration for them. Most of the students have had at least one engineer in their family: a brother, an aunt and an uncle, a cousin, a grandfather or a parent. The following quotes are evidence of how family-modelling has impacted the students' lives:

[...] [M]y mother is a doctor, but her brother, her sister and her father are engineers.

I talked about my choice with my aunt, and she said: 'If you do engineering, it's a bit more practical and you can realize projects.' I chose it in the end. (Sally)

[...] [M]y parents support me a lot [...]. I always see [my father] like running from one side to another, resolving things and fixing things, and I like to have this challenge of resolving things or problems. [...] When I was 16, I started a 'safety engineering course' during the night [...] and when I finished it, I worked a bit with my father. (Sofie)

One student, "Sally", expressed satisfaction at being able to continue the family-model, "to have something in common with other family members". This statement indicates identification with the family-model identity and culture.

Significant Learning Experiences

Learning Experiences in High School. Apart from familial support and models, the students' learning experiences also affected their career choices. Different factors were mentioned as characteristics of their learning experiences:

- the type of high school and school curriculum,
- the relationships with teachers or peers, and
- the bachelors' degree experience.

The participants chose different high schools but most with a scientific curriculum. Specifically, some of them said:

[...] [I]n high school actually, I went to [...] a school for talented students, so I got an exam for entrance [sic] to this school for both middle and high school. And we lived in this school. So, we studied there, where we had dormitories. [The school] from the scientific point of view was so good. (Helen)

I attended the 'Marie Curie scientific lyceum', because already from middle and elementary school, I preferred to do science subjects such as computer science, physics, mathematics. [...] I had the most important results in these subjects. (Sally)

One of the students had an internship at an architectural firm as part of her high school curriculum, which was an opportunity for her to realize she wouldn't like to be an architect. It was an occasion for her to have a significant conversation with a professional at that firm who helped her to examine her real passion, discovering her interest in engineering. This is evidence of how experiential learning can support people in the exploration of their vocational behaviour and preferences.

The participants' learning experiences were also influenced by the perception of unfair assessment that caused one student to lose interest in the humanities or by the demands of the teacher of History and Philosophy:

During an oral Philosophy test, even if I had answered well, I had the same grade as someone else who instead didn't answer. I didn't like it anymore. [...]. I consider subject [sic] such as Italian, History related to content that you need to learn just by heart, without understanding them. (Sally)

I feel still anxious about some school subjects, above all Philosophy. I don't know, I can't understand it. Probably because the teacher of high school taught at university and she wanted us to learn as university students. (Lisa)

The role of the teacher as part of the students' learning experiences was also highlighted by "Helen", who stressed the importance of teaching ability. The instructor needs to engage students in activities and promote their positive feelings about the subject. The following quote explains her feelings and how good teaching practice can support teacher-student relationships:

I remember some teachers that I really liked, their way to teach us. For example, one of them was so strict, but his way to teach [sic] was so interesting, for example, about Physics. It was so practical, and my mind was so involved... wow! It was so interesting for me [sic]. He played a so strong [sic] influence on me. (Helen)

Two other students recognised that they have always had an interest in scientific subjects, while another student identified the teacher of mathematics as her model because "she was really straight in what she was saying and had a good way of explaining things" (Vanessa).

Peer relationships as the opportunity to share the same interests with peers or the trust that peers showed in one's abilities reinforce personal goals. In fact, the participants said:

[...] [T]wo of my closest friends from my high school and actually all of them are engineers. (Helen)

While I attended high school, I gained high marks, and in general my classmates relied on me. They asked me to provide them with some explanations on scientific subjects. (Anna)

Learning Experiences at University. Additionally, for some students the bachelor's course was significant in their learning career choices; in fact, they persisted along the same path instead of leaving the engineering field thanks to the quality of the course, the encouragement of the teachers, the teaching methods, and the final impact of engineering knowledge on real contexts. These exemplary quotes describe some reasons for student retention:

I believe that my bachelor's course in engineering promoted the development of critical thinking, and it can't be taken for granted. Engineering will allow me to solve problems. [...] The term 'engineer' is like a 'genius'. (Anna)

During my bachelor I really liked topics about wastewater treatment in developing countries, [...] I really like it, because I want to improve something of the environmental situation of the world. (Vanessa)

[During the bachelor's course] I learned a learning method. [...] And I experienced a learning environment where I'm assessed for the results that I obtained. (Sally)

In contrast, Helen's statement explains the impact that a negative teaching approach can have on retention: "I choose [sic] the agriculture water engineering [Bachelor]. But the teacher, for example, was a hole in the ground, and all the students choose [sic] to change the way [their course], even boys, but me, I said, can I jump? No...".

These comments highlight the distinctive importance of the students' learning experiences. The participants named some relevant reasons they persevered in the course, including the opportunity to develop important abilities (critical thinking), the link between the curriculum and personal goals (improvement of real situations), and the feeling of being in a learning environment where a fair assessment can give students due recognition.

Society Culture

While the patriarchal culture of the society of some of the participants was not mentioned as an explicit determinant of their own choices, it was indirectly presented as a determinant for women's careers in general. The following statements offered a clear picture of the different cultures of the students' countries of origin:

[...] [I]n Turkey, generally, if your father told you that, 'no, you will not leave this city, you will study in the same city as me', most of the students accept this. They have to accept this one. But when I told my father, 'I will go to another country and I will study engineering', he said, 'OK'. (Nicole)

[...] I think that a lot of times women are expected to be smarter or more ambitious in their educational level during high school. (Vanessa)

My parents are both engineers and they didn't face any problems. My mom didn't face any problems. It depends if you want to have a real good job, if you have connections. (Mary)

[...] [We] are in a religious country so we all have to wear a hijab from 7 years old, so if you ask about the discrimination, I can say just a little bit about that. For example, you can't play volleyball, football, something like this, because you have to wear a hijab; women don't have to do that. But personally, I don't care about these things, and also my parents don't care so. I always play football with my neighbour's children, and my brothers support me. (Helen)

From my high school class, I think only me and one other girl decided to go into engineering. I think it depends more on the society, because some people still consider women to be successfully married than to build a career [sic]. [...] But it's not like if you want to build a career, nobody is going to stop you. (Mary)

Participants highlighted different societal cultures: “masculinity-normed”, where the father is the one who makes decisions; “male-modelling”, where women are expected to be “smarter” if they want to be as successful as men; “success-oriented” with a prestigious profession recognised as a “good job”; “religion-normed”, where the difference between men and women is part of everyday life. This aspect was explained well by “Helen” when she said:

[...] [Y]ou know our government and religion, I can say that they prefer women to stay at home. They say that, for example, engineering, it's not so... I mean, related to girls, no. Probably, if you choose something like art, something like teaching, it's more acceptable. [...] My story is a little bit complicated. In my country if you are 32 years old you have to be married. For example, if you are at university, everybody around you can say, ‘Why are you not married? Where is your husband?’ (Helen)

She also experienced this cultural and religious impact at a school where the rules were too strict:

[I attended] a good school [...], but from the gender point of view, or the religious one, not so good, it was so strict, like in all parts of the country; you have to wear hijab. They check us every day, for example, if you have make-up, if your nails are long, that stuff, so that was so awful, but in any case, I liked living with so many of my peers. (Helen)

Even if all of the gender and cultural dimensions mentioned above did not affect this group of women students so much, some participants highlighted the fact that in their country women students generally choose to pursue academic studies in education, economics, law, or medicine, or if they do choose engineering fields, they generally avoid civil or mechanical engineering, as they did:

Generally, women don't choose civil engineering or mechanical engineering, because mechanical things are dirty, or civil engineering as you know is hard for women, so they don't choose this engineering generally. [...] We can choose environmental engineering, or chemical engineering. (Nicole)

This statement showed that even the most emancipated families cannot be protected from the influence of a society's culture.

Internal and External Recognition

Internal Recognition

The students' internal recognition emerged from those variables that helped us to identify both their intrinsic interest for the engineering field, and the self-awareness of their abilities and talent, as the following statements show:

The engineering is part of me. I can't imagine myself as anything else. I really need to be in an engineering world. But there is no chance, there wasn't any chance in Iran so. [...] I can't imagine life without engineering. (Helen)

I've always been fascinated, not just by being an engineer, let's say as a profession, but by doing a job that somehow makes you make decisions, makes you carry out projects. (Lisa)

Their internal recognition is also linked to their beliefs of belonging to "talented and determined people" or having the ability to attend "scientific high school", as some students stated:

Actually I choose this engineering because of my exam results. They were good and I just choose engineering because it was in the Middle East Technical, a famous university. (Nicole).

I have always been really good at science subjects. [...] When I enrolled in university, I chose STEM fields straight away. (Sally)

I attended a school for talented students, so I had a hard entrance exam to that school. (Helen).

[Engineering] is a kind of job where I can make decisions and have a lot of satisfaction [...] I want to solve problems and go beyond the things... I want to be an engineer who reaches the highest level of [their] own competences. (Lisa)

The following statements show that the participants believe in being able to make choices related to their engineering learning paths and to persist on this path after their bachelor's degree:

Yes, during my bachelor I really liked topics about wastewater treatment in developing countries. And yes, it's something that I really like, because I want to improve something of the environmental situation of the world. (Laura)

When I completed the bachelor's degree, I was exhausted, and I wasn't sure [I was going] to continue [...] Then, I thought that it was better to continue and now I'm really happy, because I couldn't have done anything else. (Anna)

Being one of the few women attending Mechanical Engineering supported my motivation to continue along the same path. (Nicole)

The students' choice was also impacted by their belief in pursuing an altruistic career, giving back and having a positive impact on society and the environment. These quotes explain the meaning of their beliefs about being an engineer:

I think being an engineer means to be able to solve technical and mathematical problems, in order to improve systems [...] Protecting the environment had always been a big subject for me. (Vanessa)

I really like nature. I want to improve the environmental situation: it is my objective. So [...] I decided to do engineering, because I said OK, it can change the situation more in respect to the other [disciplines], because I really understand how to design, how to plan, how to understand better the problem. (Laura)

I think engineering, because I can create, study and develop things for having a better place on earth. (Sofie)

[As an engineer] I can do something a little bit useful for the world. [...] I have lots of cousins, and there are some girls in there, if they watch [sic] that Helen does some engineering stuff, has a good job, and has a good opportunity to improve their world situation, so they can imagine themselves in that position too. (Helen)

All these comments show that the students recognise themselves as “science people”, reflecting a significant sense of self-efficacy (Papafilippou & Bentley, 2017).

External Recognition

In this study external recognition, being recognised as a science person by others, is situated on a continuum with internal recognition. In fact, while students recognised their own abilities, the contextual factors such as parents, teachers, peers, relatives, positive results in scientific subjects, gave them positive feedback, encouragement, freedom in making choices, and support for starting and continuing on their engineering learning paths. This empowering “attitude” of their contextual components gave them an external recognition of their abilities, knowledge and performance related to their learning experiences in engineering fields. This contextual behaviour sent the students the message that they can belong to a STEM field and that they can be “science people”. Consequently, as in a virtuous circle, external recognition affected the students' self-efficacy and the internal recognition of their scientific career interest.

External recognition can also be identified in the outcome expectations that the students highlighted during the interviews as further determinants for becoming engineers. They are connected to different elements such as social recognition, and the possibility of becoming a problem-solver of environmental and systemic issues, a decision maker, or a manager of local or foreign companies becomes a career possibility. These example statements illustrate the students' outcome expectations and external recognition in a variety of ways:

[Being an engineer for] Being respected, and they are more active in Turkey, I mean not like teachers: if you are a teacher you have lots of holiday, and your work is not so hard. In engineering you have to study and improve yourself always. (Nicole)

I think I don't want to have a job without an actual purpose. I think I want to have a job where I have the feeling that I am doing something [...] that actually has a positive impact on the whole world. (Vanessa)

[I imagine myself as] a manager of a company that focuses on the solid waste management. [...] [W]e need to improve this in Brazil, so I think I have this opportunity to be here and learn, so when I go back to Brazil I can work on it. (Sofie)

Beside the social recognition and their active role in society, they didn't omit their desire to achieve a satisfying and rewarding job; for example, the students stated:

I hope that I have a job that I really like. That still gives me the opportunity to learn more, during working, and not being stuck in the same system of working every day. (Vanessa)

I like being [an] engineer because there is the possibility to experience the balance between the economic aspect and the effort required by the job. (Lisa)

[...] I am still thinking that engineering is a really good career opportunity. [To study Economics] it's risky because small business is not so very stable. (Mary)

These comments enhance the understanding of their choices: they are connected to social recognition, to creating solutions for real issues, but also to personal satisfaction. The statements also illuminate the students' self-efficacy and career interest.

DISCUSSION

The purpose of this study was to understand what factors influenced the international and domestic students' decisions to pursue engineering. This study addressed the following research questions: (i) *What is the impact of personal and contextual factors on career interests of women across multiple cultures?* (ii) *How are internal and external recognition of women students related to engineering career decision making?*

Consistent with previous research (e.g., Lent et al., 1994), the study showed that personal and contextual factors play an important role in determining the career interests of women, and together with other variables, such as learning experiences (activities, curriculum, peer/teacher-relationship; extracurricular experiences) and family/society's culture cultivate the women's interest in engineering (Marra et al., 2009). More importantly, the study's findings point to the important role that self-efficacy, nurtured by internal and external recognition, plays in influencing women's engineering career choice.

Compared to other studies focused on women's careers (e.g., Carlone & Johnson, 2007; Jackson & Bridgstock, 2019), the originality of this study is related to the possibility of highlighting the same effects of internal and external recognition on the students' career choices among students who belong to different cultures. Indeed, the richness of the interviews and the commonalities of variables with their effects on the international students' career decision making, gave the researchers the possibility to obtain data saturation.

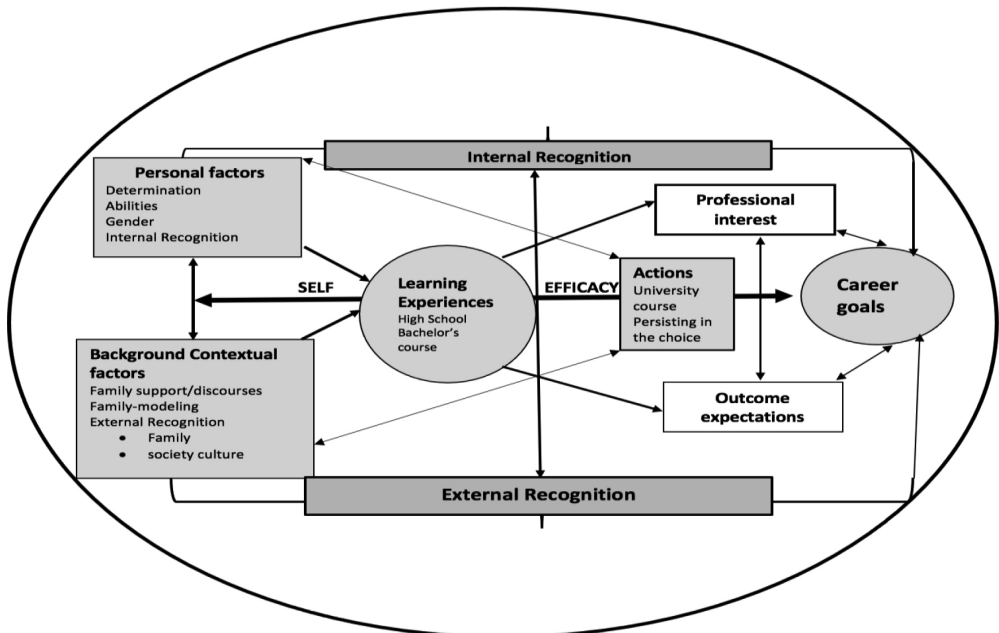
In particular, the findings allowed us to focus on the following aspects: 1) the interplay of personal and contextual determinants that acted as different components of a single system, the career decision-making process; 2) how participants make their career choice; 3) the role of self-efficacy; 4) the role of gender and the impact of culture.

The Multifaceted Career Decision-Making Process

The findings allowed us to identify the multifaceted character of career decision making (Figure 1).

Figure 1

The multifaceted career decision-making process



Note. Authors' own.

The figure shows a continuous relationship between self-efficacy and internal and external recognition as determinants of women students' career choice process. Self-efficacy is the key factor of the participants' career decisions, but it has been determined by a

well-functioning process made up of different, intertwined, internal and external components. Personal (abilities, commitment, determination), and contextual factors (family support, modelling, and culture), have nurtured their self-efficacy since the early stages of the participants' lives through informal (family, peers) and formal learning experiences (high school and bachelors' degree), which supported the reinforcement of their interest in the engineering field and their outcome expectations, also through a continuous internal and the external recognition process. This developmental process has facilitated their further choices supporting their persistence in the same field of study, and their career goals as well. Therefore, in connection with the theoretical framework of this study (Lent et al., 1994), for the group of undergraduate women, self-efficacy is a key determinant that has been developed and will probably continue to increase along a continuum, thanks to their strong family and cultural heritage and support, their learning experiences, and their outcome expectations (respected profession, permanent job, world/environment's problem solver, company management); their internal (awareness of their own abilities, talent, determination) and external (familial, school, peer, teacher, social) recognition, and their environments (family, high schools, university contexts). These factors helped them to connect their career identity development to engineering fields.

How the Participants Make their Career Choices

The participants' career choices have been determined not only by their personal abilities, but above all by the experiences that they have lived in their families, with their peers, during high school and bachelors' courses, receiving positive feedback and encouragement. Through the experiences, they have tested their abilities, received external recognition, reinforced their internal recognition (sense of self and self-efficacy), and received affirmation regarding their career goals, leading to persistence (Lee et al., 2015). The participants' outcome expectations (prestigious position, respect, social recognition), and professional interests (being a real problem-solver) display their desire to give back and contribute to society, which in turn drives learning.

The Role of Self-Efficacy

The students' self-efficacy appears as the engine of their career-interest and decision-making development. However, self-efficacy needs to be nurtured by recognition. The participants experience a double nature of recognition: 1) individual, when they recognised their own personal abilities and themselves as talented people; and 2) social, when they received recognition from their peers, teachers, parents, society. Individual and social recognition have fed the students' self-efficacy, increasing their capabilities perception for learning or performing actions and activities at expected levels, affecting their career identity and interest (Lent et al., 2008).

The Role of Gender and The Impact of Culture

The participants often connected gender to their native cultures to explain perceptions of women's career opportunities or limitations in their countries, citing dominant

cultural characteristics as “male-normed”, “male-modelling”, “stigmatized professions”, “religion-normed”, “success-oriented”. Despite some cultural barriers, the participants chose to move to a foreign country for learning and realizing their career choices, even sometimes challenging their native masculine or religious cultures. Emancipatory family cultures propelled these women to exercise educational and career freedom of choice counter to their home cultures and societal pressures. These results echo Eccles’ (2014) theory, according to which parents influence children through their advice, materials, and the exposure to a variety of experiences.

This group of women had the advantage of their family contexts, but in their narratives hide traditional cultural views relating to STEM fields. There is a well-known cultural model according to which STEM fields are too “hard” for women. In fact, the students highlighted the importance of having talent and engineering abilities, indirectly reinforcing their beliefs about the difficult nature of this discipline (Haswell, 2019).

Implications

The findings suggest relevant practical implications for educational policy makers and educational professionals in schools and higher education. Schools and communities should provide young women with exposure to scientific experiences, discourses, models, and to other women excelling in engineering and STEM careers. Gender-role socialisation should be a further initiative. Gender roles are the behaviours and attitudes that in general are encouraged and supported on the basis of the students’ gender. This phenomenon generates negative stereotypes and women leave the STEM pipeline before entering STEM professions (Tino et al., 2018, 2021), with a strong impact on their career.

The impact of learning experiences on career choices underline some implications for high school teachers and faculty: their teaching influences women’s choices and career identities. Learning environments based on peer support and positive feedback help socialise learners for careers. The exposure to real experiences, to role models in the engineering field, and teaching methods based on the management of diversity can generate an open culture of learning.

We also recommend a systematic collaboration among high school, higher education, and professional engineering contexts, to create continuous and effective action.

Limitations

Two limitations of the study can be stressed. First, the sample study was too small and may not be representative of the factors influencing all women students in engineering. Second, we interviewed a small number of participants from one institution who did not represent the full range of engineering majors. No other studies were carried out with engineering students from different countries, so other longitudinal studies can be developed, and results compared with those of international women students in other STEM programs and different universities or countries.

CONCLUSIONS

We conclude that: a) women students' engineering interest is cultivated by different contextual factors in the same way across multiple cultures because they contribute to developing the students' self-beliefs and outcome expectations, keeping them on the engineering path; b) self-efficacy process development affects the students' engineering interest; c) self-efficacy is not a stand-alone factor, but is nurtured by internal (efficacy, self-beliefs) and external (by others) recognition; d) the students' engineering career decision making is the result of a well-functioning system determined by the interdependence of personal and contextual factors.

The combination of supportive factors creates favourable conditions for developing women's interest in the engineering field. The development of engineering career decision making is a multifaceted process that starts in the early stages of women's lives. The participants' career decision making has been defined by a well-functioning system characterised by formal and informal experiences that allowed them to discover how skilful and talented they are and that they can take part in "demanding" engineering fields, becoming problem-solvers and generating change in the world.

In conclusion, the study provides important food for thought for educational contexts and policy makers, who have the responsibility to design learning environments, and educational and organisational policies for supporting women in the career decision-making process, encouraging their interest and career goals in engineering.

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