Gender differences in STIM: workpaper

Damien Canzittu

PhD. Professor, Institute of Educational Management, University of MONS (Belgium)

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Introduction

Research on gender differences in STEM (Science, Technology, Engineering, and Mathematics) participation in higher education has been extensive, focusing on various factors influencing enrollment, retention, and career choices. This synthesis aims to present key insights from multiple studies to understand the current landscape and the underlying reasons for gender disparities in STEM fields.

Gender differences: a case study (Vroomen, 2023)

Key points

- Women are underrepresented in science, technology, engineering, and mathematics (STEM) fields.
    - Women are often less motivated to pursue studies in these fields than men.
    - Women are less likely than men to succeed in these fields.
    - Women are less likely than men to hold leadership positions in these fields.
- Gender stereotypes contribute to these disparities.
    - Gender stereotypes suggest that men are more gifted in math and science than women.
    - Gender stereotypes can discourage women from pursuing studies in STEM fields.
    - Gender stereotypes can create a hostile environment for women in STEM fields.
- Perceptions of the usefulness of math tasks influence educational and career choices.
    - Students who perceive math as useful for achieving their goals are more likely to pursue studies in these fields.
    - Girls tend to have a lower perception of the usefulness of math than boys.
    - This difference in perception may contribute to why women are underrepresented in STEM fields.
- Interventions can be implemented to promote gender equality in STEM fields.
    - Teachers can strive to create an inclusive learning environment for all students.
    - Parents and mentors can encourage girls to pursue studies in STEM fields.
    - Programs can be developed to help women succeed in STEM fields.

Recommandations

- It is important to raise awareness of gender stereotypes and their impact on educational and career choices.
- It is important to promote positive role models of women in STEM fields.

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- It is important to create programs and interventions that support women in STEM fields.

By addressing these issues, we can work to create a more just and equitable world for everyone, where everyone can reach their full potential.

Currently, there is a consensus on gender equality in society. Despite this, studies show that women face inequalities in education and careers like wage gaps and underrepresentation in leadership roles (Behrendt, 2021; Toczek et al., 2005; OECD, 2015). This inequality extends to the fields of Science, Technology, Engineering & Mathematics (STEM), where women are underrepresented due to factors such as career choices influenced by societal perceptions of femininity and masculinity (Roy et al., 2014). Despite outperforming boys academically overall girls tend not to pursue math-heavy subjects or STEM fields for various reasons including seeking work-life balance traditionally associated with "feminine" careers. Consequently, they often end up pursuing careers stereotyped as feminine professions. This discrepancy raises questions about why despite excelling at mathematics equally if not better than boys do young girls avoid math-intensive paths? Researchers have explored motivational variables influencing these decisions while also investigating pedagogical approaches impacting perception of math's utility based on gender. To understand this phenomenon further we'll examine Eccles et al.'s Expectancy-Value Model which suggests students' study and career choices directly relate to their motivation and beliefs about their own abilities in mathematics.

The Expectancy-value model by Eccles and Wigfield explains how young people make career choices related to math. It suggests that two major motivational factors influence these choices: the expectations of success and the value placed on the task, which are influenced by various factors like teaching practices, socio-cultural context, and stereotypes. Expectations of success refer to an individual's beliefs about their future performance in each task. Self-concept influences confidence while self-efficacy affects one's ability to react effectively to tasks at school level or professional orientation. Task value encompasses four components including intrinsic interest, importance aligned with self-image or values, perceived usefulness for goals pursued, and anticipated effort required. These elements shape students' motivation towards subjects such as mathematics. These psychological aspects have a significant impact on individuals' educational decisions regarding STEM fields (Science Technology Engineering Mathematics). Understanding this can help improve pedagogical strategies aimed at guiding students toward mathematical careers based on their perceptions of themselves and what they find valuable in academic pursuits. It can also inform efforts to create a more inclusive and supportive environment for underrepresented groups in STEM fields.

In this paper, the focus is on how students perceive the usefulness of a task. Research conducted in Wallonia-Brussels has highlighted that perceived utility of mathematics plays a major role in steering students towards mathematical fields and careers. Perceived utility refers to a student's perception of how important an activity is for achieving specific goals. For example, if a student sees math as necessary for becoming an engineer, they are likely to be motivated to engage with it. This perception influences their motivation and ultimately affects their performance in tasks set by teachers. Two related concepts linked to task utility are "perceived instrumentality" – perceiving a link between current activities and future plans – and "extrinsic motivation," where behaviors are driven by instrumental reasons rather than inherent enjoyment. Research suggests three conditions must be met for the beneficial effects of task utility on student motivation: intrinsic goal pursuit, confidence about future prospects linking with assigned tasks, as well as clear specificity regarding career or life goals associated with those pursuits. The concept also includes two dimensions - endogenous (linked directly to specific personal objectives) and exogenous (where no direct

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connection exists), both influenced heavily by individual perceptions which can significantly impact academic success. The understanding of task utility and its impact on student motivation is essential for educators to effectively support their students' academic success.

However, a person can be more successful if they clearly establish an intrinsic goal and link it to the given task. Feeling personally effective in completing a task positively influences their own skills assessment for that task. Additionally, determining future perspectives plays a role (Dubeau et al., 2015). Asking questions about the usefulness of tasks like "what is this activity good for?" increases motivation towards the task at hand. In educational settings, perceived utility impacts student performance and engagement. The perceived utility of mathematics is particularly strong as a motivational variable (Jaegers, 2021). According to theoretical models such as Expectancy-value theory differences between boys' and girls' math motivations could explain disparities in mathematical careers rather than just academic performance (OECD report; Mullis et al., 2016; Wang et al., 2013). Girls have equivalent performances but may avoid STEM fields due to lower motivation levels compared with boys. Sociocultural context also affects individuals' perceptions which shape their motivation when it comes to choosing studies or career paths related to mathematics. Gender stereotypes play into gender divisions regarding math abilities too (Jaegers & Lafontaine, 2020 ; Jaegers , Toczek& Lafontaine, 2018).

Stereotypes are commonly held beliefs about certain groups of people. Gender stereotypes, for instance, pertain to the expectations and assumptions regarding behaviors and abilities associated with being male or female. These ideas develop early through social interactions. In schools, gender stereotypes influence students' subject preferences and career aspirations. For example, boys may feel pressured to excel in math while girls might lean towards literature based on societal views rather than their actual capabilities. These biases impact students' academic performance as well as their future choices like which subjects they study or what careers they pursue. Despite evidence showing that both genders perform equally well in various fields such as mathematics, persistent bias continues to affect educational decisions worldwide according to a 2015 OECD report. By challenging these prejudices from an early age onwards we can create more equitable opportunities for all individuals regardless of gender. This will lead to a more diverse and inclusive society where everyone can reach their full potential.

According to Jaegers (2021), the amount of time allocated for weekly math classes plays a crucial role in steering students towards mathematical fields, particularly influencing girls' choices. Attending high-volume math classes is strongly linked to aspirations for careers with significant mathematical components. However, this approach may not be as effective in attracting girls to these subjects. Stereotypes significantly impact students' performance and motivation, affecting their career choices and professional aspirations related to mathematics. It's essential that schools deconstruct stereotypes early on so that all children have access to future job opportunities. Perceived usefulness is vital in motivating girls toward mathematical studies and careers. To enhance this perception, it's important for teachers to integrate real-life examples into lessons while clearly explaining the relevance of certain topics. In conclusion, perceived usefulness greatly influences young people's interest in pursuing mathematics-related studies or careers; therefore, highlighting the importance of emphasizing the relevance of teaching methods. Ultimately, the way in which math is taught can have a significant impact on students' motivation and engagement with the subject.

This work explores two methods to help young people understand and appreciate the value of learning math, while also breaking down stereotypes. The first method is called "utility-value intervention," which emphasizes the practical usefulness of mathematical tasks. The second method, known as "orienting approach," focuses on helping students connect their school experiences with future career aspirations. These approaches aim to motivate students by making their learning more meaningful and relevant to real-life situations. They also seek to challenge stereotypes about who can succeed in math-related fields. By integrating these methods into

education, schools can support students in finding personal motivation for learning mathematics and planning for their future careers. Overall, these strategies not only make math lessons more engaging but also empower students to take control of their own educational journey by bridging academic studies with professional goals. This approach helps students see the relevance of math in their lives and fosters a sense of purpose and direction in their academic pursuits.

In this context, a teaching approach called "utility-value intervention" was developed to help students understand the relevance of learning math. This method aims to show them how math is useful in real life by either explicitly explaining its practicality or through personal writing tasks that connect classroom content with their own experiences. Studies have shown that when students perceive the usefulness of what they're learning themselves, it boosts their motivation and performance. The utility-value intervention includes various activities such as presenting interviews with professionals or older peers who explain why mastering math is important for future careers, prompting students to think about someone close to them who could benefit from using mathematics, evaluating arguments on the subject's usefulness and engaging in reflective writing assignments. This approach has proven beneficial but can be challenging for younger children or those facing difficulties. Therefore, combining both explicit information delivery and self-discovery methods seems most effective overall. Overall, a combination of explicit information delivery and self-discovery methods can cater to the diverse learning needs of individuals.

Both teaching approaches improved girls' perception of math, while only the second one affected boys. This helps break stereotypes and encourages students to pursue STEM fields.

Gender differences: the Belgian case (Jaegers & Lafontaine, 2020)

Key points

- **Gender differences in math performance:**
  - Girls tend to outperform boys in math until the age of 15.
  - After the age of 15, boys tend to outperform girls in math.
  - These differences in math performance are not due to innate differences in ability, but rather to social and environmental factors.
- **Gender differences in math motivation:**
  - Girls are less likely than boys to be interested in math.
  - Girls are less likely than boys to believe that they are good at math.
  - Girls are less likely than boys to see math as relevant to their future goals.
- **Gender differences in math participation:**
  - Girls are less likely than boys to take advanced math courses.
  - Girls are less likely than boys to major in math in college.
  - Girls are less likely than boys to pursue careers in math.
- **Causes of gender differences in math:**
  - **Social and cultural factors:**
    - Girls are often stereotyped as being less good at math than boys.
    - Math is often seen as a masculine subject.
    - Girls may receive less encouragement than boys to pursue math.
  - **Educational factors:**
    - Girls may be less likely to be placed in advanced math courses.
    - Girls may receive less support from teachers in math class.
    - Girls may be more likely to experience math anxiety.
- **Consequences of gender differences in math:**
  - **Economic consequences:**
    - Women are less likely to be employed in high-paying STEM jobs.
    - The gender wage gap is wider in STEM fields than in other fields.

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- **Social consequences:**
  - Women are less likely to be represented in positions of leadership in STEM fields.
  - Girls may miss out on opportunities to develop their mathematical skills and knowledge.

- **Interventions to address gender differences in math:**
  - **Early childhood interventions:**
    - Expose girls to math in positive and engaging ways.
    - Encourage girls to believe in their math abilities.
    - Show girls that math is relevant to their lives.
  - **K-12 interventions:**
    - Place girls in advanced math courses.
    - Provide girls with support from teachers and mentors.
    - Create a classroom environment that is welcoming to all students.
  - **Higher education interventions:**
    - Offer scholarships and other financial aid to women who are interested in majoring in math.
    - Provide mentoring and support services to women in STEM fields.
    - Create a more inclusive climate for women in STEM fields.

Gender differences in math are a complex issue with a variety of causes and consequences. However, there are several interventions that can be implemented to address these differences and promote gender equality in math. By working together, we can create a world where all students can reach their full potential in math, regardless of their gender

This study conducted with grade 12 students in the French-speaking Community of Belgium aims to investigate how performance in mathematics, motivation, and number of math classes per week influence perceptions and aspirations towards STEM studies (science, technology, engineering, and mathematics) among male and female students. It was found that despite controlling for other factors like performance or motivation levels when it comes to higher education choices related to maths programs chosen by them. In contemporary societies today, maths play a significant role in directing individuals toward prestigious academic paths. However high-achieving mathematical skills don't always translate into pursuing careers heavily reliant on maths. Research has consistently highlighted a gender-based trend where females are less likely than males to pursue fields requiring strong mathematical abilities such as those within STEM areas - science; technology; engineering &mathematics. The underrepresentation of women has been an ongoing concern since the 1980s but still remains prevalent even now according several recent researches from different perspectives including sociology, psychosocial aspects, and educational viewpoints. In addition, in many cases, researchers have determined the presence of mathematic requirements based on objective classifications while ignoring student's awareness about these demands. Accordingly, this adds significance exploring young people's perception regarding importance they place upon Maths' relevance within their desired field rather than solely relying just on objective criteria. This is especially crucial during transition years before entering college or university. The lack of similar previous investigation makes this perspective both intriguing and innovative. Therefore, understanding what influences pupils' views particularly girls who aren't intimidated by Math becomes key focus area. Within this context, certain motivational beliefs along with actual performances at school level also were considered whether if they moderate sex-based differences amongst aspiring secondary grade six boys versus girls. Additionally, the link between personal opinions about Math's inclusion in future higher education choices is discussed dueits subjective nature compared to merely assessing career aspirations directly. Due consideration should be given to understand students' perspectives if we truly want to better comprehend young people's

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academic and professional goals. Specifically, women representation alongside socio-economic disadvantages remains prominent concerns when addressing aspirational disparities concerning Mathematics-related studies & careers (Van Tuijl & WalmaVan der Molen2015).

The question of gender influence is often raised when it comes to the issue of girls' underrepresentation in math-related fields. Numerous studies have shown that girls are consistently less likely to pursue mathematics, especially at key transition points like entering higher education. Even though girls perform well in higher education, they still tend to opt for literary or health and social science sectors rather than technical fields. Various reasons can explain this division in career aspirations related to mathematics. One prominent theory suggests that individual characteristics such as past experiences and motivations play a significant role in shaping students' educational choices. According to the expectancy-value model by Eccles and colleagues, an individual's motivation influences their academic choices based on their expectations of success and perceived value attached to a task or subject area. This theory indicates that differences between boys' and girls' aspirations toward mathematical careers are mainly due to disparities in motivation and performance history rather than inherent abilities. While research shows that girls may be less motivated towards math compared with boys, there isn't always a clear difference in actual performance levels across genders—girls sometimes perform just as well as boys do. In fact, some studies suggest that instead of being unmotivated because they're not good at it, female students might avoid STEM (science-technology-engineering-math) subjects because they excel equally well if not better elsewhere—giving them more diverse options regarding future career paths. Furthermore., several pieces of research emphasize how beliefs about one's ability impact career aspirations: previous achievements don't significantly affect whether male or female students aspire toward mathematical careers once self-confidence is taken into account In conclusion; while various factors contribute towards why fewer women choose mathematical pathways – including motivational aspects - researchers highlight how personal confidence plays an important part alongside other elements such as cultural perceptions which continue influencing these trends regardless true skill level. Overall, it is important to address confidence and cultural perceptions to encourage more women to pursue mathematical careers.

When studying what influences young people's interest in pursuing math-related studies and careers, we need to consider the specifics of their educational system. In FW-B (Belgium), students can choose different paths from the age of 14, which contributes to differences in study and career aspirations. Our focus is on students following a general or technical education leading to a certificate for higher education access. In this track, students take varying hours of mathematics per week based on their options (ranging from 2 to 8 hours weekly) especially starting from the fifth year. It has been shown that these choices play an important role in shaping student aspirations for further studies and careers related to maths. Studies have indicated that as secondary school students engage more with advanced mathematical training, they are less likely to pursue social sciences at university except economics and management where there's increased attraction when math proficiency rises. Additionally, it was observed that girls are underrepresented in advanced math courses including within FW-B. These findings suggest a link between hours spent studying mathematics during senior years of high school and variations in mathematical aspirations based on gender socio-economic status. Moreover, considering motivational factors influencing academic decisions differs across various educational systems; expectations for success were found influential predominantly over academic choices among US & Canadian systems while interest played key factor Australia unlike any such analysis conducted previously within French-speaking Belgium context making it relevant here too. The research aims firstly at examining how gender impacts inclinations towards mathematic-based studies/careers along with exploring possible moderating roles by performance levels motivations pathway taken by each individual student Furthermore understanding how youngsters perceive future presence importance relevance associated with Mathematics will be considered marking uncharted territory providing basis explorative approach

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several hypotheses could emerge regarding first part research One set hypothesis looks into whether females exhibit lesser inclination than males toward Math-focused academics/careers additionally interaction effect Sex Socio-Economic Index since indications propose SES plays greater role female Mathematical pursuits compared male counterparts Next if disparities confirmed subsequent investigation delves impact variables often cited Performance prior Motivations Weekly Hours Maths final yrs HS formulated three sets assumptions While predicting performances won't diminish connection between sex, Mathematical ambitions motivation may serve weaken even nullify eventually Meanwhile assuming fewer females enrolled extensive Maths classes controlling weekly hrs might also dilute bond b/w sex aspiration towards Mathematic-predicated academia/professions. Lastly, the findings from this research will contribute to a better understanding of how gender, performance levels, motivations and perceptions impact inclinations towards mathematics-based studies and careers.

The study aimed to understand how the amount of time students spend on math influences their career aspirations. It involved 15777 high school seniors from 25 schools in Liège, Belgium. The students completed questionnaires about their gender, weekly hours spent studying math, motivation in math, educational and career goals involving mathematics. In a previous year when these same students were juniors (11th grade), they answered questions about economic status using an international survey framework called PISA. This helped researchers assess their socioeconomic background based on family possessions like books and computers as well as parental education and occupation. Additionally, the juniors also took a standardized math test focusing on material covered during sophomore (9th-10th grades) years of general or technical secondary education. This test included both algebra/number theory problems and geometry/trigonometry exercises with good internal consistency reliability at .77 alpha level. To measure student expectations for success in mathematics two scales were used: one measured self-concept related to mathematical abilities while another gauged perceived capabilities regarding specific tasks such as solving equations within academic settings or practical applications like selecting mobile internet plans according to usage patterns. Based on this data collection process over multiple years across different phases of schooling—accompanied by consistent administration procedures—the research aims to uncover potential disparities between male and female senior high schoolers' attitudes towards pursuing careers requiring strong mathematical skills depending upon the intensity of exposure through formal instruction received up until that point - specifically whether differences might be more pronounced among those who studied higher levels compared against peers whose engagement was less intense per week thereby influencing long-term professional ambitions tied directly into quantitative fields later down road following graduation post-secondary studies ultimately workforce placements accordingly various professions relying heavily statistical reasoning problem-solving expertise drawn advanced calculus linear algebra modern applied methods interconnected interdisciplinary domains ranging economics engineering computer science etcetera potentially impacting not only individual life trajectories but also broader social dynamics shaping labor markets globally toward equitable opportunities inclusive growth prosperity societies collectively moving forward positively addressing complex challenges our world faces today tomorrow together collaboratively ensuring thriving sustainable future generations ahead alike universally equally fairly justly benefiting everyone everywhere regardless race ethnicity religion nationality orientation identity expression ability age socio-economic circumstances geographic locations contexts backgrounds perspectives experiences beliefs values principles acknowledging celebrating diversity promoting unity fostering solidarity nurturing empathy compassion understanding mutual respect dignity integrity empowerment accessibility equality justice peace happiness well-being health safety security environment ecosystems natural resources biodiversity climate change sustainability stewardship conservation preservation protection responsibility accountability transparency ethical. The goal is to identify and address potential disparities between genders in attitudes towards pursuing careers requiring strong mathematical skills, particularly among those who studied at higher levels.

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In a study about students' motivation in mathematics, researchers used four scales to measure the value of the task: interest, perceived utility, anxiety and investment. They chose not to assess the importance of mathematics separately as it overlapped conceptually with interest and perceived utility. Anxiety (psychological cost) was operationalized using an anxiety scale while investment (time spent on math) represented effort expended by students. The questionnaire included questions about weekly hours dedicated to math classes since 11th grade; types of studies planned for next year were also recorded. The presence of fundamental mathematical courses within these programs was noted - coded as either present or absent based on whether at least 1/10th out of 180 credits involved such content. Students indicated their perception regarding future involvement with mathematics – categorized into strong presence versus limited/no role anticipated in future studies or careers through dichotomous coding. Their desired occupations around age 30 were also collected from a predefined list featuring professions requiring substantial mathematical skills according to O*NET classification system criteria which lists jobs that require varying levels expertise in this field — only those scoring above half have been retained after French adaptation. Furthermore, scores derived from motivational scales coupled alongside responses received via Rasch model-based logistic response item parameter test [WLE] provided standardized values comparing individuals regardless of if they had incomplete data sets. To explore variables potentially influencing aspirations towards Math-related educational paths & career choices along with perceptions concerning presence/influence Mathematics might possess over prospective higher education experiences, regression analyses were conducted initially examining link between gender considering various factors like academic performance, motivational aspects all culminating finally regressions encompassing all identified potential influencers simultaneously. The results of the regression analyses revealed significant associations between gender, academic performance, and motivational aspects with aspirations towards math-related educational paths and career choices.

The study aimed to understand how gender influences students' aspirations towards math-related studies and careers. They used a sample of 411 girls and 366 boys. They found that boys were significantly more likely than girls to aspire to math-related studies (OR = 3.06) and careers (OR = 3.21). However, the effect of gender did not change based on the student's socioeconomic status or their performance in mathematics. Additionally, they looked at various factors influencing these aspirations by running several models with different variables such as mathematical performance, motivation levels, and weekly hours spent on studying mathematics during high school. The results showed that besides gender differences, other factors also played a role in shaping students' aspirations toward math-focused paths: self-concept had an influential impact; higher perceived usefulness of maths led to increased likelihood for both genders aspiring towards it; interest was associated with greater chances for career ambitions related to mathematics among all participants while anxiety didn't seem have any significant influence. In summary: - Boys are three times more likely than girls to aspire towards math-based studies or careers. - The influence of gender remains consistent regardless of socio-economic background or academic achievement in maths. - Other elements like self-perception play roles too - those who view themselves positively may be likelier pursue STEM fields - Perceived practicality plays vital part when considering pursuing such educational/career path Interest is key motivator especially regarding thinking about potential careeers These findings shed light on important disparities between young men's & women's desires within education ensuring educators can better address differing needs adequately preparing individuals without favoring one over another solely due sex. These findings highlight the complexity of factors that influence students' aspirations towards math-focused paths and emphasize the importance of addressing individual needs rather than making assumptions based on gender alone.

The research explores the factors influencing students' aspirations for mathematical studies and careers. The study finds that, regardless of other variables like academic performance in math, boys

are at least three times more likely to aspire to mathematical studies and careers compared to girls. It also suggests that attitudes towards mathematics significantly influence these aspirations, particularly self-concept in math and perceived usefulness of the subject. Interestingly, it's observed that taking advanced secondary level math courses substantially increases the likelihood of aspiring to such fields. Furthermore, an analysis based on hours spent studying maths shows a consistent pattern: boys have higher chances than girls across different volumes of math classes taken during high school years - with the gender gap widening when considering intensive math programs. In addition, part two investigates students' perceptions about future involvement with mathematics in their higher education choices suggesting some overestimation or underestimation by certain individuals regarding its importance within their intended field. Overall, this research highlights significant disparities between genders regarding STEM (Science Technology Engineering Mathematics) career expectations which seem unaltered even when accounting for various educational dynamics. These disparities underscore the need for targeted interventions to encourage more gender diversity in STEM fields.

Additional analysis (see Annex D) shows that nearly half (48%) of the girls who perceive mathematics in their future studies tend to overestimate its presence. Most of these girls (84%) envision pursuing studies centered around human-related fields like medicine and biology. In contrast, only 18% of boys overestimate the role of mathematics when they consider it in their future studies, with a more diverse range of aspirations. Further investigation into differences between boys and girls regarding perceptions about the importance of math in higher education revealed that controlling for variables such as math performance, motivation, and hours spent on math reduces the significance previously observed based solely on gender. In essence, being male or female doesn't significantly change how young people view mathematical inclusion within their intended courses; rather this perception seems influenced by individual paths and motivations than by gender alone. Factors such as weekly hours dedicated to learning maths greatly increase chances for perceiving strong mathematical involvement in one's future studies. Similarly significant are attitudes related to perceived usefulness (OR=3.76), self-concept (OR=1.,92), and interest (OR=1,„68). Analyses confirm that females aspire less towards careers heavily involving mathematics compared to males without revealing any significant interaction effect between sex and ISÉ19. These persistent disparities suggest powerful differences exist between genders concerning career aspirations linked closely with maths despite previous research anticipating otherwise under controlled performance models. The overall model incorporating all factors showed that even after accounting for performances, motivations and study time allocated specifically toward maths, male individuals still have three times greater odds at aspiring towards mathematic-focused educational pursuits than females do. The influence exerted by sex is compared to directly evaluating academic achievements. This suggests other influential variables might overshadowing academic accomplishments, such as amount of effort invested in studying Maths or self-perception which incorporates past experiences. These findings support the notion that gender-based aspiration discrepancies result from an intricate network of multiple influences. Therefore, the impact persists regardless of socioeconomic status or specific motivational drivers involved. While Parker et al.'s earlier work did propose considering additional motivational aspects, this current study highlights lingering effects associated with gender disparity. It underscores how complex interactions among various factors contribute to persistent differences in scholarly ambitions between boys and girls, particularly in the context of educational and career aspirations.

The study shows that a student's motivation and academic path are just as important as their gender when it comes to pursuing math studies and careers. Motivation, specifically the perceived usefulness of mathematics for future studies or careers, is strongly linked to aspirations in these areas. Additionally, students' self-concept in math and confidence in using math skills in real-life situations also play a significant role. Interestingly, the research suggests that teachers should focus on connecting mathematical concepts with real-world applications to encourage students' interest

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in studying mathematics further. This finding indicates that feeling capable of using math outside school settings may lead to more enthusiasm for pursuing math-related education compared to solely feeling confident within classroom contexts. Furthermore, factors like anxiety about mathematics and the effort put into learning this subject were found not significantly influential regarding students' aspirations for further mathematical pursuits. In terms of a student's educational journey, the type of secondary-level mathematics courses they attend greatly impacts their ambitions toward studying or working with maths later. It was observed that differences between boys' and girls' aspirations become more pronounced particularly where there is an intensive emphasis on teaching hours dedicated exclusively towards mathematic subjects; here boys have almost four times higher chances than girls at aspiring towards related academic paths. Moreover, the study hypothesizes why even though some females choose such advanced classes, they still tend less often aspire towards career paths involving Mathematics. One possible explanation could be due them excelling across various disciplines hence having wider range while choosing career options unlike male counterparts who might feel primarily comfortable only within Math domain. This evidence highlights how enrollment into high-intensity Maths programs ensures access superior peer groups which can influence one's sense belongingness among top performing peers thus potentially influencing choices toward specific fields during post-secondary years. and ultimately shaping the trajectory of their professional careers.

The study focused on understanding young people's perceptions of the presence of mathematics in their future studies and careers, particularly regarding gender differences. It found that girls tend to overestimate the role of mathematics in fields such as medicine and biology, while boys often underestimate it. However, when controlling for factors like performance, motivation in math, and hours spent studying math each week, gender no longer plays a significant role. This suggests that girls may not opt for "mathematical" studies or careers due to societal stereotypes associating these fields with masculinity rather than their perception of encountering math in their future studies. Encouraging initiatives are needed to combat these stereotypes. For instance, teachers can play a crucial part by showcasing female role models related to engineering or technology during math classes and diversifying real-life contexts used for teaching mathematical concepts. It was also noted that girls who perceive more mathematics involvement in their future studies often lean towards career paths emphasizing human interaction; thus, just perceiving high levels of maths is insufficient reason for them to abandon chosen educational paths. To encourage more interest from girls toward mathematical education and professions could involve highlighting how such pursuits have a positive impact on society at large despite minimal direct interpersonal engagement - an aspect beneficially showcased through collaboration prospects (Eccles & Wang). While acknowledging its limitations including solely using external assessments instead teacher grades which might better reflect students' potential - further research avenues were recommended specifically focusing on qualitative investigations into attitudes among senior high school-level females attending advanced Mathematics courses This would provide deeper insights into why they choose specific academic/career pathways even if objectively capable otherwise. This deeper understanding could inform targeted interventions and support systems to further empower girls in pursuing mathematical education and careers.

The influence of gender on aspirations in mathematics and STEM careers is significant. However, this research suggests that by paying attention to the motivations and role of girls in advanced math classes, educators can help them envision themselves pursuing studies where they see a place for these subjects without fear. This requires addressing stereotypes about mathematical fields held by young people, especially girls. This study forms part of doctoral research funded by the National Fund for Scientific Research (FNRS-Belgium). Several other studies have also explored various factors influencing students' career choices and performance in mathematics-related fields from both psychological and educational perspectives. For instance, some researchers examined how teachers' feedback could affect students' expectations regarding success in mathematics based on

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their gender while others looked at self-concept as it relates to academic achievement over time. Additionally, there are studies exploring perceptions shaping experiences within classroom environments which impact motivation among female students engaging with science. Furthermore, long-term examinations into links between classroom environment quality, motivational beliefs were carried out alongside investigations into expectancy-value perspective's use to understand individual differences affecting decisions towards STEM careers. In addition, researchers underscored that ability isn't lacking but rather choice varies when considering women's participation rates across different scientific disciplines. These insights shed light on strategies needed to encourage more female involvement particularly through understanding student values, beliefs, and interests along with improving learning environments. It should be noted however, the need remains urgent given persisting stereotypical notions surrounding math-based professions even today. This issue has been addressed extensively due its implications not only educationally but societally too.

The research focuses on understanding the factors influencing students' motivation and career aspirations in mathematics and science, particularly related to gender differences. The studies explore how self-concept, values, perceived classroom environment, learning experiences, parental education levels, teacher feedback as well as stereotypes about math and science impact students' choices. Several articles investigate motivational processes affecting high school mathematics participation like educational aspirations for STEM-related careers by comparing samples from Australia, Canada & US. It explores why some STEM fields are more balanced than others regarding gender representation. Additionally, it looks at task value profiles across subjects relating to physical sciences or IT-related sciences in the United States versus Finland. Other areas of focus include a mixed methods study that delves into what accounts for women's decision making when majoring in STEM; evidence supporting communal goals perspective influences attraction towards Stem Careers; an investigation into actual vs perceived classroom environments shaping girls' motivations for Science ;links between Learning Environments Research Mathematics Anxiety etc These findings contribute insights crucially relevant not only within academic spheres but also extends their implications further addressing policy-making decisions aiming toward achieving equality among sexes especially focusing on understanding underrepresentation of females specifically within Math/Science disciplines. These findings contribute insights crucially relevant not only within academic spheres but also extends their implications further addressing policy-making decisions aiming toward achieving equality among sexes especially focusing on understanding underrepresentation of females specifically within Math/Science disciplines, ultimately striving for a more diverse and inclusive STEM field.

The studies mentioned explore the factors that influence students' interest in math and science, particularly how classroom environments, motivational beliefs, and gender differences impact career choices. They delve into topics such as adolescents' motivation in mathematics and science education, aspirations for STEM (science, technology, engineering, and mathematics) careers among different genders across various countries like Australia or the United States. Researchers investigated why some fields within STEM are more balanced between male and female representation than others. These investigations also assessed task value profiles across subjects to understand aspirations related to physical sciences versus IT-related sciences. Additionally, they explored malleability of communal goals impacting attraction towards STEM careers; feedback given by teachers affecting students' expectancies for success in Mathematics; self-concept influencing academic achievement through a meta-analysis of longitudinal relations. They studied student evaluations on performances being influenced by their gender with specific focus on whether girls perform better when parents have higher levels of education regarding university level achievements. There were discussions around stereotypes about math/science which could affect secondary school students' career preferences leading to a gap in participation rates between boys & girls while looking at potential ways to achieve greater equality between women & men These

researches aimed at understanding these complex issues surrounding educational/career interests ensuring equal opportunities irrespective of one's gender/ background based upon psychological perspectives / societal norms The findings suggested that it is not lack of ability but rather choice-making processes especially amongst females contributing significantly toward shaping educational trajectories ultimately manifesting themselves later down the road as occupational pursuits thereby underscoring key points pivotal from an early stage itself during schooling years til reaching adulthood indicating areas where intervention can assist future generations In summary this body evidence highlights varying influences including social cultural individual aspects governing decisions made primarily concerning preference pursuit stem-based professions providing insights solutions counteract any existing bias paving way inclusive environment conducive learning growth enabling everyone realize full potential regardless who what circumstances may be. It is crucial to address these influences and biases to create a more equitable society for all individuals, regardless of their gender or background.

Several studies have been conducted to understand the factors that influence students' choices in high school, particularly concerning their interests and career aspirations. Researchers like Sandra D. Simpkins, Pamela E. Davis-Kean, Juliette Spearman, Helen M.G Watt among others delve into various aspects such as self-concepts and values of students. One study by Ming-Te Wang examines how classroom environment affects a student's interest in mathematics over time while another paper co-authored with Jessica Degol explores different motivational pathways influencing career decisions in STEM fields from an expectancy-value perspective. Helen M.G Watt has also contributed significantly to this field through her research on the role of motivation in gendered educational trajectories related to maths and adolescents' motivational profiles regarding mathematics and science achievements striving alongside psychological well-being. Moreover, Christine Bieri Buschor et al.'s work "Majoring in STEM—What Accounts for Women's Career Decision Making? A Mixed Methods Study" uncovers insights into women's decision-making processes when choosing careers within STEM disciplines using mixed methods approach which combines qualitative interview data with quantitative survey measures providing deeper understanding about influential factors behind these crucial decisions. Overall, these findings provide valuable insights for educators, policy makers aiming at addressing issues around gender disparities especially relating to participation levels, women's underrepresentation across different domains, and other barriers impacting girls' success rates thus making it easier for stakeholders concerned with equal opportunities educationally or professionally.

The research article "Why Are Some STEM Fields More Gender Balanced Than Others?" explores why some science, technology, engineering, and mathematics (STEM) fields have a more equal gender balance than others. The study delves into the factors that influence individuals' interest in pursuing careers in specific STEM disciplines. Research from Chow et al. discusses how people's perceptions of different subjects affect their aspirations to pursue physical or IT-related sciences. Another study by Diekman et al., highlights how communal goals and beliefs can impact attraction to STEM careers based on a goal congruity perspective. Additionally, Duru-Bellat examines the role of educational institutions in perpetuating social gender dynamics while Eccles investigates subjective task value and its effect on achievement-related choices within the context of career pursuits in math and science for both males and females across various cultures. Overall, these resources provide valuable insight into understanding why certain STEM fields attract more diverse groups compared to others through exploring aspects such as individual perceptions towards particular subjects along with cultural influences impacting career motivations. Ultimately, these studies shed light on the complex interplay between individual and societal factors that shape career choices in STEM fields.

The research examines why boys and girls choose careers in math and science. It looks at different factors like parents' level of education, teachers' feedback, students' self-concept, academic achievement and social representations. The study suggests that these variables influence the

decision-making process for both genders. For instance, it's been observed that a student's perception of their own abilities can impact their performance in subjects like mathematics or sciences - this is known as "self-concept." Additionally, how successful a child becomes academically may also be linked to their self-perception over time. Parents play an important role too; children whose parents have higher levels of education are more likely to succeed in university studies than those with less educated parents. Moreover, educational success might vary based on gender stereotypes represented by society such as beliefs about which fields females should pursue versus males. Teachers' expectations could also shape students' career choices: Research has shown differences between male and female pupils regarding evaluative feedback from educators when studying maths – this could affect future decisions related to pursuing professions within STEM disciplines (Science Technology Engineering Mathematics). Overall, the study reveals various interconnected elements influencing young people's interest towards mathematical/scientific pursuits, including personal perceptions & achievements along family background societal views teacher attitudes. It is important for educators to be aware of these dynamics and strive to provide equitable support and encouragement for all students, regardless of their gender.

Several academic studies have explored the impact of gender on students' performance in mathematics and science-related fields, as well as their career aspirations. The findings from these research articles shed light on various aspects related to this topic. One study by Lafontaine and Monseur (2014) delved into whether there is a relationship between a student's gender and their math performance evaluations. Another article authored by Makarova, Aeschlimann, & Herzog (2019) examined how stereotypes about math and science influence secondary students' interest in pursuing careers in STEM fields based on their gender. Furthermore, Morin-Messabel (2014), through applications of social psychology within an educational context looked at the issue of gender disparity. Additionally, Mullis et al., OCDE reports such as PISA 2012 Results: Ready to Learn studied factors affecting engagement levels among male and female students while OECD's Atteindre l'égalité Femmes-Hommes published materials addressing equality issues for men/women. Parker et al.'s work focused on predicting university majors based upon self-conceptualization linked with academic ability; Simpkins & Davis-Kean researched links between beliefs/choices during high school days influencing future decisions; Spearman & Watt investigated girls' motivations for Science influenced through perceived classroom environments dimensions versus actual ones These diverse sources contribute essential information regarding the intersectionality involving sex or socio-cultural constructs impacting individuals' learning experiences particularly within mathematical/scientific domains leading up-to shaping ambitions towards certain professional trajectories later-on post-graduation. This research can provide valuable insights for educators, policymakers, and parents in supporting students' career development and academic success.

The studies mentioned focus on the impact of classroom environment, particularly in science and mathematics education. They explore how students' perceptions of their learning environments influence their motivation, anxiety levels, career choices, and gender disparities in STEM (science, technology, engineering & math) fields. One research study found that girls' motivations for science can be influenced by both actual and perceived classroom dimensions. This suggests that creating a positive perception about the learning environment could potentially increase girls' interest in pursuing scientific subjects. Similarly related to this is another study highlighting the correlation between the learning environment and mathematics anxiety among students. The findings suggest that an encouraging or supportive classroom atmosphere may help reduce feelings of apprehension towards math. Additionally focused specifically on STEM disciplines are investigations into student choice regarding careers within these fields. These studies emphasize understanding individual motivational pathways influencing decisions to pursue STEM-related professions as well as addressing existing gender gaps through policy implications based on current knowledge. Moreover important from an educational standpoint are longitudinal examinations

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demonstrating links between classroom settings, beliefs concerning academic success or failure along with developing interests over time—particularly focusing here on mathematical pursuits aiming at providing insights beneficial for educators working diligently improving teaching strategies while supporting students throughout their journey toward acquiring new skills thus enhancing confidence necessary moving forward academically speaking inclusive future professional aspirations too maybe even more so relevant today than ever before considering ongoing technological advancements across various industries likely shaping job market requirements significantly going forward Furthermore emphasizing equality notably also explored were discussions surrounding potential reasons behind underrepresentation seen primarily relating to females becoming less involved within certain areas such as those encompassed by sciences technologies engineering mathematics sometimes referred collectively using abbreviation "STEM" further delving deeper into specific causes consequences associated with aforementioned issues ultimately striving identifying opportunities promoting greater inclusivity diversity thereby ensuring fairer representation benefiting society large due increased range perspectives leading innovative breakthroughs fostering collaborative approaches tackling complex challenges facing us present day extending far beyond realms mere statistical data said concerns serve reminder importance cultivating nurturing talents all individuals regardless race ethnicity background socioeconomic status importantly whether male female alike hence allowing everyone equal chance contributing positively our rapidly changing world long run, these efforts are crucial in creating a more equitable and diverse workforce capable of addressing the complex challenges we face today and into the future.

The research discussed in these articles focuses on the factors influencing individuals' career choices, particularly in science, technology, engineering, and mathematics (STEM) fields. The studies explore how motivation and gender play roles in shaping educational aspirations and occupational trajectories related to math. One of the key findings is that it's not a lack of ability but rather individual choice that leads to differences in pursuing careers within STEM disciplines. This challenges the common belief that certain genders or groups lack aptitude for these fields. Motivation also plays a significant role; it affects high school students' participation in mathematics as well as their future educational and career plans. Moreover, adolescents' motivational profiles have been found to be associated with achievement striving and psychological wellbeing. Gender has emerged as another crucial factor affecting career choices: girls are often less likely than boys to pursue careers involving maths due to societal perceptions about gender roles. These ideas can impact an individual's confidence when considering options within STEM professions. Furthermore, mathematical proficiency seems pivotal when making decisions regarding STEM-related occupations among both Australian and U.S adolescents – indicating its significance as a "critical filter" influencing such preferences over time across different cultures. These pieces underline important issues surrounding education paths linked with motivation levels relating specifically towards particular subjects like Mathematics which could influence one's later professional journey especially if they pertain towards Science-based areas where Math skills are essential In conclusion this body of work highlights various influences including personal motivations ,gender stereotypes, societal expectations along with relative abilities all impacting upon young people 's orientations toward potential scientific /mathematical based vocations. Addressing these influences and providing support for the development of mathematical proficiency early in education can have a significant impact on shaping future career choices and opportunities for young people across different cultures.

The research article "Gendered Motivational Processes Affecting High School Mathematics Participation, Educational Aspirations, and Career Plans: A Comparison of Samples from Australia, Canada, and the United States" examines how motivation influences high school students' participation in math education as well as their educational aspirations and career plans. The study compares samples from Australia, Canada, and the United States. The findings suggest that gender

plays a significant role in influencing these factors. For instance: - Girls tend to have higher self-concept scores than boys. - Both girls' interest in mathematics courses is lower compared to boys. - Boys are more likely than girls to spend longer hours per week on mathematics studies. Additionally, - Factors such as anxiety levels also impact students' engagement with mathematical subjects regardless of gender. It's important to note that while some individuals may perceive certain academic disciplines based on social stereotypes or personal beliefs about what fields they should pursue according to their genders – something referred here by researchers Vermandele et al., 2010-, many other external factors can influence this decision-making process including parental background (having parents who hold at least one university degree) . In Belgium specifically (Federation Wallonia Brussels), there's freedom for high school students regarding choosing between low or intensive weekly math coursework without it affecting access into specific college programs later down the line; however teachers might provide recommendations depending upon student performance but no particular track would condition enrollment for any field within tertiary institutions afterward Despite evidence showing females capable academically when enrolled in strong science-math tracks during secondary schooling period , post-secondary choices do not necessarily reflect corresponding interests which could be due lack formal standard exams hence putting emphasis onto individual motivations behind subject selection particularly relevant given context sought after potential impacts thereof Overall, the study emphasizes understanding motivational processes influenced by various aspects like perceptions related societal norms, culturally ingrained expectations among others rather focusing purely solely intellectual capabilities thereby reinforcing need examining broader spectrum attributing decisions concerning scholastic pursuits especially where traditional standardized evaluations aren't prevalent. This highlights the complexity of factors that contribute to academic and career choices, emphasizing the need for a more holistic approach in understanding and supporting students' educational paths.

The study investigates why girls tend to avoid pursuing studies in science, technology, engineering, and mathematics (STEM) fields. It explores how students' performance in math, motivation levels, and career aspirations at the end of their secondary education are influenced by various factors. One interesting finding is that there's a phenomenon called "stereotype threat," where girls may perform worse on math tests because they fear confirming stereotypes about female incompetence in this subject when their gender is known. To counteract this effect during testing for mathematical abilities among students without revealing their gender or names but using identification codes instead was observed. Another significant observation relates to socio-economic status: even though it has an impact on both boys' and girls' interest in STEM careers initially; once academic performance and other motivational variables related to studying mathematics are taken into account while controlling for these influences, its direct influence diminishes significantly over time. It also appears that higher hours spent weekly learning mathematics corresponds with decreased participation from females — especially those who attend classes with less than 4 hours per week compared to males who dominate such courses. This ties back into stereotype threats as suggested earlier since spending more time might lead towards greater confidence which could help negate negative impacts due societal prejudices against women's competence within technical subjects like maths etcetera. Interestingly enough too! Even if certain curriculums seem heavily focused around biological sciences including medicine - representing approximately 58% according data collected- majority still do not consider them "mathematical" based disciplines despite overlapping elements between them all showing no difference concerning either sex nor social standings after accounting student performances motivations number classroom lessons each day respectively However If we look profession oriented choices available individuals upon graduation then patterns become clear – here again same trends appear regardless whether male/female background In conclusion findings suggest neither socioeconomic status nor stereotypical expectations regarding genders have any substantial effects influencing pupils decision-making process rather what really matters most seems be personal achievements ambition dedication shown towards specific areas knowledge acquisition

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attaining future goals thereby breaking free traditional norms limitations placed society itself demonstrating equality opportunity should exist everywhere equally making sure everyone feels comfortable exploring options best suited individual interests skills ability succeed achieving desired outcomes irrespective external pressures imposed upon us daily basis. This emphasizes the importance of fostering an inclusive and supportive educational environment that empowers students to pursue their passions without limitations or stereotypes.

Researchers at the University of Liège are studying students' educational and career aspirations, focusing on mathematics, gender, international surveys, reading proficiency, and equity in education systems. They aim to understand how academic achievement influences young people's professional goals in French-speaking Belgium.

Gender differencies: a society problem (Bloodhart et al., 2020)

Key points

- **STEM is a program designed for exploration, discovery, and innovation.**
  - STEM programs provide students with the opportunity to explore different fields of science, technology, engineering, and mathematics.
  - STEM programs help students develop critical thinking and problem-solving skills.
  - STEM programs prepare students for careers in a variety of high-demand fields.
- **Women are underrepresented in STEM fields.**
  - Only 28% of STEM workers in the United States are women.
  - The gender gap in STEM is even wider in some fields, such as engineering and computer science.
  - There are several factors that contribute to the underrepresentation of women in STEM, including gender stereotypes, lack of role models, and bias in the workplace.
- **There are several things that can be done to increase the participation of women in STEM.**
  - **Encourage girls to take STEM courses in school.**
  - **Provide girls with opportunities to participate in STEM extracurricular activities.**
  - **Mentor girls and young women who are interested in STEM careers.**
  - **Create a more inclusive workplace culture for women in STEM.**

STEM is an important and growing field with a lot to offer women. By working together, we can increase the participation of women in STEM and create a more diverse and inclusive workforce.

As societies evolve, there is a growing need for exploration, discovery, and innovation. This drive leads to the development of careers in various fields including science, technology, engineering, and mathematics (STEM). Despite these being promising career paths crucial for the progress of an advanced society (Gauvreau 2015), women's representation in this field remains lower than that of men. Gender Disparity in STEM Fields Research by the Chair for Women in Science and Engineering (CFSG) between 2005-2020 revealed a notable increase in female enrollment at the collegiate level within natural sciences programs – from 49% to 55%. However, disparities emerge at university levels with fewer women pursuing STEM disciplines such as pure/applied sciences and engineering compared to health sciences or education. These disparities further manifest as only around12.8%of practicing engineers being female across Canada. Furthermore, female graduates predominantly specialize in health sciences rather than other scientific domains. Factors

Contributing To Gender Gap Inclusion The declining presence of females through academic progression into professional roles can be attributed to challenges related to maintaining a work-life balance. According to report by UNESCO (2017), women may face difficulties reconciling family responsibilities with their career aspirations. This is evident as they often relinquish their studies to prioritize family needs. While financial support plays a role, this discrepancy primarily relates to time management, such as childcare upon childbirth. Women bear the brunt of these responsibilities, hindering their profession al advancement opportunities. Therefore, cultural and societal expectations impact the progression of females within STEM fields, making it necessary to create inclusive practice supportive of time management requirements for female students and professionals alike. Furthermore, girls show less interest in future engineering or computing professions compared to biology or science-related disciplines during secondary school; thus, the presentation of science curriculums should be re-evaluated to spark interest amongst girls towards stem subjects like physics or engineering. Additionally, promoting links between science subjects such as physics and engineering shows potential inspiring girls to explore these areas. As physics teaching occurs during secondary education, it provides an opportunity to determine strategies to spark engagement amidst girls towards this subject matter in order to increase girls' interest in physics and engineering, it is important to provide role models and hands-on experiences that demonstrate the real-world applications of these subjects.

The text discusses the challenges women face in the labor market and their underrepresentation in science, technology, engineering, and mathematics (STEM) fields. It highlights factors such as motherhood affecting women's participation in the workforce. The presence of preschool-aged children reduces the percentage of employed women compared to men. Furthermore, it explains that societal values influence career choices; girls often associate themselves with human relationships which steer them towards social sciences and healthcare careers rather than pure or applied sciences or engineering. It emphasizes how lack of interest among girls is a major reason for dropping out from STEM programs at an older age. Female representation within these fields also impacts female interest while addressing issues relevant to young females can help engage them more effectively. Additionally outlined are stereotypes' roles influencing career decisions made by females along with recommendations on breaking those biases through diverse role models & demonstrating STEM's relevance across various aspects of life. Moreover, highlighted is a concern regarding high school physics classes where female students tend to show less enthusiasm due to disinterest despite its broader contextual diversity potential beyond what textbooks present. In conclusion: Women encounter obstacles like balancing work with childcare responsibilities leading to lower employment rates when there are preschool-aged children within households Societal values guide many girls toward social sciences instead of pursuing studies related directly into scientific field Losses stem primarily from declining interests amongst adolescent girl students over time Stemming partly from limited appeal found during education years especially concerning Physics courses thus underscoring need for educational material review aimed at enhancing engagement regardless gender . It is important to encourage and support girls in pursuing their interests in all fields, including the sciences, to create a more diverse and inclusive scientific community.

Issue of gendered education and career orientation (Lamoureux-Duquette, 2024)

Key points

- **Historically, women's work was undervalued and confined to domestic roles**
- **Societal perceptions limited women from entering STEM fields Gender-based educational segregation and lack of career guidance restrict women's professional advancement**

- **There are still gender disparities in the workplace, with women underrepresented in STEM fields and overrepresented in care professions**
- **Women continue to shoulder most of the housework**
- **The COVID-19 pandemic highlighted the gender gap in employment opportunities**

For centuries, work tasks were divided according to gender (Darmangeat et al., 2021). Women always worked but were not recognized; their domestic labor was not considered "productive." Until the late nineteenth century, they primarily held jobs such as domestic servants or textile workers—roles aligned with societal perceptions of their "natural" characteristics like dexterity. It was only after World War II that educational and career orientation presented historical trends in the division of labor based on gender, its political and social implications, and changes in women, leading to the recognition of female employment. These sparked studies revealing a dual impact—increased activity played a key role in emancipation, while persistent inequality confined them to repetitive participation in STEM fields over time. The author highlights how societal perceptions excluded them from this field for a long time due to stereotypes about low-wage jobs with little advancement prospects, leading to a double workload balancing paid employment and domestic chores (Battagliola, 2008; Delphy, 2003). Today, despite changes since the nineteenth century, the issue of gender equality remains pertinent given the continued divide guiding vocational choices by sex; women still dominate areas such as teaching, nursing, and humanities (Crespo, 2018). Since the 1980s, scholars from various disciplines have studied how differentiated schooling influenced the occupational spaces occupied by each sex. While women make up nearly half of the workforce, around 82% are found in the health sector, whereas only 21% enter natural sciences (Ministry of Health and Social Services, 2014). The gender-based division of labor has been historically ingrained; tasks were assigned according to gender within society overall, which extended even further at home, where some productivity was not recognized if performed by women. Women predominantly held domestic roles or textile-related jobs, reflecting societal perceptions of their natural traits like dexterity or precision until World War I, when they diversified into commerce and industry but reverted after men returned post-war. It was only after World War II that women began to enter the sciences, and female employment started to shift towards care professions.

Despite an increase in women's participation in low-paying jobs, upward mobility remains limited due to gender-based educational segregation and inadequate career guidance. These obstacles are exacerbated by domestic responsibilities, resulting in a double workload rooted in deep-seated biases. A study revealed that couples, even today, often discuss the education of young children, with women spending about an hour more per day managing domestic dynamics compared to men. These dynamics have long influenced professional advancement.

The author highlights current gender disparities, illustrating statistical evidence of inclusion and exclusion. Although nearly half of the women working in STEM (science, technology, engineering, and mathematics) are in fields like IT and management, they remain underrepresented in areas such as computer science and machinery operations, traditionally dominated by men.

Professional segregation begins early in academic pathways, where tasks are often assigned based on perceived feminine skills, as opposed to technical prowess typically associated with males. Stereotypical norms, rather than personal interests, influence these professional choices.

Historically, while some women primarily worked in domestic environments, observations show they were also present in the textile industry and other traditional sectors. Researchers have studied gender-segregated vocational guidance systems, often overlooked, that shape career expectations according to gender. The works of Battagliola (2008) and Delphy (2003) demonstrate persistent imbalances and a significantly higher influence of men in various industries.

After World War II, the representation rates of men in engineering and scientific sectors increased, while women, although more present in the workforce, did not eradicate traditional inequalities. New opportunities for women emerged, but career preferences remain influenced by feminine attributes before entering non-traditional fields.

The job market, influenced by economic and cultural factors, has impacted fields such as education and healthcare professions. Despite progress after the two world wars, women still face significant systemic barriers today.

Women suggest that limited progress in career advancement is often found in less profitable and continued job prospects that offer low pay. These jobs fail to address the root causes of pay inequality compared to their male counterparts. This is evident despite calls for comprehensive solutions to these issues. Data from the Institut de la Statistique du Québec reveals that, since entering the paid employment market, women face persistent workforce disparities. These disparities burden future generations, especially as women handle diverse household chores irrespective of the era (post-war onwards).

Initial studies show that upbringing and tackling dual responsibilities significantly shape women's career paths. There is a high representation of women in fields like education, humanities, social sciences, behavioral sciences, and law. However, men continue to dominate fields such as mathematics, computer science, and architecture. This gendered division extends beyond education into professional life, where technical roles are predominantly held by men.

Research from the late 1980s shows that women from various lower-paying backgrounds face limited career advancement opportunities. They tend to explore sex-segregated trends, while men often dominate higher-status occupations with better prospects. During the COVID-19 pandemic, it became evident that more women were employed in frontline roles, placing them at greater risk but also in precarious positions, leading to significant job losses.

Inequalities in the workplace highlight disparities that extend beyond work and persist in household chores. For instance, despite an increase in female participation within paid employment, women still dominate sectors involving caregiving and health sector labor. These responsibilities constitute nearly 80% of unpaid domestic work, perpetuating traditional gender roles. This reinforces societal divisions and economic disparities between men and women.

Moreover, workplace practices have significant consequences. Women are often found in fields that pay less compared to those dominated by men. According to the Quebec Institute of Statistics (2022), working-class women have more stable careers but still face substantial inequalities. More women are choosing careers in education, humanities, social positions, and health-related fields, while men dominate fields like mathematics and computer science. This trend starts early in education, with deeply entrenched stereotypes affecting women's career choices from early schooling years, further widening the gap compared to their male counterparts.

Choosing teaching, nursing, and counseling often leads women into two distinct labor markets: family care roles that impact earnings potential and career progression. This self-selection and segregation across academic disciplines result in women often occupying less prestigious and lower-paid jobs. During the COVID-19 pandemic, frontline roles were predominantly occupied by women, making them vulnerable not only due to exposure risks but also economically, as they faced higher unemployment rates and had to take parental leaves more frequently than their male counterparts.

Traditional gender norms persist within households, where domestic work primarily falls on women rather than being shared equally with men. This hinders their professional advancement. Studies have shown that this segregation continues into employment practices, with women often taking on roles with stable working hours but lower wages. Evening or weekend shifts, which

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usually come with additional financial compensation, are less accessible to women due to family responsibilities, reinforcing traditional work conditions based on outdated gender expectations.

These patterns significantly contribute to the socio-economic standing tied directly to gender-specific employment types, undervaluing traditionally "female" professions. This impacts both income potential and overall career progression, especially when part-time work becomes necessary for raising children, further entrenching existing disparities.

In conclusion, these findings highlight long-standing challenges related not only to educational pursuits but also to future opportunities, given their direct influence on workplace dynamics and broader societal constructs. Deep-seated biases influence decisions made around studies and subsequent occupation paths. Addressing these structural inequities requires concerted efforts to pave the way toward building fairer, inclusive systems that benefit all individuals irrespective of background. Empowering everyone to reach their full potential without barriers based on sex is crucial.

Women are often found in less profitable roles compared to men, with certain sectors being dominated by either gender. Data from the Quebec Institute of Statistics for 2001 and 2019 shows that women continue to dominate areas like education, humanities, social sciences, and health-related fields, while men are more prevalent in mathematics, computer science, and architecture. This division is also observed across various professional domains over time.

This pattern reflects deeply ingrained societal stereotypes about femininity and masculinity, influencing career choices among young individuals based on their gender. It leads to a segregated job market where women struggle to access high-paying or prestigious positions due to structural inequalities. During the COVID-19 pandemic, many frontline jobs were predominantly occupied by women, who faced higher unemployment rates and took on more parental leave compared to their male counterparts.

Traditional household responsibilities still disproportionately fall on women, even though their participation in paid employment outside the home has increased. The domestic work, which continues to be largely unpaid, remains primarily associated with women, while professional work is more often attributed to men. This dynamic affects women's career progression and financial stability.

Studies show that gender segregation continues in employment practices, with women often taking roles with stable schedules but lower wages. Evening or weekend shifts, which come with additional financial compensation, are less accessible to women due to family responsibilities. This reinforces traditional work conditions and contributes to ongoing socio-economic inequalities.

The statistics presented in this report indicate little social change over the past 20 years regarding gender diversity in fields like science, technology, engineering, and mathematics (STEM). Women are heavily represented in arts and humanities, while men dominate STEM fields. Although there have been some gains, with an increase from 19% to around 25% of women in natural and applied sciences between 1998 and 2018, these improvements remain modest.

In professions related to natural and applied sciences, the average hourly wage for men stands at $30.90 compared to $26.82 for women, revealing a 13.2% difference in favor of men (Boulet, 2014). Additionally, a study revealed that over 37% of male life sciences bachelor's degree holders pursued STEM courses compared to a mere 15% of females (Alonzo et al., 2005). Male graduates are also more likely to work in their field than their female counterparts (41% vs. 22%) and are less likely to be unemployed or inactive (Frank, 2002).

The data shows that despite some progress, women continue to face significant challenges in achieving equality in both educational and professional domains. Deep-seated biases influence decisions around studies and occupation paths, leading to structural inequalities. Addressing these

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disparities requires concerted efforts to create fairer, more inclusive systems that benefit all individuals, irrespective of gender, allowing everyone to reach their full potential without barriers.

More than half of female graduates in math and computer sciences end up not working in these fields, compared to only about a third of male graduates. Statistics from Canada in 2019 show that historically, women have always been involved with computers, but their contributions were often overlooked or undervalued. This was because computing was initially seen as an extension of typewriting rather than engineering work. This perception changed when personal computers became popular, and programming started being viewed as a conceptual and prestigious field suitable for men only.

In the 1960s and '70s, during the crucial period for modern computing development, about 30% of computer workers were women. However, these careers required high levels of expertise that aligned with values like self-education and experimentation, often excluding many competent women due to perceived lack of competency. By 1991, around 30% of those employed in computing were women, but this number dropped to just 25% by 2011. The mid-'90s saw technological advancements that shifted opportunities towards men, leading to the field's increased masculinization.

Presently, Quebec universities show minimal progress in gender balance. Between 2009 and 2021, the proportion of female computer science graduates increased only from 17% to 21%. Despite overall growth in science and technology degrees, the gender disparity remains significant. For example, between 2018-19, total computer science degrees grew by 522, but the female share was only 23%. Similarly, in 2020-21, degree growth hit 785, with women accounting for just 27%.

Efforts have been made to attract more women into STEM fields (science, technology, engineering, and mathematics), starting as early as elementary school. Programs like "Les filles et les sciences," which introduces high school girls to STEM professions, and "GéniElles," offering scholarships for young girls, are implemented to stimulate interest in these fields. UNESCO also celebrates the International Day of Women and Girls in Science, involving female professionals in events to provide positive role models.

Despite these efforts, the absolute number of female graduates has grown more slowly compared to their male counterparts. For instance, Polytechnique Montréal offers annual scholarships for female students pursuing engineering studies, and UQAM's ElleCode committee organizes networking and technical learning activities to encourage women in computing.

Critics argue that current programs targeting women and girls often focus on changing them rather than addressing issues within the educational environment. To improve interest in STEM fields among girls, it's suggested to tailor content based on their interests, involve them in how subjects are taught, and contextualize learning materials by relating them to real-world situations.

Although there has been progress in increasing female enrollment in STEM fields, significant underrepresentation of women remains. Effective strategies must address the educational and professional barriers that women face, ensuring they have equal opportunities to pursue and sustain careers in these traditionally male-dominated fields.

Educators need to rethink how they structure activities, especially considering that women's preferred learning methods may differ from those typically used in classrooms. While efforts have been made to attract women to STEM fields, existing programs may inadvertently reinforce stereotypes by focusing on changing women rather than addressing systemic issues within educational environments. Research suggests several strategies to foster girls' interest in STEM subjects, including tailoring content based on their interests, highlighting achievements of female scientists, and contextualizing scientific concepts in real-world situations.

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However, there is little emphasis on social analysis related to gender issues within education systems or training programs. Despite stable numbers of women studying computer science since the 1990s, very few choose to pursue careers in this field. Understanding the factors influencing women's decisions in this regard requires a thorough examination of their social and academic experiences.

Ongoing employment disparities between genders, particularly in male-dominated fields such as sciences, remain significant. This review aims to shed light on the processes affecting women's decisions regarding employment after obtaining computer science degrees. It explores various factors influencing career choices and aims to provide a comprehensive understanding of the barriers hindering women's full participation in STEM fields.

While efforts have been made to promote diversity in STEM fields, there is still a significant drop-off of women once they finish higher education. Addressing these barriers requires dismantling systemic challenges and creating an environment that fosters inclusivity and equal opportunities for all genders.

Fewer individuals are stepping into leadership roles in fields traditionally seen as male-dominated after graduating, leading to a shift away from the perception of certain scientific areas as exclusively male territories. Sustainable science is becoming increasingly important as a result. Durkheim, a pioneer in understanding the link between society and education, emphasized the role of schools in transmitting common values to prepare individuals for their societal roles. He prioritized what should be taught over how it should be taught. In the 1960s and 1970s, Bourdieu and Passeron argued that schools perpetuate social inequalities by favoring the culture of dominant classes. They introduced the concept of "habitus," which refers to ingrained behaviors shaped by one's social background. According to them, schooling serves to reproduce both individuals and societal structures. Bourdieu's theory extends beyond economic capital to consider relational aspects such as individuals' perceptions of themselves within their social class compared to others'. This phenomenon is known as the "leaky pipeline," where fewer women pursue careers in Science, Technology, Engineering, and Mathematics (STEM) despite efforts to attract and retain them. Boudon offers individualistic explanations for unequal academic success based on rational decision-making processes influenced by cultural backgrounds.

The study aims to: Examine and describe the educational paths of women studying or graduating with degrees in computer science; Understand female experiences during university-level studies in computer sciences; Analyze obstacles faced by these individuals, which may influence their desire for professional integration into this field; Investigate if challenges they face are specifically linked to being a woman.

Computer science encompasses both theoretical aspects and practical applications related to problem-solving using computers, according to Sherbrooke University's definition. Longitudinal analysis is used to understand how various hurdles impact girls enrolled in computing courses. Despite efforts to attract and retain women in the field of science, many end up working in other fields after completing their studies. The challenges faced by women extend beyond the workplace and affect their academic journey. This study seeks to understand why there's a consistent low representation of women studying computer science since the 1990s despite recruitment efforts. It also focuses on gender disparities in educational systems and employment stages.

The author discusses the ongoing challenge facing STEM sectors, especially Computer Sciences, in attracting and retaining women despite years of efforts. The impact starts from lower academic levels and continues through educational systems and into employment stages. He delves further into theories guiding exploration, including sociological perspectives on educational pathways among other topics.

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Durkheim's view highlights the importance of transmitting shared values in society through education, while Bourdieu and Passeron emphasize how schools reinforce societal disparities. Boudon stresses the significance of personal agency in educational decision-making processes. The evolution of vocational guidance, initially centered around career advice, has shifted to encompass broader support services, especially during times of economic uncertainty like the Great Depression. Durkheim underscores the importance of schools in transmitting shared values and preparing individuals to integrate into society. Bourdieu and Passeron highlight the role of schools in perpetuating societal disparities, while Boudon emphasizes personal agency in educational decision-making.

Insights from historical contexts shed light on how vocational counseling evolved, especially in navigating turbulent times post-Depression era Québec, demonstrating an ongoing understanding of supporting individuals in making educated choices about their futures. Vocational counseling after primary school involves analyzing inequalities within education, selecting university programs, and identifying suitable candidates, focusing on vulnerable populations. It employs longitudinal methodology influenced by biographical methods to understand factors impacting education paths.

Traditionally, school orientation aims to find individuals' places in society by aligning aspirations with opportunities, considering factors like social class and gender stereotypes. However, this process may create new inequities, particularly related to computer science programs and professional integration decisions. Understanding these barriers provides insight into accessing professions and navigating career choices.

Transitions, such as progressing from kindergarten to secondary school or moving into specialized domains like vocational training, are critical moments in an individual's academic journey. In Quebec, transitioning from high school to college before entering university is becoming more common, complicating the traditional path to higher education.

Social background significantly influences secondary education experiences and access to college. Vulnerable populations face additional challenges, while students from privileged backgrounds enjoy advantages in staying longer in school and having more options for their career paths. Research shows that social origins impact secondary education and college access, highlighting the importance of analyzing inequalities within the education system.

The sociology of educational pathways employs longitudinal and biographical methods to study non-linear temporal dynamics, considering three types of time simultaneously: chronological age, social time marked by life events, and historical context. This multidimensional framework allows for a deeper understanding of how student representations shape academic orientation decisions.

Analyzing educational trajectories involves four key analytical axes: interactions between individuals and schools, subjective aspects influencing engagement levels, non-school-related conditions impacting school circumstances, and successive life events shaping academic experiences. This research aims to understand the impact of computing academics on higher retention rates and professional choices post-graduation, considering factors like socioeconomic status and work-family-study balance.

External factors such as peer influence, health issues, or personal events, like early pregnancy, may affect an individual's educational path. However, this approach suggests a linear temporality where individuals are seen as experiencing events in a logical order dictated solely by aging progressions, without considering unique personal circumstances or influences outside chronological timing. A multidimensional analysis framework offers greater flexibility regarding schooling experiences, not imposing strict linearity onto them but acknowledging transactions between individuals' interactions with socio-economic contexts during their course. This framework presents insight into future plans, integrating gender analysis with sociological perspectives that have evolved over time.

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In the past, sociology of education focused mainly on social class and paid little attention to gender issues, often overlooking women's educational situations. However, there has been a shift towards understanding the role of gender in education. Researchers now emphasize understanding students' experiences in the field of computer science and its impact on gender dynamics at school and beyond. They explore various aspects influencing educational journeys, considering objective elements like social positions and subjective factors such as personal experiences.

Additionally, research in the sociology of education has evolved to consider the impact of non-school-related situations on a student's academic journey, providing insights into future endeavors. It aims to achieve a comprehensive understanding across all fields, shaping contributions to society and global development. This evolving perspective calls for inclusive representation across diverse demographics, especially concerning gender inclusivity in academic and research careers.

As we move forward with sociological insights, it becomes crucial to address questions concerning gender roles and biases within educational pathways and career choices for women. Research now combines educational theories related to student orientation and transitions with a specific emphasis on gendered processes influencing students' choices. The aim is to gain insight into female students' schooling experiences and address disparities within computer science programs, emphasizing the need for action to rectify gender imbalances in STEM fields.

Overall, ongoing research seeks not just to reproduce existing disparities but also to acknowledge possibilities for change and achieve gender parity in traditionally male-dominated fields like computer science. While challenges remain, progress is attainable with continued support and encouragement, paving the way for a more inclusive and equitable educational landscape.

In Canada, certain professions like natural and applied sciences, trades, transportation, machinery-related jobs, as well as agriculture and public services, have traditionally been seen as male-dominated fields. Research indicates that while women express interest in these areas, they often choose not to pursue them due to perceptions of being unwelcome or facing challenges related to proving their abilities in male-dominated environments. However, researchers have begun to highlight how schools perpetuate gender roles and biases, influencing students' career choices.

Initially, studies primarily focused on how societal norms influenced women's career decisions, with little consideration for individual skills or interests. However, as societal changes occurred in the 1960s, such as increased female academic success and coeducation, opportunities for unconventional educational paths for girls emerged. The concept of "transfuge," which describes social mobility through academic success, has been applied to unconventional educational choices, allowing individuals from lower socioeconomic backgrounds to achieve upward mobility.

Furthermore, research indicates that deviation from typical career paths is viewed negatively, while conforming to traditional gender roles is perceived more favorably. Girls often avoid male-dominated fields due to perceptions of incompatibility with family life or fears of facing challenges and discrimination in those environments. On the other hand, choosing careers aligned with traditional gender roles is seen as easier and more socially acceptable, reinforcing existing gender norms.

However, it's important to recognize that educational choices are not solely based on personal interests or skills but are heavily influenced by societal gender norms. The socio-sexual division of knowledge, where certain subjects are associated with specific genders, affects students' professional aspirations. For instance, sciences are often perceived as masculine, while humanities are associated with femininity, leading to disparities in academic choices between genders.

Moreover, women studying in male-dominated fields face various obstacles, including stereotype threats, biases in campus culture, and gender-based discrimination, which affect their academic performance and confidence levels. This perspective underscores the need for comprehensive

efforts to address preconceived attitudes and societal expectations, particularly within STEM fields, to ensure equitable opportunities for all individuals, regardless of gender.

The author discusses the pervasive influence of gender norms on career choices and educational paths, particularly in fields like STEM (Science, Technology, Engineering, and Mathematics). It highlights how societal perceptions about gender roles and stereotypes affect individuals' decisions, especially young women, regarding their academic pursuits and career aspirations.

In the job market, workplace discrimination based on gender is common, reflecting deeply ingrained views about gendered occupational divisions. This discrimination is evident not only in employment outcomes but also in the experiences of individuals within male-dominated fields like STEM. Women often face additional barriers due to societal expectations aligned with traditional masculinity norms, creating significant obstacles to their presence and success in these fields.

The text underscores the complexity of factors influencing individuals' career choices, including familial background, societal expectations, and personal goals. Despite efforts to promote gender diversity in STEM, stereotypes persist, discouraging women from pursuing careers in these fields. The lack of female representation further contributes to feelings of insecurity and exclusion among women studying or working in STEM.

Moreover, the text highlights how gender biases manifest in campus culture, classroom experiences, and recruitment processes, leading to disparities in opportunities and outcomes for women. Women encounter various forms of sexism, from subtle comments to overt discrimination, which affect their confidence and professional insertion.

Efforts to address gender imbalance in STEM and other male-dominated fields require comprehensive initiatives aimed at dismantling systemic biases and promoting inclusivity. These initiatives should focus on curriculum planning, fostering belongingness, and challenging stereotypes about gender roles and abilities.

Ultimately, achieving gender diversity in the workforce is essential for fostering innovation and creating fairer work environments. However, it requires ongoing dialogue and action to address entrenched gender biases and create opportunities for all individuals, regardless of gender identity.

Others researches on gender differences: key points

- **Gender Parity Trends:**
  - More females are entering higher education, and gender gaps in STEM are narrowing, especially in the elite and mass stages of education (Chang & ChangTzeng, 2020; Smith, 2011).
  - Despite increased female participation in higher education, gendered patterns of participation persist in specific STEM fields like physics and engineering (Smith, 2011).
- **Influence of Educational Context:**
  - High school environments significantly impact students' plans to major in STEM fields, with schools that have strong STEM curricula and less gender segregation in extracurricular activities reducing the gender gap (Legewie & DiPrete, 2014).
  - Participation in extracurricular STEM programs and mentoring can positively influence female students' certainty about career goals and increase their engagement in STEM activities (Stoeger et al., 2016).
- **Classroom Dynamics and Self-Efficacy:**
  - In active-learning STEM classrooms, men tend to participate more than women, who report lower scientific self-efficacy and greater salience of gender identity (Aguillon et al., 2020).

- Research apprenticeship programs enhance self-efficacy and interest in STEM careers, with significant gender differences in attitudes and expectations towards pursuing STEM careers (Sasson, 2019).

- **Cultural and Societal Influences:**
  - Gender gaps in STEM participation are larger in societies with greater freedom of choice, where cultural patterns emphasize self-expression and identity fit, leading women away from STEM fields (Soylu Yalcinkaya & Adams, 2020).
  - In more collectivistic societies, where financial security and relational expectations are prioritized, both men and women are more likely to pursue STEM fields, resulting in smaller gender gaps (Soylu Yalcinkaya & Adams, 2020)
- **Impact of Undergraduate Research Experiences:**
  - Women are more likely to participate in undergraduate research experiences (UREs) and identify these experiences as a primary reason for pursuing graduate education in STEM fields (Harsh et al., 2012).
  - UREs contribute to similar learning enhancements for both genders but show gender-based variations in self-efficacy and interest in science (Harsh et al., 2012).
- **Barriers and Support Systems:**
  - Personal, environmental, and behavioral factors, including family and school support, significantly influence women's decisions to enroll in STEM degrees and pursue STEM careers (Tandrayen-Ragoobur & Gokulsing, 2022).
  - Women in STEM careers face significant challenges compared to their male colleagues, highlighting the need for supportive work environments (Tandrayen-Ragoobur & Gokulsing, 2022).

Soidet and Vrignaud (2018) highlight the following key points regarding gender differences in STEM fields:

- **Girls are less likely to pursue STEM careers:** Compared to boys, girls are more likely to abandon scientific aspirations during middle school and shift towards social sciences or arts. This is especially true for girls from lower socioeconomic backgrounds.
- **Societal norms and expectations:** Societal messages about career opportunities and gender roles significantly influence young people's choices. Girls might be discouraged from pursuing STEM due to stereotypes and a lack of female role models.
- **Impact of family background:** Parental education level plays a role. Children of less educated parents, particularly girls, are less likely to pursue STEM fields.
- **Importance of self-efficacy:** Belief in one's abilities, especially in math, is crucial for pursuing STEM careers. Low self-efficacy can limit girls' interest in these fields.
- **Social support matters:** Parental encouragement, having parents working in STEM fields, and engaging in relevant social activities can boost girls' confidence and interest in STEM.
- **Unequal treatment in education:** Gender bias within the educational system can negatively impact girls' confidence in their abilities and discourage them from pursuing STEM subjects. Teachers might unconsciously provide biased guidance towards girls.

The autors emphasize the need for interventions to address these gender differences:

- **Teacher training:** Educators need training to identify and challenge their own biases, ensuring equal opportunities and promoting STEM fields for all students.
- **Reflective tools:** Creating tools to help students, parents, and educators challenge their beliefs about STEM subjects and encourage girls' participation.

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- **Policy changes:** Active policy changes are needed to address gender bias within the educational system and promote equal access to STEM education for all.

Overall, by creating a more supportive and inclusive environment, we can encourage more girls to pursue careers in STEM fields and contribute to a more diverse and successful future workforce.

Ferrière and Morin-Messabel (2019) highlight the following key points regarding gender differences in STEM fields:

- **Stereotypes and Career Choices:**
  - Science and engineering are stereotyped as masculine, leading girls to be less interested in these fields.
  - Boys tend to gravitate towards STEM careers like computer science, while girls lean towards health professions.
  - These stereotypes limit opportunities for both genders.
- **Impact on Girls:**
  - Girls experience anxiety and lower confidence in math and science compared to boys.
  - Exposure to masculine imagery associated with scientists (e.g., older white man in a lab coat) discourages girls from pursuing these careers.
  - Language used in job descriptions and classrooms can influence girls' perceptions of their suitability for STEM fields.
- **Breaking the Stereotypes:**
  - Using gender-neutral language ("scientist" instead of "male scientist") encourages girls to see themselves in STEM roles.
  - Exposing children to diverse portrayals of scientists (including women and people of color) can broaden their perceptions.
  - Educational programs that challenge stereotypes and promote role models in STEM fields can inspire girls to pursue these careers.

For the authors, gender stereotypes significantly influence how students perceive STEM fields. They mention to dismantle these stereotypes through inclusive language, diverse role models, and educational interventions to ensure equal opportunities in STEM for all genders.

Canzittu and Wiels (2019) emphasize how societal stereotypes discourage girls from pursuing Science, Technology, Engineering, and Mathematics (STEM) fields:

- **Stereotype and Discouragement:** Science and engineering are seen as masculine, making girls feel less confident and interested compared to boys. This steers them towards other career paths, limiting opportunities for both genders.
- **Impact on Girls:** Girls often experience anxiety in math and science, and stereotyped images of scientists (typically an older white man in a lab coat) reinforce these negative feelings. Even the language used in classrooms and job descriptions can influence their perceptions of suitability for STEM careers.
- **Breaking the Stereotypes:** Using gender-neutral language ("scientist" instead of "male scientist") can encourage girls to see themselves in these roles. Exposing them to diverse portrayals of scientists, including women and people of color, can broaden their horizons. Educational programs specifically designed to challenge stereotypes and showcase female role models in STEM fields can inspire girls to pursue careers in these areas.

Overall, dismantling gender stereotypes through inclusive language, diverse representation, and targeted educational programs is crucial to ensure equal opportunities in STEM fields for both girls and boys.

Carrein-Lerouge and al. (2019) highlight the following key points regarding gender differences in STEM fields:

- **Stereotypes and Discouragement:**
  - Societal stereotypes portray STEM fields (science, technology, engineering, and mathematics) as masculine, discouraging girls from pursuing them.
  - This steers girls towards other career paths, limiting opportunities for both genders.
- **Impact on Girls:**
  - Girls often experience anxiety and lower confidence in math and science compared to boys.
  - Stereotypical images of scientists (typically an older white man in a lab coat) reinforce these negative feelings.
  - Even the language used in classrooms and job descriptions can influence their perceptions of suitability for STEM careers.
- **Challenges in Addressing Bias:**
  - Educators may unintentionally suppress their own biases, leading to a "boomerang effect" where they become less supportive of girls in non-traditional STEM fields.
  - Even when educators try to be unbiased, societal stereotypes can still influence their decisions.
- **Importance of Breaking Stereotypes:**
  - Using gender-neutral language ("scientist" instead of "male scientist") can encourage girls to see themselves in these roles.
  - Exposing children to diverse portrayals of scientists, including women and people of color, can broaden their horizons.
  - Educational programs specifically designed to challenge stereotypes and showcase female role models in STEM fields can inspire girls to pursue careers in these areas.
- **Need for Further Research:**
  - More research is needed to understand how to effectively address the "boomerang effect" of bias suppression.
  - Studies should explore the impact of gender stereotypes on boys considering traditionally female careers.
- **Overall Goal:**
  - To create a more inclusive and equitable educational environment where all students, regardless of gender, are encouraged to pursue their interests and talents.

Gaudron (2019) highlights the following key points regarding gender differences in STEM fields:

- **Statistics Show Major Disparities:**
  - Educational and career paths are heavily influenced by gender.

- Fields like healthcare attract mostly women, while engineering leans towards men.
- Women are underrepresented in leadership positions and work more part-time jobs compared to men.

❖ **Psychology Examines Underlying Reasons:**

- Research explores personality traits, societal expectations, and social contexts that shape gender roles.
- Studies challenge the idea of clear-cut differences between men and women, suggesting more diversity within each group.
- Social beliefs about gender can significantly influence perceptions and career choices.

❖ **Focus on Social Contexts and Breaking Stereotypes:**

- Researchers are investigating how educators, parents, and peers influence children's career aspirations.
- Training for educators and activities that address stereotypes early on are crucial.
- Language used in classrooms and career guidance can impact girls' perceptions of STEM fields (e.g., using feminine terms like "scientist" encourages a broader view).
- Programs like "S'Orienter" aim to empower individuals to make career choices free from gender bias.

❖ **Overall Goal:**

- To understand the factors behind gendered career paths and promote educational and professional opportunities for all, regardless of gender.

Alcorta et al. (2020) highlight the following key points regarding gender differences in STEM fields:

❖ **Limited Math Achievement Gap:**

- Contrary to stereotypes, boys and girls performed similarly in math across all grade levels.
- This finding challenges the notion that boys are naturally better at math.

❖ Girls Excel in French:

- Girls consistently outperformed boys in French throughout their schooling.
- This advantage emerged early and persisted through high school.

❖ Motivation Varies by Subject and Gender:

- In primary school, academic performance in French predicted interest for both genders.
- Later, girls displayed higher interest and confidence in French compared to boys with similar grades.
- Boys initially showed greater interest in math, but this waned by high school.
- Girls felt more competent and interested in math compared to boys by the beginning of high school.

❖ **Possible Explanations:**

- Teaching methods might favor one gender over the other, especially in French.
- Curriculum design could be influencing students' preferences and career choices.

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- Parental attitudes and societal expectations may play a role.

❖ **Need for Further Research:**

- Longitudinal studies could track students over time to understand if these trends persist.
- More research is needed to explore the underlying causes of these disparities.

❖ **Implications for Education:**

- Curriculum and teaching methods should be reviewed to ensure they don't favor one gender over the other.
- Strategies are needed to encourage boys' engagement and motivation in French.
- Parental and societal attitudes towards STEM fields for girls and humanities for boys need to be addressed.

Gaudron (2020) discusses various scholarly articles on gender studies, highlighting the social construction of gender and its influence on perceptions and behaviors. Here's a summary focusing on aspects related to Gender Differences in STEM fields:

❖ **Stereotypes and Biases:**

- People tend to rely on stereotypes about men and women when explaining gender gaps in STEM careers.
- Essentialist beliefs (assuming inherent traits based on gender) can limit opportunities for women in these fields.

❖ **Societal Expectations:**

- Societal norms and expectations regarding femininity and masculinity can discourage girls from pursuing STEM subjects.
- Educational systems might reinforce these biases, hindering girls' interest and progress in science and math.

❖ **Feminist Perspectives:**

- Feminist theories challenge the idea that gender determines career choices.
- Research explores social and cultural factors that shape career paths, advocating for equal opportunities in STEM for girls.

❖ **Countering Gender Disparities:**

- Studies emphasize the importance of early interventions to encourage girls' engagement in STEM subjects.
- Strategies to deconstruct gender stereotypes and promote inclusive learning environments are crucial.

❖ **Further Research:**

- More research is needed to understand the underlying causes of gender disparities in STEM.
- Longitudinal studies tracking students over time can offer valuable insights.

Overall, the passage highlights the complex interplay between social constructs, stereotypes, and individual choices regarding gender and career paths in STEM fields. It emphasizes the need for

dismantling gender barriers and creating a more inclusive environment in science, technology, engineering, and mathematics.

Montmasson-Michel (2020) explores how social background and gender interact to influence a child's experience in preschool. Here are the key takeaways regarding gender differences:

- **Socialization and Language Development:**
  - Girls from all backgrounds tend to use communication styles that align well with school expectations.
  - Family dynamics play a crucial role in shaping language skills. Girls from stable backgrounds often benefit from exposure to rich vocabulary and shared activities like reading.
  - Boys, particularly those from lower socioeconomic backgrounds, may struggle to switch between formal and informal speech patterns, impacting their academic performance.
- **Play and Gender Norms:**
  - Popular culture and toys influence children's play and behavior. Toys for girls often promote fine motor skills and communication, aligning with school requirements.
  - Boys' play can be more disruptive and involve symbolic expressions of masculinity, potentially creating conflict with school norms.
  - Girls might face pressure to conform to traditional femininity even in their play activities.
- **Academic Performance:**
  - Girls generally show stronger performance in language skills and early literacy compared to boys.
  - However, girls from underprivileged backgrounds might struggle due to limited access to educational resources at home.
- **Overall Educational Experience:**
  - Girls tend to navigate social norms and expectations more carefully than boys, potentially impacting their classroom participation.
  - Boys from dominant social classes might have an advantage due to their assertive behavior and existing cultural capital.

The study emphasizes the need for educators to be aware of these complexities and create inclusive learning environments that cater to diverse needs and backgrounds.

Giguère and al. (2020) highlight gender differences in various aspects of work, particularly focusing on women's experiences in STEM fields. Here are the key takeaways:

- **Socialization and Stereotypes:**
  - Societal expectations and gender roles can influence career choices. Women may face pressure to conform to traditional femininity, even in STEM fields.
  - Gender stereotypes can discourage girls from pursuing STEM careers, impacting their self-efficacy and leading to unequal representation in these fields.
- **Leadership and the Glass Ceiling:**
  - Women in STEM fields might be passed over for leadership positions due to unconscious bias.

- The "glass ceiling" phenomenon refers to the invisible barrier preventing women from reaching top positions.

❖ **Work-Life Balance:**

- Women in STEM may struggle to balance work and family responsibilities, leading to career challenges.
- Some studies explore strategies used by female entrepreneurs to manage work-life balance.

❖ **Compassion and Care Work:**

- The emotional labor performed by women in STEM fields, particularly in healthcare, might be undervalued compared to other professions.

❖ **Possible Solutions:**

- The importance of creating inclusive work environments that support and promote women in STEM is emphasized.
- Re-evaluating traditional career concepts and promoting feminist ideology in workplaces are suggested approaches.
- Dismantling unconscious bias and fostering equal opportunities are crucial for achieving genuine gender parity in STEM fields.

The passage underlines the need to address these complexities and create a more equitable work environment where women in STEM can thrive based on their qualifications and contributions.

Doray and al. (2020) underline key Points on Gender Differences in STEM Fields (based on the Quebec college system)

❖ **The Problem:**

- Girls are underrepresented in traditionally male-dominated programs (e.g., engineering, computer science).
- Even when girls enroll, they are more likely to switch majors compared to boys.
- This perpetuates gender segregation in the workforce.

❖ **Factors Affecting Girls' Choices:**

- **Socialization:** Gender stereotypes discourage girls from pursuing STEM fields.
- **Family Background:** Girls from disadvantaged backgrounds are more likely to switch majors.

❖ **School Experiences:**

- Feeling like a minority in male-dominated programs.
- Facing social challenges and isolation from male peers.
- Experiencing sexism from teachers and peers (both hostile and benevolent).
- Curriculum geared towards students with prior knowledge (often boys).
- Feeling pressure to outperform boys to prove themselves.

❖ **Consequences:**

- Girls may lose interest in STEM fields due to these challenges.
- They may choose traditionally "feminine" career paths instead.
- This reinforces gender inequality in the workforce.

❖ **The Need for Change:**

- We need to challenge gender stereotypes and create a more inclusive educational environment.
- Support systems are crucial to help girls succeed in male-dominated programs.
- Educational policies and interventions should be developed based on a comprehensive understanding of these issues.

❖ **Additional Considerations:**

- The study emphasizes the importance of intersectionality (considering how factors like race and class interact with gender).
- More research is needed on boys who choose female-dominated programs and how gender norms affect their experiences.
- Longitudinal studies can reveal long-term trends in students' choices.

Overall, this research highlights the complex interplay of factors that influence girls' choices in STEM fields. By addressing these issues, we can create a more equitable learning environment and encourage girls to pursue their full potential in these important fields.

Kergoat (2020) highlights key Points on Gender Differences in French Apprenticeship System

❖ **The Problem:**

- Girls are underrepresented in apprenticeships, especially in male-dominated fields like mechanics and electronics.
- This reinforces traditional gender roles and expectations.

❖ **What Research Shows:**

- Studies challenge the assumption that girls' career choices lead to their underrepresentation.
- Gender bias in selection processes seems to be a major factor.
- Girls face pressure to conform to feminine ideals during the application process.
- Girls may be discouraged from pursuing "masculine" fields due to lack of facilities and potential harassment.

❖ **Consequences:**

- Girls miss out on opportunities in high-demand fields.
- Perpetuates gender segregation in the workforce.
- Creates a less inclusive and diverse work environment.

❖ **What Needs to Change:**

- More research is needed on selection processes and how they impact girls.
- Educational systems need to provide better career guidance that breaks down gender stereotypes.
- Apprenticeship programs should create a more welcoming environment for girls in non-traditional fields.
- We need to address societal pressures that push girls towards certain career paths.

Giguère and al. (2021) highlight key Points on Gender Differences in Reaching Leadership Positions

❖ **Challenges Faced by Women:**

- Balancing work, family, and education throughout their careers.

- Entering leadership roles indirectly, often through multiple job transitions.
- Reconciling academic expectations with workplace realities.
- Navigating a male-dominated organizational culture.
- Discrepancies between what they learned and the realities of starting out in a professional role.

❖ **Factors Shaping Career Paths:**

- Initial academic choices influenced by personal interests and family background.
- Early work experiences helping women understand their values and redefine priorities.
- Need to adapt to different organizational cultures.
- Importance of considering "living labor theory" which acknowledges the interdependence between work, family, and personal life.

❖ **Implications for Counseling:**

- Need for career counseling that considers individual life projects and aspirations.
- Importance of acknowledging the challenges of balancing work and family life.
- Counseling can help women develop self-awareness, strategies, and utilize resources for navigating career paths.

❖ **Limitations of the Study:**

- Focused on women in leadership roles with direct personnel supervision, may not represent all management positions.

❖ **Future Research:**

- Explore how work experience shapes identity construction among female executives in male-dominated industries.

Mercier-Brunel (2023) highlights the key points on focusing on gender differences:

❖ **Key Points on Focusing on Gender Differences**

- **Gender stereotypes and biased evaluations:** Teachers' evaluation practices can inadvertently contribute to gender inequalities. Teachers may unconsciously hold biased beliefs about students' abilities based on their gender, which can influence their evaluations. This can lead to girls being under-evaluated and boys being over-evaluated.
- **Self-regulation and gender:** Self-regulation is the ability to set goals, monitor progress, and adjust strategies to achieve those goals. Studies have shown that self-regulation is a key factor in academic success. However, girls are often less confident in their ability to self-regulate than boys. This can be due to a number of factors, including gender stereotypes and biased evaluations.
- **The importance of fair assessment:** Fair assessment is essential for supporting learning self-regulation. When students feel that they are being assessed fairly, they are more likely to be motivated to learn and take control of their own learning. Teachers can promote fair assessment by using a variety of assessment methods, providing clear feedback, and involving students in the assessment process.

❖ **Recommendations for Addressing Gender Differences**

- **Provide teachers with training on gender bias:** Teachers need to be aware of their own biases and how these biases can affect their interactions with students. Training can help

teachers to identify and address their biases, and to develop more equitable teaching practices.

- **Create a supportive classroom environment:** Girls need to feel safe and supported in order to thrive in the classroom. Teachers can create a supportive environment by fostering a sense of community, encouraging respect for all students, and providing opportunities for students to share their voices.
- **Use a variety of assessment methods:** Traditional assessment methods, such as tests and quizzes, can be biased against girls. Teachers should use a variety of assessment methods, such as portfolios, projects, and self-assessment, to get a more complete picture of students' learning.
- **Provide students with opportunities to self-regulate:** Students need to be given opportunities to practice self-regulation skills. Teachers can do this by providing students with goal-setting activities, helping students to monitor their progress, and teaching students effective study strategies.

By taking these steps, we can help to create a more equitable learning environment for all students.

Typology of factors contributing to gender differences

Social and cultural factors	Girls are often stereotyped as being less talented in maths and STEM than boys. Low self-efficacy can limit girls' interest in these areas.	(Jaegers & Lafontaine, 2020 ; Soidet & Vrignaud, 2018 ; UNESCO, 2017 ; Vroomen, 2023)
	Maths is often seen as a male subject.	
	Girls may receive less encouragement than boys to pursue mathematics.	
	Girls have fewer models of 'scientific individuals' to project themselves towards.	(UNESCO, 2017)
	Girls may face more prejudice than boys in the STEM world.	
	The language used in job descriptions and classrooms can influence girls' perceptions of their suitability to work in STEM fields.	
Educational factors	Girls may be less likely to be placed in advanced mathematics courses. They may feel like a minority in male-dominated programmes.	(Doray & al., 2019 ; Jaegers & Lafontaine, 2020 ; Soidet & Vrignaud, 2018 ; Vroomen, 2023)
	Girls may receive less support from teachers in maths classes.	

	Girls may be more likely to feel anxiety about maths and STEM.	
	Gender bias within the education system can have a negative impact on girls' confidence in their abilities and discourage them from pursuing STEM subjects. Teachers may unconsciously provide biased guidance towards girls.	(Soidet & Vrignaud, 2018)
	Girls may feel under pressure to outperform boys to prove their worth.	(Doray & al., 2019)
Motivational factors	Women are often less motivated than men to pursue studies in these fields, especially girls from lower socio-economic backgrounds.	(Soidet & Vrignaud, 2018 ; Vroomen, 2023)
	Girls tend to have a lower perception of the usefulness of mathematics than boys.	
Family factors	Parents' level of education plays a role. Children of less educated parents, particularly girls, are less likely to pursue STEM subjects.	(Ferrière and Morin-Messabel, 2019; Soidet & Vrignaud, 2018)
	Parental encouragement, having parents working in STEM fields and involvement in relevant social activities can boost girls' confidence and interest in STEM.	

Recommendations

Interventions to Address Gender Differences in Education:

- Early Childhood Interventions: Expose girls to mathematics in a positive and engaging manner. Encourage girls to believe in their math abilities. Show girls that mathematics is relevant in their lives (Jaegers & Lafontaine, 2020).
- Kindergarten to 12th Grade Interventions: Place girls in advanced mathematics courses. Provide girls with support from teachers and mentors. Create a welcoming classroom environment for all students (Jaegers & Lafontaine, 2020).
- Higher Education Interventions: Offer scholarships and other financial aids to women interested in majoring in mathematics. Provide mentoring and support services to women in STEM fields (Jaegers & Lafontaine, 2020).
- Teachers can strive to create an inclusive learning environment for all students (UNESCO, 2017; Vroomen, 2023).

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- Parents and mentors can encourage girls to pursue studies in STEM fields (UNESCO, 2017; Vroomen, 2023).
- Programs can be developed to help women succeed in STEM fields (UNESCO, 2017; Vroomen, 2023).
- Provide girls with opportunities to participate in STEM extracurricular activities (UNESCO, 2017; Vroomen, 2023).
- Mentor girls and young women interested in STEM careers (UNESCO, 2017; Vroomen, 2023).
- Create a more inclusive work culture for women in STEM fields (UNESCO, 2017; Vroomen, 2023).
- High school environments significantly impact students' plans to major in STEM fields, with schools that have strong STEM programs and less gender segregation in extracurricular activities reducing the gender gap (Legewie & DiPrete, 2014).
- Participation in extracurricular STEM programs and mentoring can positively influence female students' certainty about career goals and increase their engagement in STEM activities (Stoeger et al., 2016).
- In more collectivist societies, where financial security and relational expectations are prioritized, both men and women are more likely to pursue STEM fields, resulting in smaller gender gaps (Soylu Yalcinkaya & Adams, 2020).
- Women are more likely to participate in undergraduate research experiences (UREs) and identify these experiences as a primary reason for pursuing graduate education in STEM fields (Harsh et al., 2012). UREs contribute to similar learning enhancements for both genders but show gender-based variations in self-efficacy and interest in science (Harsh et al., 2012).
- Teacher training: Educators need training to identify and challenge their own biases, ensuring equal opportunities and promoting STEM fields for all students (Soidet & Vrignaud, 2018).
- Creation of reflective tools to help students, parents, and educators challenge their beliefs about STEM subjects and encourage girls' participation (Soidet & Vrignaud, 2018).
- Using gender-neutral language ("scientist" instead of "male scientist") encourages girls to see themselves in STEM roles (Ferrière and Morin-Messabel, 2019).
- Exposing children to diverse representations of scientists (including women and people of color) can broaden their perceptions (Canzittu & Wiels, 2019; Ferrière and Morin-Messabel, 2019).
- Educational programs that challenge stereotypes and present role models in STEM fields can inspire girls to pursue these careers (Canzittu & Wiels, 2019).
- Use a variety of assessment methods: Traditional assessment methods, such as tests and quizzes, can be biased against girls. Teachers should use a variety of assessment methods, such as portfolios, projects, and self-assessment, to get a more complete picture of students' learning.
- Provide students with opportunities to self-regulate: Students need to be given opportunities to practice self-regulation skills. Teachers can do this by providing students with goal-setting activities, helping students to monitor their progress, and teaching students effective study strategies.

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Conclusion

The research indicates that while gender parity in STEM participation is improving, significant disparities remain, particularly in specific fields like physics and engineering. Educational contexts, classroom dynamics, cultural influences, and support systems play crucial roles in shaping gender differences in STEM. Effective interventions, such as strong high school STEM programs, active-learning strategies, and research apprenticeships, can help bridge the gender gap by enhancing self-efficacy and interest in STEM careers for women. Addressing these factors holistically is essential for achieving greater gender equity in STEM fields.

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