Understanding the leaky pipeline system: behavioural ecological approach to the social marketing of women thriving in STEM careers

Hafize Çelik

*Department of Business Administration, Bilkent University,
Ankara, Turkey, and*

Forrest Watson

*Department of Business Administration, Middle East Technical University,
Ankara, Turkey*

Abstract

Purpose – This paper aims to explore the complexity of the “leaky pipeline” of women in science, technology, engineering and maths (STEM) in the intriguing contexts where there are a high number of STEM graduates but a low number of women working in these fields.

Design/methodology/approach – The authors conducted in-depth interviews with eight STEM “leavers” and eight “persisters” in Turkey to understand the multi-level influences on their career paths.

Findings – The behavioural ecological model is applied to enrich the understanding of women’s attrition from STEM. The authors found a complex system of actors, relationships and influences that impact the negotiations of women’s felt misfit/love of their STEM career and changing self-actualisation.

Practical implications – The authors highlight that social marketers should consider the complex influences on even the most individualistic-looking decisions to produce systemic change.

Originality/value – This paper deepens the use of the behavioural ecological model in the ways that the layers of motivator and demotivator influences interact with women’s internal negotiations of career choice. The paper integrates classic theories (self-actualisation (Maslow, 1943) and two-factor model (Herzberg *et al.*, 1959)) within systems social marketing.

Keywords Gender equality, Leaky pipeline, Macro-social marketing, Systems social marketing, Behavioural ecological model, Women in STEM

Paper type Research paper

Introduction

The persistent dearth of women in the science, technology, engineering and maths (STEM) workforce has been considered a global problem for years (UNESCO Institute for Statistics, 2019). To illustrate the consequences of this problem, a UK example shows that 9 out of 10 STEM businesses are struggling to find skilled STEM staff and the lack of a qualified STEM workforce costs the UK £1.5bn a year (PCP, 2018). The underrepresentation of women in the field is especially problematic considering the high need for a qualified STEM workforce in the

coming decades (UNESCO Institute for Statistics, 2019; PCP, 2018). Only an average of 29% of researchers in the world are women (UNESCO Institute for Statistics, 2019).

Friedmann (2018) identifies four stages in the span of a career in STEM: choosing, applying, accepting and thriving. The typical assumption about the discrepancy between men and women is that too few women are choosing STEM. Accordingly, many governmental and institutional initiatives aim to empower and engage women to pursue STEM careers globally by implementing social marketing programmes starting from childhood to teenage years (e.g. *She can STEM, My skills My life, Make What's Next, Crack the CODE and Light a Spark*).

In the academic literature, the root of this wicked problem is also generally traced to the choosing phase starting from primary school kids to high school students. Some studies reveal barriers for young girls to pursue STEM such as the occupations being considered less feminine by eighth graders (Cho *et al.*, 2009), stereotype threat influencing attitudes towards mathematics (Shapiro and Williams, 2012) or perceived mismatch of STEM and communal goals (Diekmann *et al.*, 2010). Also, in the applying phase, which covers the university years, low self-confidence in academic ability (Sax, 2008) or a chilly climate of exclusion in faculty (Meinholdt and Murray, 1999; Vogt *et al.*, 2007) are barriers. More recent social marketing literature has revealed salary and compatibility of work and family life as determinants of women's career choices (Friedmann, 2018) and suggested the co-design of retention programmes at university to increase self-efficacy in STEM (Roemer *et al.*, 2020).

However, the underrepresentation of women in the STEM field is about more than just women not choosing a STEM degree and rather about the brevity of the lifespan of their STEM careers. The pattern of women leaving STEM careers is a phenomenon metaphorically called a “leaky pipeline” (Blickenstaff, 2005). Many women who make it through the first two stages do not make it through the acceptance and thriving stages. Women are more likely to leave their STEM careers than their male peers (38% to 26%) (Frank, 2019). For example, nearly half of female engineers in the US leave their career path after graduating (Fouad *et al.*, 2016). Diversity in the STEM workforce necessitates attention to all phases and not just interventions at the educational levels (Blackburn, 2017).

While the low representation of women in STEM is a global phenomenon, Turkey is one intriguing case where the leaky pipeline seems a clearer issue than too small a flow of women into STEM. UNDP (2019) Human Development Report reveals 34.7% of STEM graduates in Turkey are female, which is slightly *higher* than the averages in OECD countries (32.6%) and Europe and Central Asia (32.2%). However, women in Turkey are much *less* likely to work in related fields, with the science and technology workforce only 19.3% female, compared to 35.4% in the EU (Eurostat, 2020). The leaky pipeline effect in Turkey shows that while Turkey has relatively higher numbers of STEM graduates compared to the European average, gender diversity in the STEM workforce is not sustained.

In this research, we apply the behavioural ecological approach and model to the wicked problem of the leaky pipeline of women in STEM within the scope of acceptance and thriving levels, which cover the time phase after graduation. We add depth and nuance through in-depth interviews with several leavers and persisters in STEM to explore how the women themselves are influenced by the interplay with actors at multiple levels. Our research aims to provide a rich analysis of how outcomes are influenced by multiple layers in an ecosystem. We demonstrate that the behavioural ecological approach benefits from qualitative rigour in charting the elements of the ecosystem and identifying how they work interdependently, as Brennan *et al.* (2016) advocate.

The aim of this study is to explore the complexity of the leaky pipeline of women in STEM in the intriguing contexts where there are a high number of STEM graduates but a low number of women working in these fields and suggest a social marketing approach to sustain gender diversity in STEM. In the next section, we review the systemic social

Social marketing and leaky pipeline in science, technology, engineering and maths: Need for a systemic behavioural change

Social marketing aims to analyse, plan, execute and evaluate programmes to influence behavioural change of a targeted audience with the ultimate goal of improving personal or societal welfare (Andreasen, 1994). As the social marketing domain develops, more researchers stress the importance of systems social marketing (Truong *et al.*, 2019; Flaherty *et al.*, 2020) to understand the structural and behavioural dynamics at play in creating social change. This systems focus includes ecological frameworks, relational paradigms, a macro lens on the problem and sustainability of the behavioural change (Brennan *et al.*, 2016; Domegan *et al.*, 2016). Systems thinking that considers the dynamics of all elements of a social marketing system (Flaherty *et al.*, 2020) in general and the behavioural ecological model (Brennan *et al.*, 2016) in particular provide the overall theoretical framework for this research.

Brennan *et al.* (2016) propose a behavioural ecological approach to social marketing. “Individual behaviours are embedded in an ecological system where human beings perform their behaviours within a historical, social, cultural, physical and environment setting” (Brennan *et al.*, 2016, p. 225). The behavioural ecological approach derives from the principles of biological or environmental systems, in which everything is seen as interrelated within the complex system. This study adopts the systems thinking that behaviours are contingent on the interplay between the actors, their influences, interactions and reactions and the co-creation of outcomes.

Brennan *et al.* (2016) criticise individualistic models of change for constraining the impact of interventions and state that viewing target audiences too narrowly cause marketing myopia. Determinants of human behaviour, which are shaped by the institutions within a social system, should not be overlooked (Domegan *et al.*, 2014). Macro-social marketing uses comprehensive social marketing tools for systemic change, lifting social marketing from an individualistic behavioural change point of view (Kennedy, 2016). System-wide change amidst interconnected levels of society requires changes to institutional systems and cultural norms.

Individuals are strongly influenced by not only their micro-level internal motivations but also the multi-levelled systems in which they are placed (Wood, 2019). For long-term success, upstream social marketing accounts for policies and the environment in which individuals are positioned (Wood, 2019). Not only that but the different lifespan phases should be considered to achieve sustainable behaviour change (Andreasen, 2003). Many campaigns that target STEM women err in focussing on internal motivations in the choosing phase while ignoring the higher-level level influences on and later phases of a STEM career lifespan. Roemer *et al.* (2020) provide a good example of how motivating women to pursue STEM degrees is not enough to overcome the leaky pipeline and achieve gender diversity. We build on the same leaky pipeline framework but maintain that gender equality will require comprehensive efforts that address all levels of society and stages of women’s careers.

Theoretical background of women leaving science, technology, engineering and maths careers

Social role theory (SRT) and social cognitive career theory (SCCT) are two of the main theories in the existing literature used to explain the leaky pipeline in STEM. According to SRT, gender roles set descriptive schemas for one’s self-perception and a community’s perception of what men and women are supposed to do (Eagly, 1987). Family-oriented roles

are shown to be influential in women's withdrawal from STEM such as women who have children being more prone to leave science (Goulden and Mason, 2011). On the other hand, the SCCT (Lendt *et al.*, 1994) explains occupational migration and withdrawal, such as the leaky pipeline, on the basis of self-efficacy, outcome expectations and personal goals. Such concepts are related to the topic as withdrawn female engineers showed signs of low self-efficacy in their STEM career stories, contrasting with their persisters peers (Buse *et al.*, 2013). However, more structural and environmental influences, such as academic culture rather than gender-based differences and their social effects on the leaky pipeline of STEM highlight the importance of broader scope in a system (Xu, 2008) and thinking beyond social theories such as SRT and SCCT.

The first of two classic theories we also incorporate into a systems perspective of the leaky pipeline is Maslow's (1943, 1970) theory of hierarchy of needs and specifically self-actualisation. As this study deals with women's negotiation of career choice and persistence throughout career lifespan phases, we explore the role of self-actualisation within the leaky pipeline. The hierarchy of needs (Maslow, 1943, 1970) is a psychology-based motivation theory incorporating a five-level model of human needs, often presented as hierarchical levels within a pyramid. The top-level of this pyramid is "self-actualisation" and is defined as "becoming everything that one is capable of becoming" (Maslow, 1943, p. 382) or reaching one's true potential. Self-actualisation is an ongoing process of a series of choices that involves actualising one's potentials (Maslow, 1965). Maslow signals the relationship of one's job to self-actualisation as:

Even if all these [physiological, safety and social] needs are satisfied, we may still often (if not always) expect that a new discontent and restlessness will soon develop unless the individual is doing what he is fitted for. A musician must make music, an artist must paint, a poet must write if he is to be ultimately happy. What a man can be, he must be. This need we may call self-actualisation (1943, pp. 382–383).

The second classic theory used is the two-factor model (Herzberg *et al.*, 1959) (also known as the motivation-hygiene theory), which explores two independent sets of factors that lead to positive and negative job attitudes and job satisfaction. Motivation factors relate to satisfaction at work while hygiene factors are associated with dissatisfaction at work. Satisfaction is attained when motivation factors such as achievement, recognition and responsibility are increased. On the other hand, when hygiene factors such as company policy, physical working conditions and salary are addressed, they can take away dissatisfaction but will not bring about satisfaction. This theory is related to the link between self-actualisation and the leaky pipeline, as the systems approach brings into view the multi-layered motivators and demotivators that influence the self-actualisation and decisions to persist or leave STEM. We broaden our lens of internal negotiations to consider outer layers of influences in the system by leveraging a motivators-demotivators approach.

Cronin and Roger (1999) developed one of the first conceptual frameworks of what is more commonly referred to as the leaky pipeline, pointing out that the number of women is reduced at every stage of a "funnel". The authors suggest focussing on a "wide variety of reasons" and "funnel at every stage" to deal with the problem (Cronin and Roger, 1999, p. 644). A focussing on getting more individuals through the choosing and applying stages, an approach embraced by most of the current social marketing interventions, resembles trying to dump more water into a pipe, which has cracks that leak.

Our aim in this research is to explore the reasons for the leaky pipeline from a systems social marketing framework. We consider the under-researched acceptance and thriving phases in the career lifespan of STEM women. We consider the meso and macro-level

influences in the ecosystem in which women negotiate their self-actualisation and feelings of misfit and the resulting gender imbalance in STEM fields.

Methodology

With an aim of understanding the reasons behind the leaky pipeline phenomenon and experiences in the lifespan of STEM women, in-depth interviews were conducted with 16 women who either left STEM occupations – “leavers” – or are still working in STEM occupations – “persisters”. Purposeful sampling was used with importance given to the diversity in different branches of STEM and demographics. Snowball sampling was also used to access participants for the trust development advantage initiated by references and not cold contacts (Lynch, 2013).

The in-depth interview is an advantageous research tool to learn about important incidents in a person’s life (Belk *et al.*, 2013). The seven steps of interview investigation by Kvale (1996) have been followed, which are thematizing, designing, interviewing, transcribing, analysing, verifying and reporting. A protocol for the interview was created in the light of 11 preliminary interviews and the theoretical background of the topic. Based on the emerging themes, a framework of predetermined questions for both groups was prepared. Yet, criticality was sustained during and after each interview to detect the emergence of any non-predetermined themes. Following the grand tour about the background of the interviewee, the question sequence focussed on experiences with different actors during their careers. The STEM women’s career lifespans were investigated deeply to understand internal motivations and external influences throughout. Interviews were conducted in Turkish by the first author via online video calls due to the Covid-19 pandemic and voice recorded. The first author transcribed the recorded interviews verbatim and then translated the quotes to English.

Data analysis by both authors started after textually transcribing the interviews. Preliminary interviews revealed that answers about the changes in career lifespans had a pattern of storytelling with different actors and conflicts involved. As one of the theoretical premises of the study divides the lifespan of a STEM woman in phases (Friedmann, 2018), narrative analysis matches with the data collection method. Narrative analysis deliberately focusses on points of transformation, plot line, characters, action and a point of resistance and it links the past and the present (Lawler, 2002). We coded all the transcripts accordingly and revealed the patterns and differences between leavers and persisters. We also identified the different actors and layers of influences present in the narratives of the women. Both overt and latent coding was conducted to be able to report visible and semantic relationships.

Findings

The 16 female participants who were “leavers” or “persisters” in STEM careers ranged from 26 to 55 years of age. Educational background varied among participants with bachelor’s degree, master’s degree and ongoing PhD degree. STEM occupations of the women also varied as they involved engineers from different branches, medical staff and science practitioners. Respondents differed with regard to marital status and having kids. Duration of the interviews ranged from 55 to 120 min.

Our emerging model in Figure 1 depicts a summary of our findings on the complex reasons for the leaky pipeline of women in STEM. We introduce the model here to orient the reader towards the direction of the findings.

Developing the metaphor of the leaky pipeline (Blickenstaff, 2005), we depict how the number of women in STEM decreases at each stage (Friedmann, 2018; Cronin and Roger, 1999). The dotted boxes indicate how the micro-level negotiations are taking place within the

Leaky pipeline system

621

Figure 1.
The leaky pipeline model

meso-macro ecology. Within the pipeline are two mixing currents, “Ongoing negotiation of Misfit/Love” and “Changes in Self-Actualisation”. Our findings will detail how these currents are influenced by actors in the system around the individual. Through our data analysis, we identified three demotivators (depicted here as nails, which puncture the pipeline and make it leak more) and two motivators (shown as patches) which are external influences on the women.

The remainder of the findings section will be based on the three overall themes that we identified through our data analysis influence the leaky pipeline: behavioural ecology system around the female STEM workforce, strong influences of ecological actors as demotivators and motivators and ongoing negotiations of misfit/love in STEM and self-actualisation changes in STEM women’s career lifespans.

Behavioural ecology system around the female science, technology, engineering and maths workforce

The influence of multi-levelled actors on women’s STEM careers was one of the first findings. We observed how each individual is positioned in the ecology of different actors, relations and power dynamics that influence their behavioural preferences, decisions and actions. The actors in [Figure 2](#) were identified as influential people or stakeholders in their careers, starting from early childhood to their current lives.

Strong influences of ecological actors as demotivators and motivators

Throughout the data analysis, we explored the multi-faceted and multi-layered influences on the behaviour of persisting in or leaving STEM careers. The directions of influences were coded and analysed throughout the transcripts. Due to space limitations, for most of the themes, we will only provide one representative example from the interviews.

The negative influences by several actors in the acceptance and thriving phases of STEM women have been observed and thematised as “demotivators” accordingly to their frequency in the transcripts. These are harsh working conditions, “Bro” culture and “Woman is wolf to woman” and underappreciation. These influences are observed as reasons that discourage women and even lead them to leave STEM.

Figure 2.
The behavioural
ecology around
STEM women

Harsh working conditions. Both leavers and persisters commonly talked briefly about the harsh working conditions of STEM occupations. Yet, the analysis revealed that leavers talked about more extreme negative workplace experiences and harsh working conditions throughout their careers.

Rachel is a 40-year-old STEM leaver who used to work as a chemist in private laboratories that conducts food safety tests. Today she is planning to open up an art atelier. She stated that she left her STEM occupation because of long working hours and stress even though she used to love being a chemist. When we asked about what the major influence was for leaving her job permanently, she answered:

It is definitely about the working conditions [...] I did not see the sun for almost 2 months. I am not exaggerating; I never ever saw the sun for 2 months. I was leaving home in the morning before the sun came up and then I was coming home mostly after 10 pm. We had this working style, this boss who can be defined as mentally ill. For instance, we were not using chairs while working, we were standing in front of the computer [...] We were being monitored all day through cameras, then they started recording our voice as well. When we had a couple of chairs in the office, the phone rang and they were saying “there are too many chairs!” for us to move faster. (Rachel)

Like Rachel, most responses of the STEM leaver group had a focus on harsh working conditions including long working hours, the stress of precision-demanding tasks and the workplace being far from the city. Although persisters also shared about the challenges of their STEM jobs, they did not present such extreme negative working conditions.

“Bro” culture and “woman is wolf to woman”. Although harsh working conditions were commonly mentioned as a demotivator in STEM careers of women, we adopted a critical perspective of this being a decisive factor because working conditions are likely to equally exist for both genders. The data analysis revealed a more gender-specific demotivator related to workplace culture: “Bro” culture and “Woman is wolf to woman”.

“Bro” (From “Abi” in Turkish, which means older brother) culture is frequently mentioned by leavers and persisters as men in STEM having a dialogue of brotherhood and supporting each other from the university years through work life. Several participants

shared that men being in the majority in STEM and being supportive to each other made STEM women feel excluded or alienated.

Marie, 30, is a mechanical engineer who loves her job and wishes to persist in STEM. She reports an overall satisfying experience in STEM. Although she is a persister, she shares her frustration related to Bro culture and how this could become a reason to leave STEM:

Actually, our male friends were more protective and supportive in their inner circle [In applying phase] [...] Eventually [now in the thriving phase of their careers], male employees can go on a cigarette break and talk like “Let’s do that, bro!”. I do not like the word “bro” at all, this is another thing. Because when it comes to us, female employees, it does not work out the same way, you cannot call him “bro”, that conversation will continue in that mode [...] Communication can be disjointed at some points. (Marie)

The women in our research reported that the collaborative and closed community of men in STEM that seems to help their careers progress smoothly makes the women feel excluded and demotivates their continuation in the field.

Another common experience that STEM women in general and leavers in particular faced is the competitiveness that evolves to hostility among STEM women peers in work life. Multiple participants used the phrase “Woman is wolf to woman”, derived from [Hobbes’ \(1651\)](#) phrase of “Man is a wolf to man”, which describes the instinctively cruel animal nature of humans towards each other with regard to self-defence. Several women described this competitiveness and even cruelty for other women in the workplace as a demotivator strong enough to leave STEM occupations.

Grace, 34, is a yoga teacher who was formerly a biologist. While pursuing a master’s degree in genetic studies, conflicts with her female thesis advisor demotivated her. Eventually, she “scurried away from the laboratory” with her own words. She believes that those conflicts were fostered by other female team members in the laboratory. “Some people say, ‘A woman is a wolf to another.’ For example, in that laboratory, there was a group of women who were playing our professor against us. After years passed, I realised this situation [...] They were seeing us as their competitors”. Grace perceives that women are harsher to each other and says she does not see the same type of cruelty among male co-workers.

The “Woman is a wolf to woman” experience on top of the “Bro” culture is one of the strong demotivators identified in the analysis of the interviews.

Underappreciation. Another demotivator for STEM women is underappreciation in the workplace and home. When we ask Bella, a persister industrial engineer, if she has any regrets for her career lifespan, she shared, “You devote yourself to your job, you renounce a lot of things by investing in it. But how much value are you given or felt?” Another persister, Olivia, provides an additional layer related to underappreciation in the home. She feels underappreciated for her sacrifices after becoming a mother while still persisting successfully in a STEM occupation:

I do not get any support on this topic, neither from my family nor my husband. What I mean by support is mostly being appreciated, I mean out loud [...] Because it is really a hard thing to do [...] We have to be working, managing household chores, taking care of children and supporting them both psychologically and physically at the same time. (Olivia)

It was revealed in our interviews that STEM women are demotivated when they do not feel appreciated for their effort at work and at home.

Besides demotivators mentioned above, the positive influences that encourage and support women to persist in their STEM careers are thematised as “motivators” which are,

namely, household support systems and gender equality policies and culture in the workplace.

Household support system. In persisters' responses, one very common aspect was how they link their persistency in STEM occupations with having a support system for household responsibilities, mainly for childcare. Fiona, 36, is a mother of two children and has a dual degree in meteorological engineering and aerospace engineering. After hiring a nanny, she is grateful for the opportunity to pursue the PhD degree she had previously left. Bella, who is a persister industrial engineer with two children, relates the importance of support:

If there is no support at home and your family does not tolerate you [...] you have to give up your job. [...] Thanks to the support of my family, I can get things going on. But it is challenging to move things forward without this support [...] (Bella)

While both leavers and persisters very commonly highlighted their roles as mothers and wives, it was observed that STEM women who have stronger household support are prone to persist in their careers.

Gender equality policies or culture in the workplace. Another motivator for persisting is a work environment, which adopts gender equality policies or perspectives. Marie, 30, works in a well-known international corporation with a reputation for strong gender-equality policies. She describes working in such an environment:

One of the most significant factors that kept me here is this [gender equal culture]. Because you are aware of the fact that if you encounter something like this [gender discrimination], you are more or less aware of the consequences, what kind of precautions will be taken and how to move forward [...] This makes me more motivated and connected to my work more. (Marie)

Several participants voiced similar feelings that gender equality policies and workplace cultures were an inspirational influence for STEM careers. This situation seems to motivate them for progressing in STEM, as they feel comfortable, secure and confident.

Ongoing negotiations

Throughout the transcripts, it was observed that STEM women constantly construct and reconstruct their opinions upon two aspects: Misfit/Love in STEM and changes in self-actualisation descriptions. These are thematised as ongoing negotiations within the micro-macro influences of the ecosystem.

Misfit/love in science, technology, engineering and maths. One distinguishing factor in career lifespans was that leavers commonly mentioned they felt a misfit in their STEM occupations. When the demotivators added to a sense of misfit, women eventually left STEM. Leavers generally state that the feeling of misfit started from earlier years of choosing when several actors directed or motivated them to apply for STEM programmes. Looking back, many women feel that they were not fully informed about the content of STEM jobs. The feeling of misfit is transferred through phases with acceleration and aggregation until it becomes a major reason to leave and not return back to STEM.

Giselle is a former chemical engineer and, now in her 30s, is a translator and tutor in the UK. She dropped out of a STEM career after just a couple of months because of feeling misfit to the occupation. She explains her reason for choosing the original career path: "The only reason I became a chemical engineer is the way that the education system in Turkey works and the way the evaluation system works". During the acceptance phase, Giselle states, "At that time I always had hesitations about the job".

The responses of leavers like Giselle highlight the influence of meso and macro actors on the feeling of misfit for many women in STEM. They often choose STEM with the influence of educational policies, family members or teachers, without a passion for the occupation. This influence seems to cause a feeling of misfit and eventually become a reason to leave STEM.

In contrast to the leavers' feeling of misfit, persisters commonly mention love towards their jobs. Persisters explained an existent love for the field before they applied for a STEM major, which generally accelerated throughout their career lifespan.

Olivia is a naval engineer who is working on building ships. Olivia explained how she could persist in this career: "When I go to work, I never think 'Why am I going?' I love my job". Her main stated reason to persist is that she loves to be a naval engineer. Elsewhere in the interview, Olivia describes her occupational preference as a "personal decision" from the very beginning and that she has loved the challenges of the occupation.

Changes in self-actualisation descriptions. In the last part of the in-depth interviews, respondents were asked to recall their self-actualisation plans (best version, goals and aspired accomplishments in life) when they were about to start their career (acceptance phase right after graduation) and in their present-day. Respondents reflected on the experiential difference between both descriptions in self-actualisation in their different career phases. Table 1 provides a representative comparison of self-actualisation related responses for both groups.

The first significant empirical observation is that leavers and persisters had similar early self-actualisation descriptions. Earlier self-actualisation descriptions have the main focus on progressing through successful STEM careers.

Although their earlier self-actualisation descriptions were similar, in the current descriptions, leavers state drastically different descriptions for their perceived best versions and accomplishments in life. In contrast, persisters are typically either in the same self-actualisation path that they defined earlier or believe that they are still trying to reach their best versions. While persisters love, enjoy and feel fulfilment in their jobs and would be disappointed if they had to leave, leavers commonly had no intention to return to their STEM careers even if the negative conditions they mentioned changed.

Furthermore, perceived changes between earlier and latest self-actualisation descriptions revealed that this change occurs with strong influences from different actors as mentioned earlier (Figure 2 and Table 1). Some of the leavers prioritised happiness and a more spiritual understanding of success in their lives as a consequence of negative workplace experiences in their STEM careers. Both persisters and leavers frequently mention becoming more aware of higher household responsibilities and prioritisation of kids and marriage if they are married and/or with kids.

Although changes in self-actualisations for both groups are expected and found at the individual level to some extent, influences of interconnected levels of society (Brennan *et al.*, 2016; Kennedy, 2016) in which they are inhabited are clearly observable. Different layers of networks and actors are revealed as having influential roles in the changing self-actualisation descriptions of leavers and persisters. This finding is important with regard to the need for a systems approach for wicked problems. As self-actualisation's relationship to occupation was mentioned before, different actors influence changing self-actualisation, and therefore occupational decisions. Thus, when investigated comprehensively with a systems approach, the decision of leaving or persisting in one's occupation can be traced and linked to actors from different layers.

Table 1.
Representative
comparison of
(possibly) changing
self-actualisation for
STEM women

	Earlier SA*	Changing SA	Current SA	Reason to persist/leave
Fiona (<i>Persister</i>) 36 years-old Married 2 kids	"Before starting work, Fiona would become an academician. That is all. I can't say anything else. Fiona would be an academician"	"... back then Fiona was a woman who did not do laundry or wash dishes in her family's house and was not aware of these chores ... Current Fiona is aware that she is responsible for those chores and organizations, but life is not just about those. It is a part of life, but she knows that the science is out there and it is where she wants to reach"	"Yes, knowledge has no beginning or ending, it is infinite. When you go to that infinite source, your mode is that if you can go to a larger sea, why would I swim in the creek?"	"I love it (occupation). ... That is all, I don't know what I can say more, I just love it. One of the gaps I feel inside me is a hunger, my hunger for knowledge and the STEM field"
Aerospace Engineer *No intention to leave STEM	-Being an academician	-Aware of life-work balance	-Still being an academician	-Loves her job -Feels "hunger" for STEM
Briana (<i>Leaver</i>) 40 years-old Married 2 kids	"I started my first job, thinking that I would learn precious information and gain incredible experience. If I could do this by adding sociability and human relations to my work, it would have been a better version of me"	"... After learning and seeing certain things and seeing that these did not make me happy, I felt like I have actually chosen a slightly wrong profession. ... After I learned that I was going to be a mother had already suspended my profession"	"I don't want to do much about the computers. ... More than that, I want to have my own job, in the beauty industry. ... I am also happy with this version [of myself], too. So, I also liked being a mother. I also liked spending a lot of time with the kids"	"... The peer pressure is the exact word. I was already thinking 'Okay, is my relationship with here is over or not?' (due to harsh working conditions). And while I could not recover my working hours, the fact that such a thing happened also made my decision final. While I was looking for work, I learned that I was pregnant for the second time, so I decided to stay home with the child"
Former Computer Engineer/ Currently not working *No intention to return STEM	-Smooth progress in STEM -Practicing a social version of her occupation	-Unfulfilled with work experiences -Realised misfit in STEM -Prioritizing children	-Wants to have a start-up business in the beauty sector -Happy with motherhood as the best version	-Harsh working conditions -Conflicts with co-workers -Becoming a mother

Note: *SA: description of self-actualisation

Discussion

The empirical evidence of the depth and breadth of influences from different layers and actors on women in STEM supports the importance of the system of the wicked problem. Hence, if the problem is embedded in a system, the solution should also be at a system level. A systems social marketing approach (Truong *et al.*, 2019) and more specifically a behavioural ecological perspective (Brennan *et al.*, 2016), can enable sustainable success. By identifying and mapping the breadth and depth of influences on the individual women in STEM, we attempted to implement the first of Brennan *et al.*'s three steps for sustainable behavioural change from a systems approach (Figures 1 and 2).

Social marketing interventions for STEM should not overlook the behavioural ecology in which women are inhabited. Leavers or persisters should not be the only target group of a social marketing strategy for sustainable behavioural change; secondary and/or tertiary levels of influence in the system must be included. SRT, SCCT and Herzberg *et al.*'s two-factor model position the reasons for vocational migration at mostly the (meso) social (as in family, community, workplace, etc.) and (micro) individual levels. Although influences of meso and micro-level actors are partly supported, the findings of this study suggest that influences are spread more broadly in a multilevel context than these theories suggest (e.g. educational policies and the effect on inner negotiations of misfit/love STEM or being unable to find qualified childcare). Unlike Goulden and Mason's (2011) study with an SRT focus, our findings did not reveal any tendency to leave STEM careers after having kids. Getting married and having children was not a clear differentiator between leavers and persisters, which is aligned with Xu's (2008) study. Leavers first tried to return to their occupations after having children, but they stated that the experience of work-life after becoming a mother was different due to external factors. This is also supportive of Friedmann's (2018) finding of the importance of work and family life compatibility for STEM women.

Solutions must accordingly be shaped around the collaboration of the actors from different layers (breadth) and the degree of influence (depth) in the ecosystem (Brennan *et al.*, 2016). The depth in this sense is considered as the strong influences of actors as demotivators and motivators. Gender diversity can be facilitated by strengthening the presence of motivators and diminishing the demotivators throughout a woman's career lifespan (Herzberg *et al.*, 1959). The visualisation of this idea can be seen in the leaky pipeline figure of our study (Figure 1).

When the micro-level of influences, individual motivations, beliefs and attitudes are investigated, it was observed that inner negotiations of a misfit in STEM throughout one's career start with the influence of educational policies and family members. Both leavers and persisters did not mention any perceived low self-efficacy or low self-esteem in STEM, which are commonly studied micro-level influences (Sax, 2008; Buse *et al.*, 2013; Roemer *et al.*, 2020). However, inner negotiations of the misfit in STEM throughout one's career is found to be a micro-level influence, which is strongly influenced by educational policies and family members. This finding is parallel to an extent with the perceived mismatch of STEM communal goals (Diekmann *et al.*, 2010). However, the misfit shown in this study did not link clearly with communal goals but was rather shaped throughout the lifespan of STEM careers with the influence of motivators and demotivators.

Commonly, leavers blamed educational policies for directing them towards choosing STEM occupations. This finding reveals that the choosing and thriving phases are interlinked and the inner negotiations of misfit/love evolve from the very beginning of one's career journey. Thus, macro-level influences such as educational policies can end up influencing a leaving decision of an individual (micro element of the system) years later. Without clarification of fit, pushing young women towards STEM could be harmful to

society, which trains these young women who leave at a high rate, as well as for the women themselves who have to live through a misfit in occupational choice.

It was observed that self-actualisation descriptions are inner negotiated continually by the individuals as they grow and develop with time (as shown in [Table 1](#) and explained in the Findings section). More importantly, when investigated from a systems perspective, constant exposure to motivators and demotivators from different layers in one's behavioural ecology were shown to affect self-actualisation (a micro-level component). As mentioned earlier, Maslow's definition of self-actualisation puts the choices that individuals make at its core. However, the empirical findings of this study suggest a critical approach to the concept of "choices" as they are not made in a vacuum of an individual's inner negotiations but are made in interconnected levels of society ([Brennan *et al.*, 2016](#); [Kennedy, 2016](#)).

The findings related to changes in self-actualisation descriptions are not only supportive of the interconnectedness of influences but reveal a potentially more damaging puncture in the STEM pipeline. When leavers change their self-actualisation descriptions, under the influence of several demotivators, they do not intend to return to STEM in the future. This finding may differ from [Herzberg *et al.*'s \(1959\)](#) two-factor model because the handling of hygiene factors may not be enough to mitigate job dissatisfaction resulting from changing self-actualisation.

Considering the several empirical and theoretical studies of the existence of the leaky pipeline phenomenon ([Fouad *et al.*, 2016](#); [Blickenstaff, 2005](#); [Cronin and Roger, 1999](#)), we suggest that motivating women to pursue a STEM career is not enough to provide gender diversity in the STEM workforce. This study points out that STEM graduate women are adversely affected by many actors and influences even after they join the workforce.

Applying the behavioural ecological approach to women in science, technology, engineering and maths

The recommendations for improving gender equality in the STEM workforce come from our findings and an application of the behavioural ecological model. Following upstream social marketing views ([Wood, 2019](#); [Brennan *et al.*, 2016](#); [Kennedy, 2016](#)), we do not offer lower-level persuasion tactics such as 4Ps and singular target audience approach for social marketing interventions. Interventions should include strengthening the pipeline at all phases and a strategy for later years of acceptance and thriving phases as we found that changes in self-actualisation descriptions tend to limit women's likelihood to continue in STEM. Although the act of leave or persist is performed by an individual, the system this study reveals suggests that the target audience should be comprehensive of the ecosystem around the STEM women. Behaviour change can only come after regulating the interplays within the behavioural ecology around STEM women. We follow [Brennan *et al.*'s \(2016\)](#) three steps of mapping the influences (already demonstrated in [Figure 2](#)), the inclusion of at least two layers of influences in seeking solutions and initiation of sustained collaborations among included actors.

Our first major recommendation is the inclusion of both genders in a collaboration based on *resilience over marginalisation*. Resilience is defined as a product of the environment (instead of being an individual characteristic) where an individual learns how to cope with hardships ([Ungar, 2008](#)). [Wood \(2019\)](#) suggests that resilience should be at the core of any social marketing approach that has a systems perspective. [Roemer *et al.*'s \(2020\)](#) codesigned social marketing intervention at university supports the idea that inclusion of both genders reduces stigmatisation. The rationale behind such inclusion is linked to the highlighted problematic peer relations in workplaces as demotivators. As we revealed in our findings, the first hardship to overcome could be gender-related issues in the STEM workforce which function as demotivators: "Bro" culture and "Woman is wolf to woman". Inclusion of employees from both genders makes this change more possible. Acknowledging the existence

and results of such gender-based demotivators can be a good start to strengthen the ties of interpersonal relationships in the workforce and replace the gender-based resilience such as “Bro” culture with a broader resilience culture.

Therefore, we suggest the establishment of a community, chamber or formal organisation of all STEM fields by renowned STEM individuals with the main aim of diminishing the gender-based demotivating factors. A representative name such as “STEM Circle Community” can be considered for the organisation. Acknowledging the gender-based gap and conflicts in the workforce this study revealed, male STEM workforce can be trained about the effects of “Bro” culture on STEM women while the female STEM workforce could be influenced to build a strong resilience circle among each other and trained about the effects of high-level competition among same-gender peers in the organisation.

Our second major recommendation is to enhance the STEM Circle Community by including firms and governmental institutions. This can address the second major demotivator revealed in the findings – harsh working conditions for women in STEM. With a common goal to be achieved and a shared barrier to be overcome, it is possible to create a stronger resilience circle among the STEM workforce when every party is included. Monthly online seminars held by STEM Circle Community to lay out the situation of harsh working conditions from different branches in STEM can be organised for the entire STEM workforce. Reports of negative cases, such as a STEM woman leaving her occupation due to extreme work hours or intrusive surveillance, can be documented by the assigned members. Afterwards, the reports can be leveraged to set a dialogue between related governmental institutions and the resilient group who gained social power from unity. Inclusion of the firms and governmental institutions alongside the STEM workforce within the STEM Circle Community is crucial as these actors impact STEM women’s career decisions.

By such inclusion and collaboration, governmental clout can also be leveraged to overcome underappreciation, another demotivator. Similar to the in-house training of the STEM workforce, companies can be trained about the effects of underappreciation. The related governmental institution can assign some representative companies which are experienced on the topic to train other firms in a local industrial aggregation. Firms and governmental representatives can be informed about the ways of creating a win-win platform between them and the STEM workforce.

Our third major recommendation is a collaboration between the firms and all stakeholders to enhance the most important motivators revealed in the findings: strong household support and gender equality culture. For both motivators, firms and governments can take the lead role to enhance gender diversity in the STEM workforce. Aggregated firms in such a community can establish qualified local childcare centres mutually shared by nearby firms, which could receive support from the government because the entire economy is impacted by the underrepresentation of women. Also, firms should be formally visited and informed about the benefits of a gender-equal culture with examples by the STEM Circle Community. By such visits, the community would also get the chance of expanding its membership numbers, as a direct dialogue with the STEM workforce can be facilitated.

Overall, we suggest that the leaky pipeline in STEM is not due to cumulative individualistic behaviour, but rather due to different powers and influences of social, cultural and institutionalised systems – meso and macro layers – in which individuals are inhabited. Considering the influences of motivators and demotivators and ongoing negotiations of misfit/love in STEM and changes in self-actualisation, a social marketing approach should use a behavioural ecological approach for the sustainable success of gender diversity in the STEM workforce.

This research is one of the first to apply systems thinking to the latter phases of the leaky pipeline in STEM. More specifically, the study uses the behavioural ecological point of view to explore the multi-faceted reasons for inequality in STEM and accordingly offers suggestions

for practice. A contribution to social marketing is the importance of the full lifespan in addressing wicked problems. The findings of this study reveal that the problem of the leaky pipeline in STEM is rooted in a broader system of motivators, demotivators and inner negotiations more complicated than suggested by most existing social and occupational theories and their partial perspectives. The systemic nature of a problem highlights the importance of considering all levels to arrive at a solution (Roemer *et al.*, 2020). Per the principles of systems logic and the behavioural ecology perspective, wicked problems need to be treated for their complexity at all levels and with acknowledgement of their entire lifecycle.

Limitations and future research

This research was conducted with participants from Turkey, and thus reflects findings from a particular culture in which the leaky pipeline in STEM exists. This presents an opportunity for further studies within different behavioural ecological systems and how the peculiarities influence the pipeline differently. Another limitation was the data collection phase being online via video calls due to Covid-19 pandemic conditions. Future research could be enriched by observations of women within their professional workplaces. Also, this study not being longitudinal, but being conducted at one point in time of leavers' and persisters' lives, is limited by the recalling of memories and experiences from participants and how, for example, they may reinterpret feelings of a misfit in earlier career phases. This study also limited data collection to the STEM leavers and persisters and their perceptions of the other actors' influence on their career choices. Future research could gather data from a more diverse set of actors.

We recognise a need for more research on the interaction between the micro-level negotiations and the systems-level social marketing approaches. This study is a first attempt at exploring the interplay of Herzberg *et al.*'s (1959) two-factor model with the behavioural ecological complexity. Similarly, future research can go into more depth on the negotiations of psychological phenomena like self-actualisation with the complexity of an interconnected ecology. Also, an academic review of the results of individually-focussed campaigns for STEM can be conducted to assess the importance of systems and lifecycle thinking in social marketing interventions. We hope our study inspires new systems thinking in grappling with the wicked problems confronting society.

References

- Andreasen, A.R. (1994), "Social marketing: definition and domain", *Journal of Public Policy and Marketing*, Vol. 13 No. 1, pp. 108-114, doi: [10.1177/074391569401300109](https://doi.org/10.1177/074391569401300109).
- Andreasen, A.R. (2003), "The life trajectory of social marketing: some implications", *Marketing Theory*, Vol. 3 No. 3, pp. 293-303, doi: [10.1177/147059310333004](https://doi.org/10.1177/147059310333004).
- Belk, R., Fischer, E. and Kozinets, R.V. (2013), *Qualitative Consumer and Marketing Research*, SAGE Publications, USA.
- Blackburn, H. (2017), "The status of women in STEM in higher education: a review of the literature 2007-2017", *Science and Technology Libraries*, Vol. 36 No. 3, pp. 235-273, doi: [10.1080/0194262X.2017.1371658](https://doi.org/10.1080/0194262X.2017.1371658).
- Blickenstaff, J.C. (2005), "Women and science careers: leaky pipeline or gender filter?", *Gender and Education*, Vol. 17 No. 4, pp. 369-386, doi: [10.1080/09540250500145072](https://doi.org/10.1080/09540250500145072).
- Brennan, L., Previte, J. and Fry, M.L. (2016), "Social marketing's consumer myopia: applying a behavioral ecological model to address wicked problems", *Journal of Social Marketing*, Vol. 6 No. 3, pp. 219-239, doi: [10.1108/JSOCM-12-2015-0079](https://doi.org/10.1108/JSOCM-12-2015-0079).
- Buse, K., Bilimoria, D. and Perelli, S. (2013), "Why they stay: women persisting in US engineering careers", *Career Development International*, Vol. 18 No. 2, pp. 139-154, doi: [10.1108/cdi-11-2012-0108](https://doi.org/10.1108/cdi-11-2012-0108).

- Cho, S., Goodman, M., Oppenheimer, B., Codling, J. and Robinson, T. (2009), "Images of women in STEM fields", *Journal of Science Communication*, Vol. 08 No. 3, pp. 1-5, doi: [10.22323/2.08030203](https://doi.org/10.22323/2.08030203).
- Cronin, C. and Roger, A. (1999), "Theorizing progress: women in science, engineering, and technology in higher education", *Journal of Research in Science Teaching*, Vol. 36 No. 6, pp. 637-661.
- Diekman, A.B., Brown, E.R., Johnston, A.M. and Clark, E.K. (2010), "Seeking congruity between goals and roles: a new look at why women opt out of science, technology, engineering, and mathematics careers", *Psychological Science*, Vol. 21 No. 8, pp. 1051-1057, doi: [10.1177/0956797610377342](https://doi.org/10.1177/0956797610377342).
- Domegan, C., McHugh, P.M., Devaney, M., Duane, S., Joyce, J. and Daly, O. (2014), "Case study: waves of change-collaborative design for tomorrow's world", in Brennan, L., Binney, W., Parker, L., Aleti, T. and Nguyen, D. (Eds), *Social Marketing and Behaviour Change: Models, Theory and Applications*, Edward Elgar, Cheltenham, pp. 208-219.
- Domegan, C., McHugh, P., Devaney, M., Duane, S., Hogan, M., Broome, B.J., Layton, R.A., Joyce, J., Mazzonetto, M. and Piwowarczyk, J. (2016), "Systems-thinking social marketing: conceptual extensions and empirical investigations", *Journal of Marketing Management*, Vol. 32 Nos 11/12, pp. 1123-1144, doi: [10.1080/0267257X.2016.1183697](https://doi.org/10.1080/0267257X.2016.1183697).
- Eagly, A.H. (1987), *Sex Differences in Social Behavior: A Social-Role Interpretation*, Erlbaum, Hillsdale.
- Eurostat (2020), "Human resources in science and technology (HRST_ST_RSEX DATA file)", available at: https://ec.europa.eu/eurostat/databrowser/view/HRST_ST_RSEX/default/table (accessed 25 January 2021).
- Flaherty, T., Domegan, C., Duane, S., Brychkov, D. and Anand, M. (2020), "Systems social marketing and macro-social marketing: a systematic review", *Social Marketing Quarterly*, Vol. 26 No. 2, pp. 146-166, doi: [10.1177/1524500420925188](https://doi.org/10.1177/1524500420925188).
- Fouad, N.A., Singh, R., Cappaert, K., Chang, W. and Wan, M. (2016), "Comparison of women engineers who persist in or depart from engineering", *Journal of Vocational Behavior*, Vol. 92, pp. 79-93, doi: [10.1016/j.jvb.2015.11.002](https://doi.org/10.1016/j.jvb.2015.11.002).
- Frank, K. (2019), "A gender analysis of the occupational pathways of STEM graduates in Canada", Statistics Canada, Catalogue no.11F0019M(429), available at: www150.statcan.gc.ca/n1/pub/11f0019m/11f0019m2019017-eng.pdf (accessed 25 January 2021).
- Friedmann, E. (2018), "Increasing women's participation in STEM industry: a first step for developing a social marketing strategy", *Journal of Social Marketing*, Vol. 8 No. 4, pp. 442-460, doi: [10.1108/JSOCM-12-2017-0086](https://doi.org/10.1108/JSOCM-12-2017-0086).
- Goulden, M. and Mason, M.A. (2011), "Keeping women in the science pipeline", *The Annals of the American Academy of Political and Social Science*, Vol. 638 No. 1, pp. 141-162, doi: [10.1177/0002716211416925](https://doi.org/10.1177/0002716211416925).
- Herzberg, F., Mausner, B. and Synderman, B. (1959), *The Motivation to Work*, Wiley, New York, NY.
- Hobbes, T. and Smith, W.G.P. (1909), *Hobbes's Leviathan: reprinted from the Edition of 1651*, Clarendon Press, Oxford.
- Hobbes, T. (1651), *De Cive: Or, the Citizen, Reprint 1949*, Appleton-Century-Crofts, New York.
- Kennedy, A.M. (2016), "Macro-social marketing", *Journal of Macromarketing*, Vol. 36 No. 3, pp. 354-365, doi: [10.1177/0276146715617509](https://doi.org/10.1177/0276146715617509).
- Kvale, S. (1996), *Interviews: An Introduction to Qualitative Research Interviewing*, SAGE Publications, USA.
- Lawler, S. (2002), "Narrative in social research", in May, T. (Ed), *Qualitative Research in Action*, SAGE Publications, Ch.11, p. 242.
- Lendt, R.W., Brown, S.D. and Hackett, G. (1994), "Toward a unifying social cognitive theory of career and academic interest, choice, and performance", *Journal of Vocational Behavior*, Vol. 45 No. 1, pp. 79-122, doi: [10.1006/jvbe.1994.1027](https://doi.org/10.1006/jvbe.1994.1027).
- Lynch, J.F. (2013), "Aligning sampling strategies with analytical goals", in Mosley, L. (Ed.), *Interview Research in Political Science*, Cornell University Press, Ithaca, N.Y., pp. 31-44.

- Maslow, A.H. (1943), "A theory of human motivation", *Psychological Review*, Vol. 50 No. 4, pp. 370-396.
- Maslow, A.H. (1965), "Self-actualization and beyond", *Proceedings of the conference on the training of counselors of adults, Boston University, MA*.
- Maslow, A.H. (1970), *Motivation and Personality*, Harper and Row, New York, NY.
- Meinholdt, C. and Murray, S.L. (1999), "Why aren't there more women engineers?", *Journal of Women and Minorities in Science and Engineering*, Vol. 5 No. 3, pp. 239-263, doi: [10.1615/JWomenMinorScienEng.v5.i3.30](https://doi.org/10.1615/JWomenMinorScienEng.v5.i3.30).
- PCP (2018), "STEM skills indicator", available at: www.stem.org.uk/sites/default/files/pages/downloads/stem-skills-indicator-findings.pdf (accessed 25 January 2021).
- Roemer, C., Rundle-Thiele, S., Pang, B., David, P., Kim, J., Durl, J., Dietrich, T. and Carins, J. (2020), "Rewiring the STEM pipeline - a C-B-E framework to female retention", *Journal of Social Marketing*, Vol. 10 No. 4, pp. 427-446, doi: [10.1108/JSOCM-10-2019-0152](https://doi.org/10.1108/JSOCM-10-2019-0152).
- Sax, L.J. (2008), *The Gender Gap in College: Maximizing the Developmental Potential of Men and Women*, Jossey-Bass, San Francisco.
- Shapiro, J.R. and Williams, A.M. (2012), "The role of stereotype threats in undermining girls' and women's performance and interest in STEM fields", *Sex Roles*, Vol. 66 Nos 3/4, pp. 175-183, doi: [10.1007/s11199-011-0051-0](https://doi.org/10.1007/s11199-011-0051-0).
- Truong, V.D., Saunders, S.G. and Dong, X.D. (2019), "Systems social marketing: a critical appraisal", *Journal of Social Marketing*, Vol. 9 No. 2, pp. 180-203, doi: [10.1108/JSOCM-06-2018-0062](https://doi.org/10.1108/JSOCM-06-2018-0062).
- UNDP (2019), "Share of graduates in science, technology, engineering and mathematics programmes at tertiary level, female", available at: <http://hdr.undp.org/en/indicators/175906> (accessed 25 January 2021).
- UNESCO Institute for Statistics (2019), "Sustainable development goals fact sheet: 55 women in science", available at: <http://uis.unesco.org/sites/default/files/documents/fs55-women-in-science-2019-en.pdf> (accessed 25 January 2021).
- UNESCO (2017), "Cracking the code: girls' and women's education in science, technology, engineering and maths (STEM)", available at: <https://unesdoc.unesco.org/ark:/48223/pf0000253479> (accessed 25 January 2021).
- Ungar, M. (2008), "Resilience across cultures", *British Journal of Social Work*, Vol. 38 No. 2, pp. 218-235, doi: [10.1093/bjsw/bcl343](https://doi.org/10.1093/bjsw/bcl343).
- Vogt, C., Hocevar, D. and Hagedorn, L. (2007), "A social cognitive construct validation: determining women and men's success in engineering programs", *The Journal of Higher Education*, Vol. 78 No. 3, pp. 336-364, doi: [10.1080/00221546.2007.11772319](https://doi.org/10.1080/00221546.2007.11772319).
- Wood, M. (2019), "Resilience research and social marketing: the route to sustainable behavior change", *Journal of Social Marketing*, Vol. 9 No. 1, pp. 77-93, doi: [10.1108/JSOCM-01-2018-0006](https://doi.org/10.1108/JSOCM-01-2018-0006).
- Xu, Y.J. (2008), "Gender disparity in STEM disciplines: a study of faculty attrition and turnover intentions", *Research in Higher Education*, Vol. 49 No. 7, pp. 607-624, doi: [10.1007/s11162-008-9097-4](https://doi.org/10.1007/s11162-008-9097-4).

Corresponding author

Hafize Çelik can be contacted at: hafizecelik1606@gmail.com