科技部補助專題研究計畫報告

以性別化問題解決歷程預測STEM選擇：多元文化資料之學習分析

報 告 類 別 ： 成果報告
計 畫 類 別 ： 個別型計畫
計 畫 編 號 ： MOST 108-2629-H-004-001-
執 行 期 間 ： 108年08月01日至110年07月31日
執 行 單 位 ： 國立政治大學教育學系

計 畫 主 持 人 ： 邱美秀

計畫參與人員： 大專生-兼任助理：林品萱
大專生-兼任助理：田恆一

本研究具有政策應用參考價值：■否 □是，建議提供機關
（勾選「是」者，請列舉建議可提供施政參考之業務主管機關）
本研究具影響公共利益之重大發現：□否 □是

中 華 民 國 110 年 07 月 27 日

中 文 摘 要 ： 本研究通過識別高等教育中與科學、技術、工程和數學（STEM）選擇相關的因素中的性別差異，提出了基於男性事物與女性人興趣（MTFPI）假設的性別化過程的概念框架。本研究使用 台灣教育長期追蹤資料庫（TEPS）7 年級（n = 20,055）、9、11 和 12 年級以及 24-25 歲時的後續 TEPS-Beyond（TEPS-B）(n = 2,700)的縱向數據資料。使用權重進行相關分析，使得結果可以代表原來 7 年級母群的結果。結果大致支持 MTFPI 假設。男性的 STEM 選擇與中學教育各個階段高的數學成績、低的數學挫敗感、高的工作性別刻板印象，以及低的人際智能技能（例如領導力、與他人合作和口頭表達）信心有關。女性的STEM選擇與數學教師在數學課堂中的清晰解釋和優質互動呈正相關。這些結果大致支持提出的MTFPI 假設，即男性對包括成就在內的事物更感興趣，而女性則喜歡與人互動。教育者需要關注兩性之間的不同興趣，作為適性教學的一部分，永邀請兩性在高等教育中學習 STEM。

中 文 關 鍵 詞 ： 性別差異； 縱向數據； 數學成績； 數學教學； STEM選擇

英 文 摘 要 ： This study proposes a conceptual framework for gendered processes based on the male-things vs. female-people interest (MTFPI) hypothesis by identifying gender differences in factors relating to science, technology, engineering, and mathematics (STEM) choices in higher education. This study used longitudinal data from the Taiwan Education Panel Survey (TEPS) for Grade 7 (n = 20,055), 9, 11, and 12 and the follow-up TEPS-Beyond (TEPS-B) for 24-25-year-olds (n = 2,700). Correlation analysis was conducted with weight-activated so that the result can represent that from the original Grade 7 population. The results generally support the MTFPI hypothesis. Males' STEM choice is related to high mathematics achievement and low frustration in mathematics in all stages of secondary education, high gender stereotype about their jobs, and low confidence in people-smart skills (e.g., leadership, collaboration with others, and oral expression). Females' STEM choice is positively related to mathematics teachers' clear explanation and desirable interaction in the mathematics classroom. These results generally support the proposed MTFPI hypothesis that males are more interested in things, including achievement, while females enjoy engaging in interaction with people. Educators need to pay attention to the differential interests between genders as part of the basis for adaptive teaching to invite both genders to study STEM in higher education.

英 文 關 鍵 詞 ： gender difference; longitudinal data; mathematics achievement; mathematics teaching; STEM choice

The Problem Context: Gender Differences in STEM from Differential Processes

The persistent underrepresentation of females in science, technology, engineering, and mathematics (STEM) has raised issues of adaptive educational provisions to increase females' choice to study STEM. Traditionally perceived, the key to gender differences in STEM choice is gender differences in STEM achievements, capacities, or abilities (Good et al., 2008). With the concern of parental and socioeconomic status (SES) factors in determining children' STEM achievements as outcomes (Penner & Paret, 2008), gender differences in problem-solving processes elect as a key precedent of achievements and with potentials for educational intervention to overcome SES constraints (Zhu, 2007).

In order to understand gender differences in the learning process without touching the macro cultures (e.g. countries) hard to be changed, we can assume that the creations in this world (as part of the culture) contain those created by both genders and thus attract both genders to approach them successfully and happily. For instance, among the diverse STEM fields, gender gaps favor males in engineering, mathematics, computer science, and physics but slightly favor females in biology and veterinary (Hyde, 2014). Therefore, domains, tasks, or problem types within a cultural artifact category can serve as mini different cultures that can be used to detect factors in relation to gender differences.

This study used STEM choice in higher education as the outcome variables of domains, tasks, or problem types, to examine a gendered problem-solving process: *The male-things vs. female-people interest hypothesis*. The hypothesis is initially evidence by the fact that males have more interest in things, engineering, science, and mathematics whereas females have more interest in

people and more agreeableness or tender-mindedness (Hyde, 2014). A meta-analysis on interest inventory find that males prefer engineering disciplines and females prefer medical services or social sciences (Su & Rounds, 2015). More girls expect to become health professionals and more boys expect to become scientist, engineers, and ICT professionals, engage in science activities, and are interested in learning science (Organization for Economic Cooperation and Development [OECD], 2016, pp. 119, 125).

To examine the male-things vs. female-people interest hypothesis, we can go to a more detailed level to look at people's behaviors. Firstly, the terms of things and people are defined in terms of mathematics achievement and interaction affordances in the physical aspects and their related feelings, beliefs, and attitudes in the psychosocial aspects.

Gender Differences in 'Things Interest': Achievement and Psychosocial Responses

The conception that boys have higher achievements in STEM and girls have higher achievement in languages not only match public expectation but also is evidenced in some research (Robinson & Lubienski, 2011) though not universal (Chen & Zimmerman, 2007). Gender differences in STEM achievements (in nature) and related affective factors (e.g., values of tasks and self-concept in mathematics) have long been viewed as the main factors for the consistent phenomenon in most human societies that more males than females involved in advanced studies and careers in STEM (Wang et al., 2015).

Most recent cross-cultural and meta-analysis studies, however, indicate that social-cultural factors address gender differences in STEM choices and achievements, known as the *gender stratification hypothesis* (Else-Quest et al., 2010). A salient example is that from pre-K to high school, gender differences in STEM achievement are small and subject to gender equality in a

certain culture or society, with gender equal societies having fewer gender differences in STEM, mainly mathematics achievement (Guiso et al., 2008). The diminishing gender differences in STEM or mathematics achievements lend support to the *gender similarities hypothesis* (Hyde, 2005).

Second, boys have more positive attitudes, affect, or emotions toward STEM than girls do (Barkatsas et al., 2009). There are only some exceptions, especially for primary school students (Yüksel-Şahin, 2008). Males' more positive emotions (e.g. higher self-efficacy and lower anxiety in mathematics) in turn may lead to higher mathematics achievements (Pajares & Miller, 1994) or directly lead to STEM choice controlling for achievements (Carli et al., 2016; OECD, 2016). These emotions are psychological phenomena including more innate ones (e.g. interest; as an in-depth part of nature) or more social-cultural ones (e.g., usefulness for future employment; as a part of nurture; Miller & Halpern, 2014), which are hard to distinguish their biological and social bases.

For broader approaches, Girls show more total change and higher rate of approach in reading but less in mathematics, starting from primary school (Cameron et al., 2014). Compared with German grade-9 boys, girls have lower intrinsic value, personal importance, job utility, and future-life utility, and perceive more cost in effort and emotion arousal (Gaspard et al., 2015). The whole picture is the females experience negative experiences in both achievement (as physical outcomes) and achievement-related psychosocial factors.

Gender Differences in People Interest: Social Affordances and Psychosocial Responses

Females tend to write more interactive messages online than males, but males write more socioemotional messages (Barret & Lally, 1999). In game-based mathematical problem-solving, boys report more on scores, levels, obstacles, and tricks, relatively relevant to the game, whereas

girls report more their feelings and social communication with others, relatively irrelevant to the game (Ke, 2008).

Females may be vulnerable to stereotype threat of inferior female ability in STEM (e.g. males are better at mathematics) and have a lowered test result (Good et al., 2008). Viewing STEM as being for brilliant people may state part of the reasons for underrepresentation of females in such fields (Meyer et al., 2015). This raises anxiety and results in lowered achievement in solving mathematical problems but not in solving general problems (Johns et al., 2005). Unlike the detrimental effect of stereotype threat on achievement, an emphasis on differential problem-solving processes between genders may go beyond the debate between the *gender similarity hypothesis* and *gender reality hypothesis* (Lippa, 2006) and thus directly benefit adaptive instruction.

Males appear to have more social dominance behavior than females (Jonkmann et al., 2009). Boys have more likelihood of being aggressive/victimized and aggressive than girls, while boys and girls have similar chances of being victimized (Shao et al., 2014). Old females have less quality of life than old males (Bain et al., 2003). Girls' interpersonal skills mediate the effect of weight status at the kindergarten stage on mathematics achievements in Grade-5, but this mediating effect does not apply to boys (Gable et al., 2012).

In summary, females' people interest accompanies a sense of equal status with others and engage in interacting with people through complex networking, which may be due to females' long-standing lower social status than males' in human society. Males value a hierarchical system of people, which appears to transform people to things and organize them.

Hypotheses

The above review of literature suggest that there are differential features between genders in problem-solving process interest. Although the differences are qualitative in nature, they could be depicted using a coordination, with two vectors X and Y, in mathematics.

<Insert Figure 1 here.>

Based on the above literature view, this study aims to examine the male-things vs. female-people interest hypothesis. In terms of statistical examinations, this study aims to examine the following two hypotheses.

Hypothesis 1. For things aspects, males' STEM choices are more positively associated to achievement and more sensitive to achievement-related feelings (e.g., frustration), while females are less.

Hypothesis 2. For people aspects, females' STEM choices are more positively associated to interaction affordances in their learning contexts and more resilient to social constraints (e.g., gender stereotypes and social competences), while males are less.

Method

Data Source and Sample

This study used cohort data from the Taiwan Education Panel Survey (TEPS) (Chang, 2001–2007) and its follow-up (TEPS-B) (Kuan, 2017), complied by the Survey Research Data Archive, Taiwan. The first wave of the TPES data was collected in 2001 from grade-7 students (born in 1988/1989) and their parents (n = 20,055). The participants were followed up at grades 9, 11 and 12. TEPS-B started to follow up the TEPS's participants at ages of 24–25 years (n = 2,722) in 2014.

This first wave of TEPS-B data was used as the basis to merge with all the four waves of TEPS data. In order to generalize to the original grade-7 student population, this study used sampling weights provided by TEPS-B. Cases without weights were deleted, which resulted in a final sample size of 2,700 for later data analysis.

Measures

Outcome: STEM Choice in Higher Education

The participants' STEM choices were coded as 4 = STEM, 3 = agriculture and medicine, 2= social sciences, and 1=humanities, in order from more to fewer mathematics uses.

Things Factors Relating to Mathematics

1. Mathematics achievements (physical aspects): The participants experienced mathematics tests at the four waves of TEPS (i.e., grades 7, 9, 11, and 12), respectively. The mathematics test were developed by experts on mathematics and tests, with reference to related international large scale tests. The scores of the four tests were scaled using the 3-p model of item response theory, allowing for comparison of competences between the four waves.

2. Frustration in mathematics (psychosocial aspects): At Wave 3 (i.e., grade 11), the participants self-reported whether they felt frustrated before grade 4, at grades 5-6, at grades 7-9, at grade 10, and at grade 11, respectively (1 = yes; 0 = no).

People Factors Relating to Mathematics

1. Mathematics teaching (physical aspects): At both Waves 2 and 4 (i.e., grades 9 and 12), the participants self-reported whether their mathematics classes had clearly addressed lecture and good interaction, respectively (1 = yes; 0 = no).

2. Gender stereotype (psychosocial aspects): At Wave 4 (i.e., grade 12), the participants self-reported how their choices of major study fields and most favorite job after 10 years of graduation

are suitable for both genders (= 1), males (=2), or females (=3, recorded to 2). Higher scores represented higher degrees in gender stereotype for their chosen fields and jobs.

3. Social competences (psychosocial aspects): At the ages of 24-25 years, the participants indicated their perceptions of how good heir current skills are in oral expression, collaboration with others, and leadership, respectively (1 = very good to 4 = very bad, reversely coded).

Family Background Factors

1. Family income: At Wave 1 (i.e., grade 7), the participants' parents indicated their family income (1= fewer than 20,000NTD to 6 = more than 200,000NTD).

2. Parental education: At Wave 1 (i.e., grade 7), the participants' parents indicated their own and their spouses' education levels (1 = junior high school or below to 5 = graduate school)

Data Analysis

Correlation analyses were conducted for the all, female, and male samples separately. Sampling weights were activated. With the activation of the weight, the results obtained by the 2,700 cases of TEPS-B can be inferred to the original TEPS population at grade 7.

Results

The correlation analysis results are presented in Table 1. All the correlations are small (i.e. below 0.360; Taylor, 1990). The correlation patterns are different for all, male, and female samples, separately.

<Insert Table 1 here.>

All Students

For the all student sample, in terms of 'Things interest', significant measures related to STEM choices are the four mathematics achievements in secondary education stages in the physical

aspects. Frustration in mathematics from primary to grade 10 are negatively related to STEM choices.

In terms of 'People interest', the physical aspects, social affordances fail to relate to STEM choices. Two psychosocial aspects, confidence in oral expression and collaboration with others, negatively relate to STEM choices.

No background factor has significant relationship with STEM choice for the all student sample.

Male Students

In terms of 'Things interest', males' STEM choices were related to all the four mathematics achievements. Frustration in mathematics was negatively related to STEM choices from grades 5-10.

In terms of 'People interest', social affordances of the physical aspect did not relate to STEM choices. Four psychosocial aspects, gender stereotype in chosen jobs as well as confidence in oral expression, cooperation, and leadership negatively related to STEM choice.

Males have one background factor related to STEM choice. That is, males have a lower chance to study STEM fields in higher education if their parents have higher educational levels.

Female Students

Factors related to STEM choices for females were quite different from those for all students and males. In terms of 'Things interest', females' STEM choices only related to achievement at grade 11 and mathematics frustration at grades 5-6.

In terms of 'People interest', females' STEM choices positively relate to the physical aspect at grade 9. These social affordances included clear lecture and good interaction in mathematics teaching. Social affordance at grade 12, however, fails to show these relationships.

Like the all participant sample, no background factor relates to females' STEM choice.

Discussion

The MTFPI Hypothesis: Gender Differences in Factors for STEM Choice

The patterns of factors relating to STEM choices are quite different between genders. The results for all students appear to mix the results of both genders. One size-fit-all may mot be proper, and gender needs to be a moderating factor for STEM choice. These results generally support the proposed MTFPI hypothesis that males are more interested in things (e.g., achievement), while females enjoy engaging in interaction with people.

The gender similarity hypothesis suggest that females and males are the same in mathematics achievements. However, for STEM choice as a learning outcome, there exists at least some gender differences in problem-solving processes, such as those predicted by the MTFPI Hypothesis

In this manner, this study appears to support *the gender stratification hypothesis* more. It is because the MTFPI hypothesis suggest gender differences rooted in differential processes of interests, with relative concerns about physical and psychological constraints.

'Things Interest' and Family Background: A Traditional Agenda for Males

For the physical aspect of the 'Things interest', Males' STEM choice relates to mathematics achievements and related psychosocial factors (frustration in mathematics) more than females. Mathematics achievement and affect (e.g., motivation and emotion) have long been researched as factors relating to later STEM achievement, educational investment, and career choices (Wang et al., 2015). Besides, the role of SES in STEM choice applies only to males, not to females.

All the results suggest that traditional factors (e.g., frustration and SES) relating to (mathematics) achievement tend to be more salient for males than for females.

For educational practices, achievement are relatively cumulative, quantitative, and comparable o competitive, for which drives may emerge moving from survival to striving. Achievement-

related psychosocial feelings (e.g., frustration), therefore, may threaten students. Educators need to be aware of these achievements-related challenges in both physical and psychosocial aspects, especially for males.

People Interest: A New Agenda for Females

Females' STEM choices are relatively related to people factors of the physical aspect. The factors are clearly-addressed lecture and good interaction in mathematics teaching. A nuance finding that the these factors only significant for grade 9 but not for grade 12. The result suggests that high-quality interaction in mathematics learning at earlier stages is especially important in determining females' future STEM choice than later stages. Educators need to pay attention to females' need for good lecture and interaction in mathematics classrooms, which especially should start at an earlier stage, including starting at home numeracy activities (Chiu, 2018).

In the psychosocial aspect, males' STEM choice is negatively related to most factors, including gender stereotype in jobs and confidence in oral, collaborative, and leadership, revealing males' vulnerable to psychosocial constraints. On the other hand, females are more resilient to these psychosocial factors, as revealed that none of which relates to females' STEM choice.

All these findings suggest that these factors in people interest appears to be relatively under-emphasized in past research. For educational practices, educators need to pay attention to strengthen females' people intelligences.

Conclusion

Contribution

This study builds a conceptual framework for the MTFPI hypothesis, which extends past speculation to a more concrete structure. Further, the framework is examined using STEM choice in higher education as the outcome to be correlated to earlier things and people factors in both

physical and psychological aspects for all, male, and female samples, separately. The results generally support the MTFPI hypothesis in that the correlation patterns are quite different between male and female samples. Males' STEM choices are elated to achievement and achievement-related psychosocial factors. Females' STEM choices are related to people high-quality input and interaction in mathematics learning. Females reveal resilience to gender stereotype in jobs and fewer vulnerability to people interaction skills, compared with males. For educational practices, educators may need to pay attention to the differential interests between genders as adaptive teaching for inviting both genders to study STEM in higher education.

Limitations of this Study and Suggestions for Future Research

The empirical data were collected solely from a specific culture. The findings should be limited and need to be examined using data from other cultures. All the correlation coefficients are small, though significant. The reasons may be that study field choices in higher education is a complex issue, involving diverse individual and sociocultural factors (Chiu, 2017).

References

Bain, G. H., Lemmon, H., Teunisse, S., Starr, J. M., Fox, H. C., Deary, I. J., & Whalley, L. J. (2003). Quality of life in healthy old age: Relationships with childhood IQ, minor psychological symptoms and optimism. *Social Psychiatry and Psychiatric Epidemiology, 38*, 632-636.

Barkatsas, A. T., Kasimatis, K., & Gialamas, V. (2009). Learning secondary mathematics with technology: Exploring the complex interrelationship between students' attitudes, engagement, gender and achievement. *Computers & Education, 52*, 562-570.

Barrett, E., & Lally, V. (1999) Gender differences in an on-line learning environment. *Journal of Computer Assisted Learning, 15*, 48-60.

Cameron, C. E., Grimm, K. J., Steele, J. S., Castro-Schilo, L., & Grissmer, D. W. (2015). Nonlinear Gompertz curve models of achievement gaps in mathematics and reading. *Journal of Educational Psychology, 107*, 789 -804.

Carli, L. L., Alawa, L., Lee, Y., Zhao, B., & Kim, E. (2016). Stereotypes about gender and science: Women≠ scientists. *Psychology of Women Quarterly*, *40*, 244-260.

Chang, L.-Y. (2001-2007). *Taiwan Education Panel Survey (C00124B, C00124H, C00137B, C00175A, C00189A)* [Data file]. Survey Research Data Archive, Academia Sinica (http:// srda.sinica.edu.tw).

Chen, P., & Zimmerman, B. (2007). A cross-national comparison study on the accuracy of self-efficacy beliefs of middle-school mathematics students. *The Journal of Experimental Education, 75*, 221-244.

Chiu, M.-S. (2017). High school student rationales for studying advanced science: Analysis of their psychological and cultural capitals. *Journal of Advances in Education Research, 2, 171-182*.

Chiu, M.-S. (2018). Effects of early numeracy activities on mathematics achievement and affect: Parental value and child gender conditions and socioeconomic status mediation. *EURASIA Journal of Mathematics, Science and Technology Education, 14*(12), em1634.

Else-Quest, N. M., Hyde, J. S., & Linn, M. C. (2010). Cross-national patterns of gender differences in mathematics: A meta-analysis. *Psychological Bulletin, 136*, 103-127.

Gable, S., Krull, J. L., & Chang, Y. (2012). Boys' and girls' weight status and math performance from kindergarten entry through fifth grade: A mediated analysis. *Child Development, 83*, 1822-1839.

Gaspard, H., Dicke, A.-L., Flunger, B., Schreier, B., Hafner, I., Trautwein, U., & Nagengast, B. (2015). More value through greater differentiation: Gender differences in value beliefs about math. *Journal of Educational Psychology, 107*, 663-677.

Good, C., Aronson, J., & Harder, J. A. (2008). Problems in the pipeline: Stereotype threat and women's achievement in high-level math courses. *Journal of Applied Developmental Psychology, 29*, 17-28.

Guiso, L., Monte, F., Sapienza, P., & Zingales, L. (2008). Culture, gender, and mathematics. *Science, 320*, 1164-1165.

Hyde, J. S. (2014). Gender similarities and differences. *Annual Review of Psychology, 65*, 373-398.

Johns, M. Schmader, T., & Martens, A. (2005). Knowing is half the battle: Teaching stereotype threat as a means of improving women's math performance. *Psychological Science, 16*, 175-179.

Jonkmann, K., Trautwein, U., & Lüdtke, O. (2009). Social dominance in adolescence: The moderating role of the classroom context and behavioral heterogeneity. *Child Development, 80*, 338-355.

Ke, F. (2008). A case study of computer gaming for math: Engaged learning from gameplay?. *Computers & Education, 51*, 1609-1620.

Kuan, P. Y. (2017). *Taiwan Education Panel Survey and Beyond/2014: Face to face interview follow-up survey of Panel-1/2 CP and Panel-1 NCP (Public Access Data) (E10259_3)* [Data file]. Survey Research Data Archive, Academia Sinica. doi:10.6141/TW-SRDA-E10259_3-2

Lippa, R. A. (2006). The gender reality hypothesis. *American Psychologist, 61*, 639-640.

Meyer, M., Cimpian, A., & Leslie, S. J. (2015). Women are underrepresented in fields where success is believed to require brilliance. *Frontiers in Psychology, 6*, 235.

Miller, D. I., & Halpern, D. F. (2014). The new science of cognitive sex differences. Trends in *Cognitive Sciences, 18*, 37-45.

Organization for Economic Cooperation and Development (2016). *PISA 2015 results (Volume 1): Excellence and equity in education*. OECD Publishing.

Pajares, F., & Miller, M. D. (1994). Role of self-efficacy and self-concept beliefs in mathematical problem solving: A path analysis. *Journal of Educational Psychology, 86*, 193-203.

Penner, A. M., & Paret, M. (2008). Gender differences in mathematics achievement: Exploring the early grades and the extremes. *Social Science Research, 37*, 239-253.

Robinson, J. P., & Lubienski, S. T. (2011). The development of gender achievement gaps in mathematics and reading during elementary and middle school: Examining direct cognitive assessments and teacher ratings. *American Educational Research Journal, 48*, 268-302.

Shao, A., Liang, L., Yuan, C., & Bian, Y. (2014). A latent class analysis of bullies, victims and aggressive victims in Chinese adolescence: Relations with social and school adjustments. *PloS One, 9*(4), e95290.

Su, R., & Rounds, J. (2015). All STEM fields are not created equal: People and things interests explain gender disparities across STEM fields. *Frontiers in Psychology, 6*, 189.

Taylor, R. (1990). Interpretation of the correlation coefficient: a basic review. *Journal of Diagnostic Medical Sonography, 6*(1), 35-39.

Wang, M. T., Degol, J., & Ye, F. (2015). Math achievement is important, but task values are critical, too: examining the intellectual and motivational factors leading to gender disparities in STEM careers. *Frontiers in Psychology, 6*, 36.

Yüksel-Şahin, F. (2008). Mathematics anxiety among 4th and 5th grade Turkish elementary school students. *International Electronic Journal of Mathematics Education, 3*, 179-192.

Zhu, Z. (2007). Gender differences in mathematical problem solving patterns: A review of literature. *International Education Journal, 8*, 187-203.

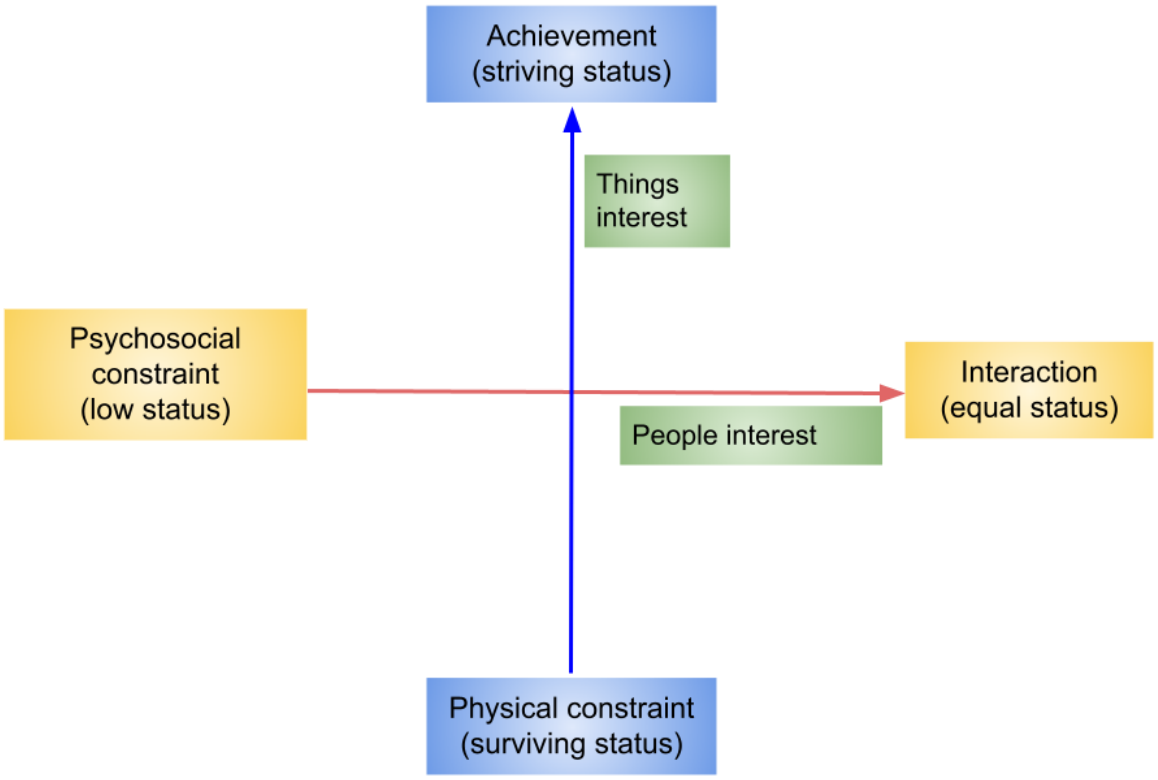
Table 1

Correlations between STEM choices and Related Factors

Measures	Factors	All	Males	Females
Things	*Physical aspects*			
Interest	Mathematics achievement at grade 7	0.136**	0.155**	0.076
	Mathematics achievement at grade 9	0.148**	0.163**	0.087
	Mathematics achievement at grade 11	0.191**	0.190**	0.105*
	Mathematics achievement at grade 12	0.127**	0.124**	0.081
	Psychosocial aspects			
	Frustration in mathematics before grade 4	-0.095**	-0.063	-0.081
	Frustration in mathematics in grades 5-6	-.0161**	-0.100*	-0.118*
	Frustration in mathematics in grades 7-9	-0.143**	-0.124**	-0.086
	Frustration in mathematics in grades 10	-0.100**	-0.094*	-0.040
	Frustration in mathematics in grades 11	-0.030	-0.038	0.046
People	*Physical aspects*			
Interest	Mathematics teaching: clear lecture (grade 9)	0.058	0.021	0.132**
	Mathematics teaching: good interaction (grade 9)	0.016	-0.019	0.095*
	Mathematics teaching: clear lecture (grade 12)	0.015	0.024	0.029
	Mathematics teaching: good interaction (grade 12)	-0.019	-0.045	0.049
	Psychosocial aspects			
	Gender stereotype in chosen study fields	0.008	-0.081	0.034
	Gender stereotype in chosen jobs	-0.013	-0.130**	-0.014
	Confidence in oral expression	-0.105**	-0.119**	-0.033
	Confidence in collaboration with others	-0.036*	-0.064*	0.015
	Confidence in leadership skills	-0.026	-0.056*	-0.003
Background	Family income	-0.011	-0.039	-0.006
	Parental educational levels	-0.026	-0.056*	0.000

Figure 1

A Conceptual Framework for Gendered Processes Based on the Male-Things vs. Female-People Interest (MTFPI) Hypothesis



108年度專題研究計畫成果彙整表

計畫主持人：邱美秀			**計畫編號：**108-2629-H-004-001-		
計畫名稱：以性別化問題解決歷程預測STEM選擇：多元文化資料之學習分析					
成果項目			量化	單位	質化 （說明：各成果項目請附佐證資料或細項說明，如期刊名稱、年份、卷期、起訖頁數、證號...等）
國內	學術性論文	期刊論文	0	篇	
		研討會論文	1		Chiu, M.-S. (2021). Gender differences in factors relating to STEM choices in higher education: male-thing vs. female-people interest hypothesis. Paper presented at 4th Eurasian Conference on Educational Innovation (ECEI) 2021, National Taitung University, Taitung, Taiwan, February 5 - 7. Conference website http://www.ecei.asia/
		專書	0	本	
		專書論文	0	章	
		技術報告	0	篇	
		其他	0	篇	
國外	學術性論文	期刊論文	1	篇	Chiu, M.-S.; Xiong, W., & Kuan, P.-Y. (2021). Graduates' career success predicted by mathematical and affective abilities, effective higher-education learning and economic contexts: A bioecological positivity to success model Journal of Education and Work, 34(3), 313-330. (Scopus) https://doi.org/10.1080/13639080.2021.1931668
		研討會論文	0		
		專書	0	本	
		專書論文	0	章	
		技術報告	0	篇	
		其他	0	篇	
參與計畫人力	本國籍	大專生	2	人次	二位大專生任研究助理，培育其研究工作相關能力。
		碩士生	0		
		博士生	0		
		博士級研究人員	0		
		專任人員	0		

	非本國籍	大專生	0		
		碩士生	0		
		博士生	0		
		博士級研究人員	0		
		專任人員	0		
其他成果 （無法以量化表達之成果如辦理學術活動、獲得獎項、重要國際合作、研究成果國際影響力及其他協助產業技術發展之具體效益事項等，請以文字敘述填列。）			將數篇性別相關學術論文轉為大眾化的內容，在youtube上發表。		