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What Lies beneath Sustainable Education? Predicting and Tackling Gender Differences in STEM Academic Success

Maura A. E. Pilotti

College of Science and Human Studies, Prince Mohammad bin Fahd University, Dhahran 34754, Saudi Arabia; maura.pilotti@gmail.com; Tel.: +966-13-849-8558

Abstract: In many societies across the globe, females are still underrepresented in science, technology, engineering, and math (STEM fields), although they are reported to have higher grades in high school and college than males. The present study was guided by the assumption that the sustainability of higher education critically rests on the academic success of both male and female students under conditions of equitable educational options, practices, and contents. It first assessed the persistence of familiar patterns of gender bias (e.g., do competencies at enrollment, serving as academic precursors, and academic performance favor females?) in college students of a society in transition from a gender-segregated workforce with marked gender inequalities to one whose aims at integrating into the global economy demand that women pursue once forbidden careers thought to be the exclusive domain of men. It then examined how simple indices of academic readiness, as well as preferences for fields fitting traditional gender roles, could predict attainment of key competencies and motivation to graduate (as measured by the average number of credits completed per year) in college. As expected, females had a higher high school GPA. Once in college, they were underrepresented in a major that fitted traditional gender roles (interior design) and over-represented in one that did not fit (business). Female students' performance and motivation to graduate did not differ between the male-suited major of business and the female-suited major of interior design. Male students' performance and motivation to graduate were higher in engineering than in business, albeit both majors were gender-role consistent. Although high school GPA and English proficiency scores predicted performance and motivation for all, preference for engineering over business also predicted males' performance and motivation. These findings offered a more complex picture of patterns of gender bias, thereby inspiring the implementation of targeted educational interventions to improve females' motivation for and enrollment in STEM fields, nowadays increasingly available to them, as well as to enhance males' academic success in non-STEM fields such as business.

Keywords: sustainable higher education; gender; academic success; STEM

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1. Introduction

Women remain the largest disadvantaged group throughout the world. Although significant differences exist between subgroups of women based on a variety of factors, often reinforcing each other, such as geography (e.g., the Global North and the Global South), economic and social status, and ethnicity, marked disadvantages characterize most women's lives, which have implications for their experience of education [1].

The benefits of gender equity have been highlighted by several studies at both macro and micro levels. For instance, a study modeling the potential outcomes of gender equity at the macro level in the European Union [2] has found that it can boost economic growth, mainly because it is associated with improving employment rates, reducing poverty rates, and increasing gross domestic product (GDP) per capita. A similar argument is put forth in a review of the literature by Kabeer and Natali [3], who found reliable evidence of the contribution of gender equity to economic growth in a variety of domains such as education and employment. In support of this argument, studies have shown that greater

women's participation in fields traditionally dominated by men, such as engineering, can promote creativity and productivity in the workplace [4,5]. Benefits have been found to extend to subjective well-being [6]. To wit, gender differences in subjective well-being favoring men have been reported to be linked to gender inequity, primarily in the form of women's deficient access to or exclusion from resources and opportunities.

In light of the benefits of gender equity, considerable attention has been devoted to the uneven educational attainment of women and men since it has spillover effects in other domains, such as employment, income, and standard of living. In the Western world, female students have been reported to exhibit greater school marks regardless of the subject matter [7], although in standardized tests, male students have been found to outperform females, especially when quantitative scientific competencies are measured [8]. Null gender differences or declines in the magnitude of the differences in standardized tests as a function of the passage of time have also been reported [9,10]. In other parts of the world, exceptions to this pattern exist. For instance, in the Kingdom of Saudi Arabia (KSA), evidence of gender differences tends to favor females on both standardized tests and high-school grade point average (HSGPA) [11]. Yet, across the globe, women are underrepresented in science, technology, engineering, and math (i.e., STEM fields) [12–14]. Thus, it comes as no surprise that closing the gender gap in higher education, for instance, by promoting women's enrollment in STEM fields, ranks among one of the most prominent pathways to gender equity [15,16].

Gender equity in education is considered one of the prerequisites for sustainable development by the United Nations [17,18]. According to the Brundtland Commission, otherwise known as the United Nations World Commission on Environment and Development, sustainable development comprises activities that "ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs" [19] (p. 16). In this definition, development is not described narrowly in economic terms, but holistically, incorporating human, social, and political dimensions, all linked to the imperative of sustainability. Within this framework, gender inequality is seen as "intersectional", in that it is often correlated with other inequalities [20] fostering women's exclusion in key social, educational, cultural, and economic domains. Thus, the pursuit of gender equity is conceptualized as a means to nurture human potential by ensuring the right of all to a full, self-determined, and dignified life.

1.1. Definition of Gender Equity

Broadly speaking, equality means being the same, whereas equity means being fair. Thus, gender equity specifically refers to the aim of giving everyone the full range of opportunities and resources to enable each individual to reach desired outcomes. In the educational arena, gender equity can be operationalized as *gender parity* [16], whose goal is achieving equal access to and participation in education for women and men based on their proportional representation in the population. Common indicators of gender parity in higher education may include the gross or net enrollment of women and men in degree programs involving science, technology, engineering, and mathematics (STEM fields), or non-STEM fields, or the proportion of women and men who graduate from such programs. Gender parity indicators may appear static, offering a one-time window into access to and participation in higher education of a given population, but each can be a dynamic measure of change if the measurement is taken over at least two points in time. Yet, they give little information about what is actually happening to students once they enter higher education, thereby potentially masking greater inequalities in the content of the education that is received by each constituency. To wit, gender parity is merely the starting point for assessing gender equity. Usually, indicators of *gender equality* are used to measure how students function in higher education [16]. They may entail measures of attainment of key competencies and other performance measures (which indicate the extent to which women and men convert educational access into educational capital), self-reports of choice of a specific field of study, or time to complete an undergraduate degree relative to the

requirements of the degree (e.g., credit hours). As gender equality measures are general indicators of how women and men function within the educational institution in which they are enrolled, to be useful for targeted interventions they are to be interpreted through the lenses of the specific social context in which female and male students live. For instance, consider that students' self-reported choice of a given field of study may be attributed to an independent act of volition or may be imposed, explicitly or implicitly, by the social context of origin through the way fields are presented and made accessible. Understanding the extent to which choices are of one type or the other can determine the effectiveness of interventions targeting a weakness in a particular student constituency.

As might be expected, cultural and religious customs shape gender inequality. In most parts of the world, gender inequalities continue to reflect the long-standing norms and values that govern relations between men and women, which define the structural dimensions (e.g., workforce participation, income, and political representation) as well as the psychological idiosyncrasies (e.g., attitudes, including gender stereotypes) of a particular socio-economic entity [6,21]. In highly patriarchal societies, gender inequity festers [22]. The resulting formal and informal discriminatory practices have been thought to be one of the main culprits of women's low rates of participation in education and employment [23]. Potrafke and Ursprung [24] argue that the social and economic aspects of globalization lead institutions to converge to common denominators, including gender equity. The evidence supporting their argument suggests that institutional changes brought about by a society's aims to join the global economy can benefit women, counteracting ingrained patriarchal influences. Of course, institutional change may appear an exclusively top-down phenomenon, a misconception often generated by a policy approved by a governmental body and disseminated to the people it serves. Yet, change usually starts earlier, from the bottom, specifically from the recognition of unmet needs by ordinary people, which as a result of being voiced, challenges the status quo and induces the top to formalize what already was simmering under the surface [25,26].

The multifaceted complexities of a society in transition are difficult to gauge as they reflect a wide range of factors and areas of impact. Thus, the present study singles out patterns of gender inequities in college students of a society in transition from a gender-segregated workforce with marked gender inequalities to one whose aims of integration in the global economy demand that women pursue once forbidden careers thought to be the exclusive domain of men. This study examines a decade (2006–2015), during which the issue of gender equity in higher education was fiercely debated by opposing sides, while sporadic, but targeted top-down actions, such as the opening of once male-only programs and professions to females [27], were directed towards balancing opportunities and access to resources in education and employment.

1.2. The Case of the Kingdom of Saudi Arabia

The Kingdom of Saudi Arabia (KSA) is the ideal testing ground, sort of a Petri dish, for assessing the extent to which the push for globalization encouraged by institutional forces and supported by its youth has brought gender equity in education within a society that has been defined by marked disparities between males and females. According to the revised overall KOF ("Konjunkturforschungsstelle", otherwise known as Economic Cycle Research Institute) index of globalization [28–30], which combines economic, social, and political dimensions of globalization, and rates them on a scale from 0 to 100, KSA has steadily become globalized. Of interest is the decade examined in the present study (2006–2015), which is the decade when the integration push was initiated and slowly implemented through the opening of a variety of male-only academic programs and institutions to women. During this decade, the de facto index, which measures activities, increased from 53.86 to 58.28, whereas the de jure index, which measures policies that purportedly enable such activities, increased from 59.20 to 63.30. As noted earlier, Potrafke and Ursprung [24] argue that globalization strengthens gender equity. The measure of gender equity used by Potrafke and Ursprung (e.g., Social Institutions and Gender Index,

SIGI), which estimates the extent to which women are institutionally constrained in their lives, is not available for KSA in the timeframe that is desired. The Gender Parity Index (GPI) released by UNESCO [31], which measures relative access to higher education (i.e., the number of male students over the number of female students in higher education), is available, though. It shows a decrement from 1.3 in 2006 to 1.0 in 2015, suggesting movement towards equal access. More broadly, evidence from field research illustrates a society that has been under considerable pressure to "modernize", mostly from its sizable youth population, and from foreign agents and media, both of which have suited internal institutional aspirations to increase KSA's participation in the global economy [32–34]. For each of these constituencies, an appetite for change, irrespective of whether it has prioritized particular social, economic, or legal matters, has had to contend with concerns that change may obliterate the indigenous culture and entirely replace it with a Westernized one.

Gender equity has been at the center of the debate between modernity and tradition, particularly during the selected decade, a debate that may have slowed but not prevented the social changes demanded by the youth of KSA. The 2011 Royal Decree issued by the Ministry of Labor, which opened to women a myriad of jobs previously the exclusive purview of men, seems to be merely the culmination of the inevitable weakening of institutional constraints of gender segregation. Not surprisingly, a slow drip of other decrees followed in the years to come expanding women's integration into the labor force, decrees that, for instance, gave women greater mobility through driver licenses and independence through opportunities to travel without the supervision or the assent of a male guardian. Decrees made the possibility of change, even if at a slow pace, tangible in a country whose values and beliefs have been deeply rooted in cultural traditions and religious customs within a patriarchal family-oriented structure.

The present study examines a decade (2006–2015) in which the 2011 royal decree sits almost in the middle, encompassing the pressures that foreshadowed it and those that followed it. Events foreshadowing it may include the initially sporadic institutional actions opening academic programs that were once male-only admission to women, as well as informal plans to make the workplace less gender-segregated. Actions and plans coalesced in the announcement of the 2030 Vision in 2016 [35], a strategic framework to diversify KSA's economy and improve the overall well-being of its citizens through targeted investments in health services, education, infrastructure, etc. The present study provides a unique viewpoint from which to examine the choices and performance of young women and men in higher education, during a time when the structural changes demanded by women towards gender equity were merely in the making, either still being debated and discussed, or at the outset of implementation. Thus, the choices and performance of young women and men in higher education during this timeframe can be considered the conditions from which progressively more robust institutional actions have taken place (e.g., broader female students' accessibility to programs offered by an increasing number of KSA public and private institutions; and quality control policies of the education imparted to men and women). To understand where change began can help one comprehend the nature of the change to come, including its slow rate and unrealized potentials.

2. Materials and Methods

2.1. Sample

The sample consisted of 1879 female and 1590 male undergraduate students who had graduated from a University located in the Eastern Province of KSA. They had enrolled as full-time students directly from high school within a period of 10 years (2006–2015). Males had obtained an undergraduate degree in either engineering (a STEM discipline) or business (a non-STEM discipline), both of which could be considered fields of study fitting the gender roles assigned to men in a patriarchal society. Women had obtained an undergraduate degree in either interior design (a female-suited field) or business (a male-suited field). Interior design was offered by the College of Engineering as an option

to an engineering degree, which was accessible only to males at that time [36] due to gender segregation practices. Transfer students were excluded (8.3%) since they entered the university with already some coursework completed. Participants' ages ranged from 18 to 25. They were Arabic–English bilinguals of Middle Eastern descent. English language competencies were assessed at the time of admission through a standardized test (English Placement Test, EPT).

2.2. Procedure

At the time of enrollment, the selected university offered an undergraduate education whose core curriculum and pedagogy followed a U.S. student-centered model approved by the Texas International Education Consortium (TIEC, Austin, TX, USA) English was the primary mode of instruction. The university was organized into two main academic units: the College of Engineering, which offered engineering majors to men and interior design to women, and the College of Business, which offered business majors. In KSA, the profession of interior design is an engineering profession recognized by the Saudi Council of Engineers (SCE). To ensure adequate samples for statistical analysis, the particular majors offered by the College of Engineering to men (such as civil, mechanical, electrical, and computer engineering) were aggregated under the umbrella "engineering-majors". Similarly, the different majors offered by the College of Business (such as accounting, finance, business administration, management information systems, and human resource management) were aggregated under the umbrella "business majors". The main academic units of the university were served by the College of Arts and Sciences, responsible for administering the core curriculum of basic competencies to all students irrespective of their major, and the Preparatory Program, responsible for serving students whose English competencies did not allow them to take core courses immediately upon admission. Students' English language competencies were measured by the EPT, whose scores ranged from 0 to 80. The EPT is administered to high school graduates by the National Center for Assessment (NCA). It consists of 80 dichotomously scored items in which 20 items are related to reading comprehension, 40 items are related to sentence structure, and 20 items are related to compositional analysis [37]. Students' scores determined whether they could enroll in the core program, which offered university-level instruction on foundational competencies, or the preparatory program, which offered them targeted English instruction before formal admission to core. For all students, formal admission to core required that they passed a standardized English proficiency test (such as IELTS or TOEFL) with a score that qualified them as competent users of English as an expressive and receptive language (including oral and written formats).

The core curriculum consisted of courses intended to cultivate and develop basic competencies upon which students could rely to address the particular demands of the program of study they selected. The present research focused on six key competencies that faculty of both colleges identified as essential to the success of their students: communication, reasoning, mathematics, natural sciences, self-assessment, and ethics. There were 1 to 4 courses for students to complete under each competency. For instance, communication included courses in general written communication, general oral communication, technical and professional writing, and research report writing; reasoning included critical thinking and problem-solving; mathematics encompassed statistics, calculus, and algebra; natural sciences included introductory courses in biology, chemistry, and physics; self-assessment incorporated metacognition training and practice of key academic skills to prepare students for their major's coursework; and ethics entailed courses devoted to a critical examination of ethical matters in everyday life as shaped by culture and religion. The courses covering ethics were the only ones that were taught mostly in Arabic to ensure suitable coverage of materials from the Middle East.

The Office of the Registrar provided students' records whose research utilization complied with the guidelines of the Office for Human Research Protections of the U.S. Department of Health and Human Services and with the American Psychological Associa-

tion's ethical standards. Records included the grades received in college by students under each of the selected competencies, high school GPA (HSGPA), EPT score, selected major (indexing chosen field of study), the number of credit hours completed, and the number of years taken to obtain a college degree. Records were appropriately coded to eliminate any identifying information. Whenever more than one course was covered by a given competency, the average grade was computed. No information was available regarding withdrawal rates. Thus, the present investigation focuses exclusively on the performance of students who succeeded in their academic endeavors.

3. Results

The results reported below are considered significant at the 0.05 level. Table 1 reports descriptive statistics on key variables organized by gender and major in college (i.e., chosen field of study).

Table 1. Mean (*M*) and standard error of the mean (*SEM*) of college precursors, college competencies, and a motivation index.

Variables	Female Interior Design	Male Engineering	Female Business	Male Business
College Precursors				
High School Grade Point Average (HSGPA)	91.55 (0.30)	88.12 (0.27)	91.30 (0.21)	85.48 (0.34)
EPT	43.99 (0.95)	55.32 (0.83)	45.69 (0.68)	55.93 (1.01)
Field Choice	34.65%	61.57%	65.35%	38.43%
College Competencies				
Communication	85.63 (0.24)	82.36 (0.18)	85.42 (0.17)	79.88 (0.25)
Reasoning	86.32 (0.30)	82.46 (0.25)	86.30 (0.23)	79.71 (0.33)
Math	78.25 (0.34)	78.23 (0.25)	78.46 (0.24)	73.82 (0.29)
Self-Assessment	84.98 (0.22)	81.41 (0.17)	86.47 (0.17)	79.25 (0.26)
Natural Sciences	81.21 (0.35)	78.74 (0.22)	80.62 (0.28)	76.40 (0.35)
Ethics	91.15 (0.22)	87.21 (0.17)	90.83 (0.16)	84.56 (0.24)
Motivation to Graduate				
Credit Hours Completed	130.31 (0.15)	138.47 (0.08)	126.06 (0.07)	125.84 (0.06)
Years to Graduation	5.49 (0.04)	5.61 (0.04)	5.34 (0.03)	5.51 (0.06)
Motivation	24.51 (0.18)	25.83 (0.18)	24.55 (0.14)	24.51 (0.26)

Motivation = credit hours completed/years to graduation.

3.1. Description of Gender Differences in the Sample

Overall female graduates outnumbered male graduates, χ^2 (1, n = 3469) = 24.08, $p < 0.001$. Did the choice of field of study change over time? To examine whether there were shifts in female and male students' preferences for degrees within the decade selected, the year of enrollment was split into two halves of 5 years. A chi-square test was computed on the number of either female or male students who selected a given major as a function of demi-decade. Not only females were overrepresented in business majors relative to interior design, but also their presence in business increased from the first demi-decade to the second demi-decade (63.06% versus 67.62%), whereas in interior design it declined from 36.94% to 32.38%, χ^2 (1, n = 1879) = 4.31, p = 0.038. In contrast, males' overrepresentation in engineering increased from the first demi-decade to the second demi-decade (59.21% versus 64.54%), whereas their presence in business declined from 40.79% to 35.46%, χ^2 (1, n = 1590) = 4.71, p = 0.038. Thus, the trend of females flocking to business majors, thereby moving away from a profession fitting traditional gender-role expectations, and males preferring engineering to business majors appeared to define the initial response of this sample of young adults to the push for the integration of KSA into the global economy.

For the entire sample, the first set of analyses involved the determination of whether there were gender differences in key college-precursor variables for gendered engineering and business disciplines. The selected precursors were students' HSGPA (serving as a global measure of college readiness), and EPT (indexing English language competencies).

For statistical purposes, engineering majors for men and interior design for women were aggregated under the label "gendered engineering degrees". The reason being that the occupation of interior design is an engineering profession recognized by the Saudi Council of Engineers (SCE) in KSA. A two-way ANOVA with gender and (future) major as the between-subjects factors on HSGPA illustrated that although females had higher HSGPA than males, $F(1, 3465) = 277.62$, $MSE = 61.50$, $p < 0.001$, $\eta p^2 = 0.074$, and HSGPA was higher for students who later selected a gendered engineering major, $F(1, 3465) = 27.20$, $MSE = 61.50$, $p < 0.001$, $\eta p^2 = 0.007$, there was a significant interaction of gender and major, $F(1, 3465) = 18.61$, $MSE = 61.50$, $p < 0.001$, $\eta p^2 = 0.005$. Females' HSGPA did not significantly differ between interior design and business majors, $t(1877) < 1$, *ns*, whereas males' HSGPA was much higher for engineering than business majors, $t(1588) = 6.17$, $p < 0.001$. In contrast, the same two-way ANOVA on EPT merely illustrated greater English proficiency for males than females at the time of enrollment, $F(1, 3465) = 153.21$, $MSE = 606.21$, $p < 0.001$, $\eta p^2 = 0.042$ (other $Fs \leq 1.76$, *ns*).

College performance variables were students' grades in courses measuring competencies in communication, reasoning, math, self-assessment, natural science, and ethics. Considering that students had to handle majors, which varied in the number of credit hours required, as well as made personal choices for electives, which determined the number of credit hours ultimately completed, a measure of the amount of coursework accomplished each year was computed. Specifically, the overall number of credit hours taken divided by the number of years spent in college was considered an index of students' motivation to graduate. The greater the value of this variable, the greater a student's motivation was assumed to be. A two-way ANOVA with gender and major as the between-subjects factors on each of the selected competencies illustrated a consistent pattern of overall higher scores for female students, $Fs(1, 3465) \geq 66.52$, $MSE \leq 75.74$, $p < 0.001$, $\eta p^2 \geq 0.019$, and of higher scores for students in gendered engineering majors, $Fs(1, 3465) \geq 22.39$, $MSE \leq 75.74$, $p < 0.001$, $\eta p^2 \geq 0.006$. The only exception to the patterns of main effects was self-assessment for which there was no overall difference between gendered engineering and business majors, $F = 2.65$, *ns*. However, gender and major also yielded a significant interaction for all competencies, $Fs(1, 3465) \geq 8.06$, $MSE \leq 75.74$, $p \leq 0.005$, $\eta p^2 \geq 0.002$. Namely, there were no significant differences in the competencies of interior design and business female students, $t(1877) \leq 1.27$, *ns*. The only exception was self-assessment for which female business majors scored higher than female interior design majors, $t(1877) = 5.39$, $p < 0.001$. In contrast, there were consistently higher scores for male engineering majors than male business majors, $ts(1588) \geq 5.90$, $p < 0.001$. Thus, there was no indication that female students' majors were differentially difficult. There was also no evidence that the courses in engineering majors, which fall under the STEM umbrella, were "harder" for males than those in business majors, which fall under the umbrella of non-STEM fields.

Could the greater performance of male engineering students across all competencies be due to their taking fewer credits per year? If so, higher grades in core classes would not necessarily mean higher performance. To answer this question, a measure of students' motivation to graduate was computed as the ratio of the number of credits completed over the number of years needed to graduate. The greater the value of this ratio, the higher the students' motivation was assumed to be. A two-way ANOVA with gender and major illustrated that although students in gendered engineering majors completed a greater number of credit hours per year than business majors, $F(1, 3465) = 11.66$, $MSE = 27.96$, $p = 0.001$, $\eta p^2 = 0.003$, and males completed more credit hours per year than females, $F(1, 3465) = 11.67$, $MSE = 27.96$, $p = 0.001$, $\eta p^2 = 0.003$, the motivation pattern was not even, as demonstrated by a significant interaction of gender and major, $F(1, 3465) = 13.17$, $MSE = 27.96$, $p < 0.001$, $\eta p^2 = 0.004$. To wit, females in business and interior design engineering completed an equivalent number of credit hours per year, $t(1877) < 1$, *ns*, whereas males in engineering completed a greater number of credit hours per year than males in business, $t(1588) = 4.31$, $p < 0.001$.

3.2. Do Precursors Predict College Performance Differently for Female and Male Students?

Regression analyses were conducted to determine whether there were gender differences in the contribution made by precursors (HSGPA, EPT, and chosen field of study) to each college performance variable (see Tables 2–8). The motivation guiding these analyses was that unique patterns of contribution for males and females would inform the development of effective targeted interventions.

Table 2. Regression analysis of precursor variables serving as predictors for *communication competencies* of female and male students.

College Precursors	B	Standard Error of the Mean	Beta	*t*-Test	Significance (≤)
Female Students					
(constant)	56.450	1.661			
HSGPA	0.293	0.018	0.357	16.655	0.000
EPT	0.048	0.005	0.187	8.736	0.000
Field Choice	0.222	0.273	0.017	0.813	*ns*
Male Students					
(constant)	68.639	1.552			
HSGPA	0.092	0.017	0.128	5.340	0.000
EPT	0.061	0.006	0.260	10.925	0.000
Field Choice	2.271	0.294	0.184	7.712	0.000

Female students' $R = 0.385$; Male students' $R = 0.341$.

Table 3. Regression analysis of precursor variables serving as predictors for *reasoning competencies* of female and male students.

College Precursors	B	Standard Error of the Mean	Beta	*t*-Test	Significance (≤)
Female Students					
(constant)	55.547	2.238			
HSGPA	0.320	0.024	0.298	13.470	0.000
EPT	0.035	0.007	0.104	4.682	0.000
Field Choice	0.000	0.368	0.000	−0.001	ns
Male Students					
(constant)	69.386	2.136			
HSGPA	0.081	0.024	0.085	3.438	0.001
EPT	0.061	0.008	0.192	7.877	0.000
Field Choice	2.571	0.405	0.156	6.343	0.000

Female students' $R = 0.305$; Male students' $R = 0.261$.

Table 4. Regression analysis of precursor variables serving as predictors for *math competencies* of female and male students.

College Precursors	B	Standard Error of the Mean	Beta	*t*-Test	Significance (≤)
Female Students					
(constant)	33.569	2.266			
HSGPA	0.468	0.024	0.411	19.463	0.000
EPT	0.048	0.007	0.136	6.440	0.000
Field Choice	−0.249	0.373	−0.014	−0.669	ns
Male Students					
(constant)	52.160	1.999			
HSGPA	0.211	0.022	0.225	9.565	0.000
EPT	0.064	0.007	0.207	8.928	0.000
Field Choice	3.896	0.379	0.240	10.275	0.000

Female students' $R = 0.419$; Male students' $R = 0.394$.

Table 5. Regression analysis of precursor variables serving as predictors for *self-assessment competencies* of female and male students.

College Precursors	B	Standard Error of the Mean	Beta	*t*-Test	Significance (≤)
Female Students					
(constant)	61.851	1.582			
HSGPA	0.248	0.017	0.319	14.772	0.000
EPT	0.044	0.005	0.182	8.431	0.000
Field Choice	−1.482	0.260	−0.122	−5.703	0.000
Male Students					
(constant)	69.493	1.564			
HSGPA	0.085	0.017	0.120	4.898	0.000
EPT	0.045	0.006	0.195	8.012	0.000
Field Choice	1.964	0.297	0.162	6.620	0.000

Female students' $R = 0.317$; Male students' $R = 0.279$.

Table 6. Regression analysis of precursor variables serving as predictors for *natural science competencies* of female and male students.

College Precursors	B	Standard Error of the Mean	Beta	*t*-Test	Significance (≤)
Female Students					
(constant)	30.119	2.537			
HSGPA	0.517	0.027	0.404	19.219	0.000
EPT	0.073	0.008	0.182	8.676	0.000
Field Choice	0.578	0.417	0.029	1.386	*ns*
Male Students					
(constant)	56.270	2.014			
HSGPA	0.188	0.022	0.204	8.439	0.000
EPT	0.073	0.007	0.240	10.036	0.000
Field Choice	01.878	0.382	0.118	4.915	0.000

Female students' $R = 0.426$; Male students' $R = 0.329$.

Table 7. Regression analysis of precursor variables serving as predictors for *ethical competencies* of female and male students.

College Precursors	B	Standard Error of the Mean	Beta	*t*	Significance (≤)
Female Students					
(constant)	64.365	1.518			
HSGPA	0.298	0.016	0.393	18.524	0.000
EPT	−0.016	0.005	−0.069	−3.250	0.001
Field Choice	0.212	0.250	0.018	0.848	ns
Male Students					
(constant)	67.922	1.474			
HSGPA	0.199	0.016	0.291	12.217	0.000
EPT	−0.007	0.005	−0.030	−1.290	ns
Field Choice	2.120	0.280	0.179	7.580	0.000

Female students' $R = 0.407$; Male students' $R = 0.368$.

For both male and female students, and irrespective of the major selected, HSGPA and English proficiency (as measured by EPT) exhibited a positive contribution to performance in all competencies as well as to motivation to graduate. The exception was ethics. In males, no significant contribution of English proficiency to ethics was detected. Since courses in ethics were mostly taught in Arabic, it is not surprising that males' performance in such courses did not benefit from their knowledge of the English language. Females'

performance in ethics, instead, was impaired by English proficiency, thereby suggesting that for these speakers, knowledge of English came at the expense of knowledge of Arabic.

Table 8. Regression analysis of precursor variables serving as predictors for *motivation* (number of credits completed/time to graduation) of female and male students.

College Precursors	B	Standard Error of the Mean	Beta	*t*	Significance (≤)
Female Students					
(constant)	6.866	1.227			
HSGPA	0.153	0.013	0.243	11.770	0.000
EPT	0.081	0.004	0.414	20.043	0.000
Field Choice	0.060	0.202	0.006	0.298	*ns*
Male Students					
(constant)	11.647	1.522			
HSGPA	0.097	0.017	0.137	5.761	0.000
EPT	0.082	0.005	0.350	14.943	0.000
Field Choice	1.111	0.289	0.091	3.847	0.000

Female students' $R = 0.457$; Male students' $R = 0.376$.

A preference for engineering over business benefited male students' performance across all competencies, whereas female students' chosen field of study (interior design versus business) did not matter to their competencies. The exception to this pattern was self-assessment competencies, which were higher for female students who preferred business over interior design.

4. Discussion

The main findings of the present investigation offer a much more complex picture of gender differences in college attainment within a society in transition than that suggested by earlier studies merely underscoring females' superior academic performance [11]. They can be summarized in two main points. First, even though women's HSGPA, a general measure of college readiness, was overall higher than that of males and did not differ between chosen majors, females tended to prefer a field of study (business) that did not fit traditional female roles to one that fitted them perfectly (interior design). Men selected the STEM field of engineering over the non-STEM field of business, suggesting that professions traditionally viewed as male-suited possessed features that do not always interest young men. The appeal of engineering may reflect the culture of KSA, which is high in uncertainty avoidance (i.e., the extent to which members of a social system maintain rigorous codes of conduct and beliefs to avoid unpredictable, unclear, and unstructured situations) [38,39]. In such a culture, professional success in business is seen as more uncertain, and thus less attainable, than in engineering for which employment usually involves a public-sector job with much greater stability and financial security. On the other side, for women, the field of business offers greater opportunities for employment than interior design, which is a smaller field already occupied by many women. In this context, the cultural relevance of uncertainty avoidance can be easily overshadowed by the allure of financial freedom and independence offered by a private business.

Second, at the time of enrollment, HSGPA did not differentiate female college students who chose either interior design or business majors but identified males who chose an engineering (STEM) major. The present data do not offer enough information on the extent to which the choice made by each student was dictated by personal preferences versus compliance with external forces. Yet, the greater freedom afforded to males within the timeframe selected for the present investigation may explain males' greater motivation to graduate in a field (engineering) over another (business) if it is assumed that they had a greater personal say in the decision-making process of life choices.

Consistent with this interpretation are three sets of findings supporting the idea that the presence or absence of gender differences in particular behavioral measures may be related to students' degree of self-determination. Consider, for instance, that although both HSGPA and English language proficiency predicted the academic success and motivation of all students, preference for a STEM field such as engineering also predicted academic success in male students. Preference for a female-suited major (interior design) over a male-suited major (business) did not predict academic success in female students. Additionally, consider that men entered college with higher English proficiency than women irrespective of the major they chose. Men's greater English proficiency may be attributed to the greater freedom of mobility and human interaction afforded to them at the time the data of the present study were collected. Once in college, although women tended to be more academically successful than men across most competencies [11], differences existed within each gender. Namely, academic success and motivation to graduate were equal for female interior design and business majors, but greater for male engineering majors than business majors. Thus, female students' higher marks may merely reveal the healthy determination of human agents operating under a restricted range of options and resources to "make it no matter what"!

5. Conclusions

Broadly speaking, gender equity refers to the goal of giving everyone the full range of opportunities and resources needed to reach desired outcomes. Equality means being the same, whereas equity means being fair. Thus, equity recognizes that the allocation of resources and opportunities to women and men must be proportional to their needs, with consideration given to the circumstances they face and the individual contributions they make [40]. Gender equity in the context examined by the present investigation seems to face two interconnected obstacles: lower self-determination of women, and the lower academic performance of males mostly in the non-STEM field of business. The fact that STEM choices, such as conventional engineering and other STEM programs, were yet to become a robust reality for female college students during the timeframe examined by the present investigation is an institutional obstacle associated with women's limited self-determination. What can be done to improve enrollment and ensure motivation in STEM fields for female students, now that such fields are open to them [41]? Furthermore, what can be done to improve academic performance in men majoring in business? The university from which the current data set was obtained has developed a series of initiatives, which is in the process of implementing. Their goal is not limited to dispelling counterproductive myths (e.g., for women, the widespread idea that females "are bad at math" or "lack interest in STEM careers", and for men, that "professional success with a business major is more uncertain"). Undoubtedly, myths start earlier in life through the assimilation of societal stereotypes that purport to define appropriate career paths or lifestyles in one's society, as demonstrated by research on children [42]. Such stereotypes then shape one's self-concept, including confidence in personal abilities (i.e., self-efficacy), thereby defining choices and responses to environmental circumstances.

Yet, myths can be weakened, if not dismantled, by experience gathered from targeted interventions [43]. To this end, actions are devoted to making subject matters more relevant to young minds with the aim of increasing the appeal of particular majors, as well as performance and motivation to graduate from those majors. Initiatives are devised to target the unique needs of males and females as instruction remains gender-segregated. Most importantly, they are increasingly data-driven. The current research is just one instance of the belief that knowledge and understanding of students' choices and performance in the context in which they exist can guide effective as well as sustainable institutional actions.

Concerning the goal of dispelling myths that foster counterproductive attitudes towards specific academic subjects, inter-disciplinary efforts have been exerted to engage female students in quantitative research projects supervised by faculty. These efforts, which are sustained by research assistantships offered by the institution, require students to be

exposed to all aspects of research. They have been motivated by evidence that practical applications of mathematical knowledge (e.g., statistics) and, more broadly, of the scientific method enhance female students' competence in science [44] and may lessen the fear of mathematics [45,46]. As mathematics is a gateway subject for STEM disciplines, this fear has broad ramifications, including the belief that women do not succeed in STEM due to innate differences in ability. Through research experience, students are expected to recognize the usefulness of mathematics and its connection to research in their discipline, making it more approachable.

For both males and females enrolled in mandatory competency core courses, which are the gateway to courses in students' selected majors, practical applications of concepts and theories across disciplines have been enhanced, guided by a pedagogy that combines a student-centered model with culturally relevant contents to promote cognitive, affective, and behavioral engagement [47], as well as global competency [48]. Elective, topical core courses have also been added to allow students to assess the flavor of a discipline before embarking on it. In recognition of the relevance of sustainable development, knowledge of this conceptual domain has been added to the existing learning outcomes of core courses and courses of specific majors. Most importantly, an interdisciplinary elective course in sustainability has been developed and consistently offered every semester to both women and men [49]. The course attempts to connect different STEM fields while offering students the opportunity to engage in personally enriching and socially valued interdisciplinary work. In such a course, the need to go beyond technical knowledge is recognized since sustainable behaviors for transformative action are motivated by much more than mere declarative information. To effectively educate for sustainability, while keeping an eye on the future, alternative forms of knowledge are valued (such as procedural knowledge), the complexities that arise within interconnected systems are explored, and the ability to collaborate with people from diverse backgrounds are nurtured. These changes have been introduced along with actions intended to strengthen the advising of students. The assumption is that broader dissemination of information about college majors, and deeper coverage from not only formal advisors and faculty but also senior students or past graduates may enhance the visibility of role models as well as the quality and quantity of the information relevant to students' enrollment decisions and engagement.

It is important to note though, that the results of the present investigation refer to a society in transition from a strict code of conduct that glorified stereotypical gender inequalities to one that is slowly moving towards gender equity [32–34]. Dator [50] has proposed a conceptual framework for understanding social change, including four types of beliefs and related responses: continued growth (i.e., development is expected to continue undisturbed at the same pace and in the same direction); collapse (i.e., due to some circumstances, the current social system is expected to regress to past arrangements, including a slower pace of change); discipline (i.e., continued growth is seen as either undesirable or unsustainable, thereby leading a social system to reorganize to exercise constraint); and transformation (i.e., past norms, beliefs, and behaviors are replaced by new norms, beliefs, and behaviors, to address current and future challenges). The decade selected for the present investigation may be seen as the starting point of a period of transformation or merely the starting point of a period of continued growth, depending on people's idiosyncratic views of change. Namely, some individuals may view change as continued growth, at times too slow, whereas others may see it as a transformation [51]. Notwithstanding differences in opinion, it is reasonable to assume that the results of the present investigation, which stem from KSA, generalize to societies that have pursued a trajectory of institutional change in traditional norms of conduct, a trajectory motivated by the desire to join the global economy (e.g., countries in the Gulf region). Yet, caution in generalizing from one society to another must be exercised. The nature of the particular structural changes that people have faced, the rates at which such changes have been implemented, and the responses of the intended recipients may vary, even among societies sharing similar cultural and religious traditions. Most importantly, the visibility of institutional changes may not correspond

to the magnitude of their current impact on different aspects of daily life. Le Renard [52] (p. 3) notes that "institutional actions, official declarations, lectures, decrees, regulations, reports, and measures" have led to visible reforms in "women's participation in society and women's rights in Islam". Reforms have redefined the "possibilities, opportunities, and spaces accessible to Saudi women". For instance, albeit change in KSA is much more palpable now than during the decade examined in the current study, it has a long way to go if gender equity is the goal. For instance, now, women can pursue professions and jobs before forbidden, possess greater freedom of movement and self-determination, and can even assume leadership and political positions. However, working outside the house is still a challenge for many women, thereby keeping women's employment rates noticeably low [53].

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