Differences in Gender Perceptions of Higher Education Institutions (HEI) Students and Teachers on Science Technology Engineering Agriculture Mathematics (STEAM) Education

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Abstract The study compared the gender differences perceived by teachers and students on the current Science Technology Engineering Agriculture Mathematics (STEAM) practices in Philippine Higher Education Institutions (PHEIs). It is assumed in this study that STEAM fields are often male-dominated, and STEAM courses are less attractive to female students. A descriptive survey was used in this study. Data were collected from a validated questionnaire. Teachers of STEAM disciplines (n=1,016), and students (n=24,172) were selected using multi-stage random sampling. Purposive sampling was used in selecting CHED higher education institutions centers of excellence in selected regions. Means and t-tests were computed in analyzing the data using a statistical tool. Findings revealed that male and female students are significantly different in the perception of

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the program objectives and program outcomes, faculty, program curricula, instructional materials, procedures and techniques, assessment and evaluation, and administrative support and policies. Male and female teachers similarly perceived the factors except for some in specific STEAM fields. The research suggests that gender disparity could be minimized in STEAM degrees by implementing gender policies.

Keywords: Gender differences, STEAM Education, Teaching and Learning Practices

Introduction

STEM education has been the focus of attention in the academe to make STEM attuned to the demands of the 21st century. Many countries have been aware of the vital function of STEM in their innovation and the development of critical mass. STEM graduates are highly needed to deal with complicated problems and formulate inventive solutions (www.seameo-innotech.org, 2018) because they are considered problem-solvers. They also indicate the strength of a country's growth and development. Australia believes that to ensure the economic growth of 22% per year, it has to advance in the physical and mathematical sciences. Australia will drop out of the upper 20 economies without improved STEM education by 2050 (Chief Scientist Report, 2014). Development in China's economy is also a result of its increased STEM graduates. With 4.7 million STEM graduates in 2016, China is leading to global success (World Economic Forum, 2016). This economic growth is followed by India, which has 2.6 million STEM graduates, and the U.S. ranks third (McCarthy, 2017).

However, studies show a disparity in the enrollment between male and female students in STEM courses. STEM attracts girls' attention during high school but drops off in college, hence a minority of female STEM involvement in higher education (DeWitt & Archer, 2015).

The Fourth Industrial Revolution brings about the new wave of technological innovation and, in turn, calls for a technology-driven workforce. Global workforce transformation (Morales et al., 2019) is vital to respond to the knowledge economy's demand. Production of the technologically-skilled workforce can be done through STEM education (Fiddis, 2017) and will determine a country's long-term economic success (Human Capital Report, 2016). Even curricular reforms have been done to address STEM limitations and to interest more applicants. Part of this reform is the inclusion of agriculture in tertiary (Stine, 2016) and arts in the K to 12 curriculum (Bequette & Bequette 2012, Herro et al., 2017). In the Philippines, the Commission on Higher Education (CHED) also initiated reforms by including agriculture-fisheries and arts with STEM (CHED, 2015; Deocaris, 2018), thus establishing the Philippine STEAM Education (Morales et al., 2019).

Distribution of enrolment in natural science (1%), engineering and technology (13%), information technology (10%), agriculture-fisheries (3%), and mathematics (0.4%) (STEAM hereafter) face high rates of attrition. Except for information communication technology and some engineering courses, enrolment in these programs at both graduate and undergraduate levels has been thin on the ground compared to the non-STEAM programs (CHED, 2019). Similarly, the dwindling number of STEAM faculty with a graduate degree is alarming. It is identified that qualified teachers contribute to the number of interested undergraduate students enrolling in STEAM programs (Morales et al., 2019). Consequently, there was a decline in the number of STEAM scholar-graduates recorded from 2012 to 2015 (DOST SEI, 2017). United Nations Educational, Scientific and Cultural Organization

(UNESCO) (2016) pointed out the decreasing participation of women in STEAM fields as the level of education rises. *Such is contrary to UNESCO's sustainable development goals that emphasize the significance of STEAM in posing solutions to the global world's challenges such as climate change, peace, and equality among men and women.* Correspondingly, the demand for STEAM professionals has been increasing. Considering the rate of professionals in the fields, over half of the global population is women; however, they are underrepresented in STEAM fields. UNESCO Institute for Statistics estimated that only 38% of women were represented as scientific researchers worldwide (UNESCO, 2017).

Only about 46% of females work in STEAM-related employment in the Philippines (DOST-SEI, 2010). The gradual increase in female participation in STEAM from 2013 to 2015 dramatically contributes to the country's global competitiveness. However, gender disparity in some STEAM courses remains. The Philippine population of males (53,773,50.4%) and females (52,826,49.6%) has a slight disparity in gender (Philippine Statistics Authority [PSA], 2018). However, the proportion of graduates by discipline groups from the PSA survey (AY 2013-2014) has proven gender disparity. Among the top five fields, women are mostly in Education Science and teacher training (F-76.3%; M-23.7%), Medical (F-71.6%; M-28.4%), and Business (F-66.4%; M-33.6%). Men are mostly in Engineering and Technology (M-71%; F-29%) and IT-related disciplines (M-50.6%; F-49.4%) (Men and Women Handbook, PSA, 2016). In the recent study by the Commission on Higher Education (April 2017) regarding enrollment of students in STEAM fields, out of 1,398,991 enrolled, only 18% could graduate. The distribution of working women and men (PSA, 2014 survey) by industry groups further proven that women workers were mostly engaged in the household (89.9%), education (72.9%), human health, and social work activities (66.9%). On the other hand, most workers in construction (97.9%), agriculture (71.5%), Information and Communication (62.2%), transportation (96.5%), and fishing (90.1%), mining (90%), electricity, steam, and air conditioning industries (84.9%) were men.

CHED data affirms graduates' paucity in STEAM fields, suggesting the country's somewhat imprecise direction of STEAM education. In 2019, there were only 265,952 and 1,545 graduates in the baccalaureate and doctorate levels, respectively. Given this compelling situation, and if STEAM disciplines fail to attract highly qualified female students, an answer is needed to an important question, "Why is there a gender imbalance in STEAM degrees, and why are women not choosing STEAM?" The current education system is promoting gender balance and recognizing the contribution of women in STEAM fields. The low participation of women in STEAM fields, if not given attention, will continue to escalate. Women's potential to join the workforce is essential to advancing the country's technical and scientific knowledge. However, there is a shortage of research initiatives in higher education institutions to understand STEAM education's gender differences.

Gender Differences in STEAM Education

Recent studies in STEAM education emphasize the divergence between male and female students. Male students show significant interest in engineering and technology than females who are more into natural sciences, mathematics, and medicine (Carnavale, Smith & Melton, 2011; Corbett et al., 2008; Iglesias et al., 2018; Unfried, Faber & Wiebe, 2014). There is a pronounced gender gap in how male and female students see STEAM education, resulting in less participation in STEAM careers and the workforce. The gender gap indicates females' lack of interest and positive attitude toward most STEAM courses (National Science Board, 2010; Unfried, Faber & Wiebe, 2014) except in science (Bernardo et al., 2008). It is irrefutable that, worldwide, females are still disproportionately small in number in STEAM fields, whether in undergraduate or professionals, consequential to a considerable disparity in STEAM education (Iglesias et al., 2018; UNESCO, 2017).

Students' successes depend much on the teacher's effectiveness in the classroom (Faitar & Faitar, 2013). Teachers' preparedness, beliefs and attitudes, behavior, and expectations of students significantly affect female STEM students' academic interest and performance (Iglesias et al., 2018). Female engineering students' declining motivation and part are attributed to their perceived less inclusive classroom environment (Riegle-Crumb & Moore, 2013), triggering a lack of interest and later dropping the course. Students' dropping the course proves that STEM teachers still significantly influence students' engagement with STEM courses.

A gender-sensitive curriculum can highly encourage equal participation of male and female students in STEAM education. However, examining the gender patterns, researchers have shown that there are still gender gaps in attitudes (Riegle-Crumb & Moore, 2013) between male and female students leading to less female representation in STEM fields. Male and female students need to see STEAM education's inclusivity, particularly in science. Curriculum developers need to help STEAM teachers broaden students' engagement inside and outside the science classrooms (DeWitt & Archer, 2015).

Education must implement gender-sensitive policies and frameworks and ensure that teacher training, recruitment, and learning materials are free of gender biases. Gender-sensitive instructional materials and modalities can attract better participation of females in STEM fields. However, studies have shown that STEM class procedures tend to produce an unequal pattern of aspiration and involvement among students (Calabrese Barton et al., 2013; DeWitt & Archer, 2015). Instructional materials, procedures, and techniques in teaching STEM, when perceived as non-inclusive and promoting marginalization, may contribute to students' unequal gender involvement. Iglesias and colleagues (2018) opined that learning resources in all education levels still permeate gender stereotypes that influence female students' decision to pursue STEM degrees.

The lack of STEM gender-sensitive assessment tools and evaluation processes can contribute to the disparity of perception between males and females. A grading system that does not reflect students' actual knowledge (Bernardo et al., 2008) contributes to students' dissipating interest in STEM fields. The lack of assessment procedures that truly mirror students' learning has been reported, particularly in science education (Osborne & Dillon, 2008).

School factors such as administrative support can play a role in developing gender-bias perception in STEAM teaching. STEAM faculty members work with the whole school community with a multi-layered structure. This situation may seriously affect the delivery of STEAM education and may be detrimental in promoting equal opportunity for both genders. Studies have shown that the school environment is a significant factor that encourages female students' prolonged effort in STEM courses (Faitar & Faitar, 2013). The administration of career-relevant activities can better enable students to pursue STEM professions (DeWitt, & Archer, 2015) since it could foster a better appreciation of the fields.

Research Purposes

This paper is part of a more extensive study investigating students' and teachers' collective perceptions about the teaching and learning of STEAM. This research compares the gender differences perceived by students and teachers on the current STEAM practices**.** Studies claim that STEAM degrees are male-dominated, and these courses are not suitable for females, which this study intends to describe. Specifically, the study analyzed the differences in gender perceptions of teachers and students about program objectives and program outcomes; faculty; program curricula; instructional materials, procedures and techniques; assessment and evaluation; and administrative support and policies.

Methodology

Research Design

This study compared the gender differences in STEAM education using a descriptive survey design and collected data related to gender roles of STEAM teachers and students through a validated questionnaire.

Instrument Used

The study utilized a five-point Likert scale questionnaire drafted using relevant literature, including CHED Policies, Standards, and Guidelines of STEAM programs and initial data collected from scoping interviews with STEAM students and teachers from the researchers' HEIs. The survey questionnaire measures both STEAM teachers' and students' gender perceptions, including gender roles about the following dimensions that characterize the teaching and learning of STEAM: program objectives and program outcomes, faculty, curriculum, instructional procedures and techniques, assessment and evaluation, and administrative support and policies.

Data Collection and Analysis

The survey questionnaire was pilot tested to the sampled 35 teachers and 130 students from STEAM fields of participating research teams (MSEUF, PNU, USM, and BSU). A .89-Cronbach alpha established the reliability and consistency of the questionnaire. The participants' consent was sought following the ethics of research, and ethics clearance was sought from the MSEUF ethics board. The research teams administered the survey to higher education institutions identified by CHED as centers of excellence/ development in the country's regions. Quantitative data were analyzed using statistical tools such as percentage, weighted mean, and T-test.

Participants of the study

STEAM teachers and students served as respondents of the study. Purposive sampling was used in selecting the higher education institutions (public and private), which are CHED recognized as centers of excellence/development in the identified regions: Regions IVA, CAR, NCR to represent Luzon, Regions VI, VII, and VIII from the Visayas and Region XI in Mindanao. Multi-stage random sampling was used in selecting student and teacher respondents.

Programs	Teachers (N=1,016)		Students (N=24,172)	
	Male (n/f)	Female (n/f)	Male (n/f)	Female (n/f)
Science	68/152	84/152	1,128/3640	2512/3640
Technology	116/232	116/232	3550/5917	2367/5917
Engineering	232/381	149/381	4124/6249	2125/6249
Agri/Fisheries	90/174 22/33	84/174 11/33	2836/6596 344/860	3760/6596 516/860
Mathematics	27/44	17/44	646/910	264/910
Total	555	461	12628	11544

One thousand sixteen (N=1,016) STEAM teachers were the respondents in this study represented by (Science, n=152 (45% male, 55% female); Technology, n=232 (50% male, 50% female); Engineering, n=381 (61% male, 39% female); Agriculture, n=174 (52% male, 48% female); Fisheries, n=33 (67% male, 33% female) and Mathematics, n=44 (61% male, 39% female). The majority of the teacher respondents are male (55%), while female respondents comprised 45% except in the Science program, where there are more female teachers. For student respondents, cluster sampling of sections (2nd year to 4th year) was randomly selected from STEAM programs. Twenty-four thousand and one hundred seventy-two student-respondents (N=24,172, 50% male and 50% female) distributed in STEAM programs - Science (n=3,640 (31% male,69% female; Technology, n=5,917 (60% male,40% female); Engineering, n=6249 (66% male,34% female); Agriculture, n=6,596 (43% male,57% female); Fisheries, n=860 (40% male,60% female) and Mathematics, n=910 (71% male, 29% female) were enumerated. These data are indicative of which programs are male-dominated and which are female-dominated. STEAM classes were divided according to their gender in analyzing collected data using means and t-test through the SPSS software.

Results and Discussion

The findings of the study reflect the collective perception of students and teachers concerning STEAM education.

On Program Objectives and Outcomes

The results of the independent-samples t-test reveal that there was a significant difference in the overall scores of female (M=4.29, SD=.53) and male (M=4.21, SD=.52) STEAM students condition; t (11974)=12.68. The results show that male and female students perceive program objectives and outcomes in STEAM education as significantly different

Table 1.

Means and t-test for gender differences on STEAM program objectives and outcomes as perceived by students and teachers.

	Program Objectives and Program Outcomes													
	Science		Technology		Engineering		Agriculture		Fisheries		Mathematics		Overall	
	F	M	F	M	F	M	F	M	F	M	F	M	F	M
Students	4.26[a] (.52)[b]	4.25 (.57)	4.25 (.53)	4.16 (.53)	4.27 (.53)	4.21 (.53)	4.33 (.53)	4.21 (.49)	4.46 (.49)	4.37 (.51)	4.31 (.51)	4.32 (.44)	4.29 (0.53)	4.21 (0.52)
	N=2510	N=1130	N=2377	N=3540	N=2143	N=4106	N=3780	N=2816	N=518	N=342	N=647	N=263	N=11975	N=12197
	0.56[c]		6.16		4.15		9.59		2.65		-.42		12.68	
	.57[d]		.00		.00		.00		.01		.68		0.00	
Teachers	4.51 (.55)	4.55 (.55)	4.46 (.49)	4.54 (.50)	4.23 (.62)	4.39 (.64)	4.70 (.41)	4.56 (.51)	4.65 (.41)	4.73 (.38)	4.39 (.46)	4.63 (.42)	4.46 (0.55)	4.48 (0.58)
	N=84	N=68	N=115	N=117	N=147	N=234	N=83	N=91	N=11	N=22	N=17	N=27	N=457	N=559
	-.44		-1.26		-2.23		1.87		-.57		-1.74		-0.55	
	.66		.21		.03		.06		.57		.09		0.59	

[a]*Mean.*
[b]*Standard deviations are enclosed in parenthesis.*
[c]*Computed t-Test for equality of mean.*
[d]*Significant at .05 confidence level.*

but female (M=4.46, SD=.55) and male (M=4.48, SD=.58) teachers condition; t (456)=.55, p=.05, see it differently.

Research has shown that male and female students exhibit divergence in attitude towards STEAM fields, specifically in engineering and technology (Unfried, 2014). STEM- fields are seen as male-dominated (Archer, 2015), and females are more inclined to humanities. UNESCO (2017) revealed that females are still less in number in the STEAM fields of study in post-secondary school education.

Even in fisheries, gender discrepancy is present. The males rule it since propelling wooden boats, and hauling nets are physically arduous. The traditional view that women should care for the family also contributes to this gender-bias perception (Franz, 2017; Kleiberet al., 2015).

Program objectives and outcomes are clearly expressed and defined to help students acquire the knowledge and competencies necessary for their future career and professional responsibilities. However, looking closely at the overall mean of males (μ=3.98, SD=.744) in all STEAM programs, identifying specific skills required by profession is extensively applied only. Since part of the program objectives and outcomes is to produce highly skilled graduates, male samples view themselves as not very much skilled and fully equipped with abilities necessary for the practice of their STEAM profession. This result is the same with female science students, whose sample mean is 3.96 (SD=.751) and the lowest among all the STEAM courses.

Teachers' mean differences regarding their perceptions of program objectives and outcomes show that only Engineering teachers have different perceptions of the current practices. Although both male and female teachers view that the STEAM program objectives and outcomes are very extensively applied in the current practice, the male teachers (x=4.39, *SD*=.64) are more agreeable to its very extensive application than the female teachers (x=4.23, *SD*=.6). Male teachers perceive that the program's objectives and outcomes are clearly expressed, well defined with clear-cut and specific target skills, preparing them with the knowledge and practical skills for their future career and professional responsibilities. Moreover, male teachers view the program outcomes specifying the student's ability to use techniques, skills, and modern tools necessary for the practice of their future profession. On the other hand, female teachers only perceive the program objectives as clearly defined, preparing students with the needed competencies and practical skills required to become professionals as very extensively applied. All other specific indicators are perceived to be extensively applied.

On STEAM Faculty as Perceived by Students and Teachers

The results of the independent-samples t-test reveal that there was a significant difference in the scores for gender perception of female (M=4.31, SD=.51) and male (M=4.22, SD=.54) STEAM students condition; t (11974)=13.78 while the female (M=4.20, SD=.63) and male (M=4.20, SD=.65) teachers condition; t(456)= -.13, p = .05 does not have a significant difference.

Gender perception of faculty members strongly differs in STEAM disciplines aside from students in the Mathematics program. Female students perceive their teachers as influential to their interest, participation, confidence, achievement, and determination to finish in STEAM programs (Iglesias et al., 2018). The results agree with the said research that there is a significant difference between male and female students on how they perceive the STEAM faculty's current practices. Moreover, a study from Faitar and Faitar (2013) also coincides with the results that

Table 2.

Means and t-test for gender differences on STEAM faculty as perceived by students and teachers.

	STEAM Faculty													
	Science		Technology		Engineering		Agriculture		Fisheries		Mathematics		Overall	
	F	M	F	M	F	M	F	M	F	M	F	M	F	M
Students	4.35[a] (.50)[b]	4.32 (.52)	4.29 (.50)	4.18 (.58)	4.27 (.51)	4.20 (.55)	4.28 (.52)	4.20 (.54)	4.49 (.47)	4.41 (.48)	4.38 (.50)	4.38 (.47)	4.31 (.51)	4.22 (.54)
	N=2510	N=1130	N=2377	N=3540	N=2143	N=4106	N=3780	N=2816	N=518	N=342	N=647	N=263	N=11975	N=12197
	.56[c]		7.75		5.21		5.92		2.56		-.22		13.78	
	.57[d]		.00		.00		.00		.01		.82		.00	
Teachers	4.32 (.58)	4.45 (.57)	4.22 (.58)	4.29 0.58)	3.83 (.65)	3.97 (.67)	4.58 (.43)	4.56 (.46)	4.22 (.27)	4.59 (.41)	3.90 (.75)	4.30 (.73)	4.20 (.63)	4.20 (.65)
	N=84	N=68	N=115	N=117	N=147	N=234	N=83	N=91	N=11	N=22	N=17	N=27	N=457	N=559
	1.39		-.86		-1.92		.32		-3.07		-1.81		.13	
	.17		.40		.06		.75		.00		.08		.90	

[a]*Mean.*

[b]*Standard deviations are enclosed in parenthesis.*

[c]*Computed t-Test for equality of mean.*

[d]*Significant at .05 confidence level.*

female students perform better in STEM disciplines with faculty who make a prolonged effort in the natural sciences and mathematics.

The data also shows that both male and female students perceived their STEAM faculty as experts in their field of specialization, with a professional license, sufficient training, and relevant field experiences. STEAM students also recognize the faculty's professional development effort, like participating in society meetings and conferences. However, the sample mean scores for both male (*M*=4.09, *SD*=.834) and female (*M*=4.11, *SD*=.772) Science students on using helpful assessment tools to evaluate student achievement are extensively applied only. Students under the science program are looking for a more appropriate measure to assess their performance in class. Furthermore, students under STEAM education perceive their faculty members to engage in research development and extension programs (male μ=4.28, SD=.746; female μ=4.42, SD=.697). However, lower means (male μ=4.01, SD=.823; female μ=4.13, SD=.778) were evident for publication and research dissemination in reputable platforms. Male STEAM students (male μ=4.06, SD=.820) even observe that their STEAM teachers utilize less the relevant research findings in classroom instruction. Lastly, the lowest mean score for male (M=3.94, SD=.852) agriculture students was noted on STEAM teachers producing copyright and patents from research projects and activities.

From the teacher respondents' mean scores of their perception of the STEAM faculty, only Fisheries teachers have a significant difference in male (x=4.59, SD=.40) and female (x=4.22, SD=.27). Both male and female teachers perceived faculty's professional qualifications with relevant graduate degree programs and government and institutional requirements that match the courses they teach to be applied extensively. Moreover, they perceive that the faculty follows the course outline, learning materials, and grading policy. Faculty are also viewed to be knowledgeable in didactic and technical development. The difference in their perception of the current practice of faculty lies in research engagement and publication. Female teachers have extensively applied practice in research publication (F=3.53) and produce limited copyright and patents (F=2.27). On the other hand, male teachers perceived the faculty to have extensively applied in research publication (M=3.94) and moderately applied in producing copyrights and patents (M=3.17). Comparing the gender difference in research publication, including copyright and patents, male faculty has higher publication than female faculty under the Fisheries program.

On Program Curricula

The results of the independent-samples t-test reveal that there was a significant difference in the scores for gender perception of female (M=4.38, SD=.50) and male (M=4.32, SD=.52) STEAM students condition; t(11974)=9.79 while the female (M=4.45, SD=.59) and male (M=4.49, SD=.57) teachers condition; t(456)= -1.04, p = .05 does not have a significant difference. This finding corroborates Buser, Niederl, and Oosterbeek (2012) on the significant difference between male and female students' perceptions of the STEAM curriculum. From their study results, 40% of male students were attracted to the science curriculum than 17% of female students who chose the same track.STEAM students perceive the STEAM curriculum as receptive to professional and technological training requirements and the labor market demands. The curriculum design meets the educational challenge of the time and emphasizes translatable competence and lifelong learning. STEAM programs help students achieve competencies for their future careers. Male (μ =4.53, *SD*=.451) and female (μ=4.59, *SD*=.439) students in the Fisheries program provided the highest mean for the

Table 3.

Means and t-test for gender differences on STEAM program curricula as perceived by students and teachers.

	Program Curricula													
	Science		Technology		Engineering		Agriculture		Fisheries		Mathematics		Overall	
	F	M	F	M	F	M	F	M	F	M	F	M	F	M
Students	4.26[a] (.54)[b]	4.23 (.53)	4.39 (.48)	4.25 (.51)	4.42 (.50)	4.37 (.53)	4.39 (.49)	4.31 (.49)	4.59 (.44)	4.53 (.45)	4.44 (.49)	4.42 (.45)	4.38 (.50)	4.32 (.52)
	N=2510	N=1130	N=2377	N=3540	N=2143	N=4106	N=3780	N=2816	N=518	N=342	N=647	N=263	N=11975	N=12197
	1.40[c]		10.05		3.87		6.50		2.12		.67		9.79	
	.16[d]		.00		.00		.00		.03		.50		.00	
Teachers	4.52 (.50)	4.50 (.54)	4.46 (.60)	4.57 (.55)	4.19 (0.72)	4.38 (.62)	4.67 (.44)	4.61 (.46)	4.67 (.35)	4.78 (.41)	4.42 (.49)	4.66 (.41)	4.45 (.59)	4.49 (.57)
	N=84	N=68	N=115	N=117	N=147	N=234	N=83	N=91	N=11	N=22	N=17	N=27	N=457	N=559
	.29		-1.51		-2.63		.89		-.87		-1.72		-1.04	
	.77		.13		.00		.37		.39		.09		.30	

[a]*Mean.*
[b]*Standard deviations are enclosed in parenthesis.*
[c]*Computed t-Test for equality of mean.*
[d]*Significant at .05 confidence level.*

STEAM curriculum, emphasizing current practices are very extensively applied. Looking closely at the sample mean scores of male (*M*=3.73, *SD*=1.418) and female (*M*=3.64, *SD*=1.482) students in the science program, students provided the lowest score on on-the-job practicum training. Science students perceive that providing OJT or practicum practice as a pre-requisite for graduation in the STEAM program is extensively applied only compared to all the rest, which are very extensively applied.

Only the Engineering program has a significant gender difference in the curriculum's perception of teachers perception. The differences lie in the dean, faculty, and students' involvement in evaluating and revising the curricula, which is significantly lower among female teachers (F=3.93) than male teachers (M=4.08). However, both of the respondents perceived this indicator to be extensively applied. The male teachers perceived students' preparation for licensure examination and professional certifications to be very extensively applied (M=4.37) than the female teachers who perceived this to be extensively applied (F=4.13). Similarly, in terms of the curriculum content's responsiveness to students' professional and technical preparation needs, male teachers perceived it to be very extensively applied (M=4.32) than female teachers who perceived it to be extensively applied (F=4.15).

The current literature evidences the implementation of engineering curricula, which is inclined toward male teachers rather than female teachers.

On Instructional Materials, Procedures and Techniques

The results of the independent-samples t-test reveal that there was a significant difference in the scores for gender perception of female (M=4.20, SD=.55) and male (M=4.14,

Table 4.

Means and t-test for gender differences on STEAM instructional material, procedures and techniques as perceived by students and teachers.

	Instructional Materials, Procedures and Techniques													
	Science		Technology		Engineering		Agriculture		Fisheries		Mathematics		Overall	
	F	M	F	M	F	M	F	M	F	M	F	M	F	M
Students	4.17[a] (.57)[b]	4.15 (.60)	4.24 (.50)	4.14 (.55)	4.20 (.54)	4.17 (.57)	4.15 (055)	4.08 (.55)	4.33 (.56)	4.28 (.59)	4.26 (.58)	4.28 (.48)	4.20 (.55)	4.14 (.56)
	N=2510	N=1130	N=2377	N=3540	N=2143	N=4106	N=3780	N=2816	N=518	N=342	N=647	N=263	N=11975	N=12197
	1.15[c]		7.33		2.34		5.55		1.29		-0.71		7.54	
	.25[d]		.00		.02		.00		.20		.48		.00	
Teachers	4.45 (.47)	4.50 (.61)	4.43 (.52)	4.45 (.56)	4.00 (.73)	4.15 (.66)	4.64 (.47)	4.63 (.42)	4.54 (.33)	4.49 (.47)	4.14 (.65)	4.57 (.48)	4.35 (.61)	4.34 (.62)
	N=84	N=68	N=115	N=117	N=147	N=234	N=83	N=91	N=11	N=22	N=17	N=27	N=457	N=559
	-.57		-.25		-2.17		.18		.35		-2.48		.23	
	.57		.80		.04		.86		.73		.02		.82	

[a]*Mean.*
[b]*Standard deviations are enclosed in parenthesis.*
[c]*Computed t-Test for equality of mean.*
[d]*Significant at .05 confidence level.*

SD=.56) STEAM students condition; t(11974)=7.54 while the female (M=4.35, SD=.61) and male (M=4.34, SD=.62) teachers condition; t(456)=0.23, p = 0.05 does not have a significant difference.

Iglesias and colleagues (2018) support that male and female STEAM students' perception differs from instructional materials, procedures, and techniques. According to the study results, the teachers' learning materials can influence getting STEM degrees. Some female students see the materials of the STEAM curriculum as "sexist or stereotypical depictions of men and women" on scientific and academic activities

STEAM students see those teaching methods are appropriate to the subject and encourage teacher-student interaction. Interdisciplinary and multidisciplinary approaches are used, ICT and other instructional media except for Agriculture students who view ICT use (M=3.95, SD=.81; female M=4.11, SD=.71) interdisciplinary approaches (male M=4.07, SD=0.71; female M=3.93, SD=0.89) as less applied to their program.

Although teachers' overall results suggest no gender difference in perception, the Engineering program shows differences in perception of male and female teachers using instructional materials, teaching methods, and defining the policy for successful classroom supervision. Teachers perceived the utilization of instructional resources, teaching methods, and classroom management as extensively applied with a slight mean difference lower for female Engineering teachers in instructional materials evaluation (F=3.72; M=3.82) and effective classroom management (F=4.03; M=4.25). In the Mathematics program, male teachers' mean scores suggest that they have very extensively applied the instructional materials, teaching methods and techniques, and effective classroom management in their teaching. The female teachers also very extensively applied the instructional materials, although lower in mean scores than male teachers in the areas of instructional materials evaluation (F=3.88; M=4.26); use of interdisciplinary/multidisciplinary approaches in teaching (F=3.96; M=4.47), and in defining the rules and policies for effective classroom management (F=3.92; M=4.63).

On Assessment and Evaluation

The results of the independent-samples t-test reveal that there was a significant difference in the scores for gender perception of female (M=4.21, SD=.55) and male (M=4.17, SD=.56) STEAM students condition; t(11974)=5.97 while the female (M=4.27, SD=.62) and male (M=4.29, SD=.65) teachers condition; t(456)= -0.34, p=.05 does not have a significant difference. Overall, the data shows that perception of assessment and evaluation is influenced by the gender of students except for teachers

STEAM programs aim to test the students' competence about the set policies, standards, and guidelines. The general criteria for assessing student performance are about the national regulations and framework and are clearly understood by the students. The university implements a definite grading system with well-defined evaluation tools and procedures to measure the attainment of learning objectives and course outcomes. However, students' views on STEAM assessment practices differ mainly in activities to measure the attainment of learning objectives and course outcomes. Female students under Agriculture and Technology programs shared during the FGD that they are sometimes excused from actual demonstrations when they have a monthly menstrual period. No gender differences among teachers' perceptions of STEAM assessment and evaluation.

Table 5.

Means and t-test for gender differences on STEAM assessment and evaluation as perceived by students and teachers.

	Assessment and Evaluation													
	Science		Technology		Engineering		Agriculture		Fisheries		Mathematics		Overall	
	F	M	F	M	F	M	F	M	F	M	F	M	F	M
Students	4.18[a] (.59)[b]	4.17 (.62)	4.25 (.54)	4.17 (.54)	4.24 (.53)	4.19 (.55)	4.18 (.54)	4.11 (.56)	4.35 (.55)	4.31 (.57)	4.27 (.56)	4.26 (.50)	4.21 (.55)	4.17 (.56)
	N=2510	N=1130	N=2377	N=3540	N=2143	N=4106	N=3780	N=2816	N=518	N=342	N=647	N=263	N=11975	N=12197
	.09[c]		5.25		3.08		4.80		1.04		.08		5.97	
	.92[d]		.00		.00		.00		.30		.93		.00	
Teachers	4.31 (.57)	4.47 (.64)	4.31 (.58)	4.43 (.55)	3.96 (.66)	4.09 (.69)	4.55 (.52)	4.47 (.56)	4.64 (.11)	4.53 (.47)	4.16 (.70)	4.49 (.56)	4.27 (.62)	4.29 (.65)
	N=84	N=68	N=115	N=117	N=147	N=234	N=83	N=91	N=11	N=22	N=17	N=27	N=457	N=559
	-1.51		-1.55		-1.83		.90		.94		-1.70		-.34	
	.13		.12		.07		.37		.36		.09		.74	

[a] *Mean.*
[b] *Standard deviations are enclosed in parenthesis.*
[c] *Computed t-Test for equality of mean.*
[d] *Significant at .05 confidence level.*

On Administrative Support and Policies

The results of the independent-samples t-test reveal that there was a significant difference in the scores for gender perception of female (M=4.07, SD=.63) and male (M=4.05, SD=.63) STEAM students condition; t(11974)=2.87 while the female (M=4.14, SD=.73) and male (M=4.19, SD=.74) teachers condition; t(456)= -.92, p=.05 does not have a significant difference.

Male and female students perceived that administrative support was available for both teachers and students. However, males specifically under the Agriculture and Technology programs see that visits from the department head or dean in the class and classroom observation at least once every semester show concern for students' welfare. At the same time, females are not much concerned about it.

Institutions offer prime and continuous professional development programs to intensify faculty and student aptitude. The administration supports STEAM education by encouraging faculty members to be involved in formal and informal schooling to keep informed and up-to-date teaching methods. The administration also recognizes the importance of providing modern facilities for teaching and learning, readily available for students' and teachers' use. In terms of male and female teachers' perceptions of administrative support and policies, Engineering and Mathematics programs show a significant difference in the results. Both male and female teachers in Engineering programs perceived that administrative support and policies are extensively applied with a mean slightly higher among male teachers than female teachers (M=3.98; F=3.66). The result means that male teachers perceived the support of the administration more than the female teachers in the following areas: support to faculty professional development and students' needs; moral and financial support in the enhancement of teaching and

Table 6.

Means and t-test for gender differences on STEAM administrative support and policies as perceived by students and teachers.

	Administrative Support and Policies													
	Science		Technology		Engineering		Agriculture		Fisheries		Mathematics		Overall	
	F	M	F	M	F	M	F	M	F	M	F	M	F	M
Students	3.99[a] (.66)[b]	3.99 (.69)	4.19 (.57)	4.09 (.58)	4.10 (.59)	4.07 (.64)	4.00 (.64)	3.96 (.63)	4.21 (.67)	4.12 (.70)	4.11 (.60)	4.18 (.55)	4.07 (.63)	4.05 (.63)
	N=2510	N=1130	N=2377	N=3540	N=2143	N=4106	N=3780	N=2816	N=518	N=342	N=647	N=263	N=11975	N=12197
	.01		6.82		1.77		2.62		1.98		-1.72		2.87	
	.99		.00		0.08		.01		.05		.09		.00	
Teachers	4.14[c] (.68)[d]	4.27 (0.82)	4.36 (.58)	4.41 (0.53)	3.66 (.71)	3.98 (.80)	4.53 (.55)	4.38 (.73)	4.03 (1.11)	4.24 (.63)	4.07 (.68)	4.41 (.33)	4.14 (.73)	4.19 (.74)
	N=84	N=68	N=115	N=117	N=147	N=234	N=83	N=91	N=11	N=22	N=17	N=27	N=457	N=559
	-.98		-.64		-3.72		1.49		-.70		-2.17		-.92	
	.33		.53		.00		.14		.49		.04		.36	

[a]*Mean.*
[b]*Standard deviations are enclosed in parenthesis.*
[c]*Computed t-Test for equality of mean.*
[d]*Significant at .05 confidence level.*

learning; instructional materials preparation; rewards and incentives for exemplary performances that bring honor to the institution and the country. In the mathematics program, male teachers perceived the administration's support to be very extensively applied than the female teachers with a mean that falls under extensively applied (M=4.41; F=4.07). The administrative support as perceived by the male teachers more than the female teachers is evident in the head visits and observation of classes; the determination of class size to facilitate teaching and learning; preparation of instructional materials and modules; rewards and incentives for exemplary performances that bring honor to the institution and the country; attendance to formal and informal training.

Conclusion and Recommendations

The study describes the gender perceptions of teachers and students on the current practices of STEAM education. Data were collected to look at the gender differences taken from the validated survey questionnaires and focus groups. The gender differences in teachers' and students' perceptions are considered factors as reference points in the analysis, such as program objectives and outcomes, faculty, program curricula, instructional materials, procedures and techniques, assessment and evaluation, and administrative support and policies. The results draw implications regarding the gender roles of teachers and students in STEAM education.

Given this study's findings, male and female students still differ significantly in their perception of the factors studied and vary according to STEAM degrees. In almost all factors, gender differences are seen in the fields of Technology, Engineering, Agriculture, and Fisheries. No gender differences have been found in Science and Mathematics. Gender differences can be attributed to the nature of the discipline.

Technology, Engineering, Agriculture, and Fisheries were found to be male-dominated. Some of the students' tasks and the strategies used are gender-related or based on their physical and biological attributes. One notable instance was the plowing of field, which inhibits the female students from doing the actual practice during their menstrual cycle. Teacher education programs should guarantee that those teaching professionals are educated on gender-sensitive approaches to maximize both men's and women's full potential in the STEAM fields. Gender fair education should be embedded in the review of curricular programs and instructional materials, and instruction modalities.

On the contrary, the Science and Mathematics fields were gender-neutral. Teachers were not considering whether the students were males or females in teaching these subjects. Tasks assigned to the students are generally not gender-specific. The results in Science and Mathematics fields suggest not having too much gap between male and female students. However, the result further showed the underrepresentation of women in STEAM fields. It is imperative to promote and recruit more women role models. Scholarships such as DOST could be targeted to consider opportunities for more women to advance their careers in STEAM fields.

Overall data reveal that male and female students are significantly different in their perception of the study's factors. In contrast, male and female teachers are generally the same in their perception except for some factors in some STEAM fields. STEAM teachers must be aware of and sensitive to gender perception and needs in teaching STEAM.

The study further recommends that enforcement of gender policies in making the teachers aware of males' and females' needs in the classrooms while learning the subjects must adequately be implemented. Gender disparity should be minimized in the management of STEAM degrees through the proper implementation of gender policies. Advocacy and awareness-raising for gender education of higher education institutions be strengthened by continuing the administrative support services to attract more women in the STEAM fields that will contribute to the country's peaceful and sustainable future. Similar studies concerning other gender issues in STEAM education are encouraged for future research to generate more data involving other higher education institutions for gender-balanced STEAM teaching.

This study's factors as dimensions through which the current practices in the teaching and learning of STEAM in Philippine HEIs provide a glimpse of the gender differences in STEAM education as perceived by teachers and students. Other researchers may consider investigating deeper reasons behind gender disparity in the practice of STEAM teaching and learning for future research. The results might help teachers to be more gender-sensitive in their teaching of STEAM courses.

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