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ASSESSING GENDER-SENSITIVE PEDAGOGICAL PRACTICES IN STEAM EDUCATION IN SENIOR SECONDARY SCHOOLS IN GWAGWALADA, FEDERAL CAPITAL TERRITORY, NIGERIA

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Abstract: The study assessed Gender Sensitive Pedagogical Practices (GSPP) in Science, Technology, Engineering, Arts and Mathematics (STEAM) education among senior secondary schools in Gwagwalada Area Council of FCT, Nigeria. Four research questions were answered and four hypotheses were tested at 0.05 level of significance. The study adopted a descriptive survey design. The population of the study was 499 comprising 82 teachers and 417 students of 13 private secondary schools in Gwagwalada Area Council of FCT and a sample of 50 teachers and 180 students was drawn. The instruments used for data collection were structured questionnaires designed by the researchers. Data was analysed using mean, standard deviation and independent t-test. Findings of the study revealed that significant difference existed between the mean responses of teachers and students concerning the extent of use of GSPP in STEAM Education in the sampled senior secondary schools (p = 0.000 < 0.05). The study also found a significant difference in the mean responses of male and female students concerning the benefits of GSPP in STEAM in Education (p = 0.023 < 0.05). Furthermore, findings revealed no significant difference in the mean responses of male and female teachers on the challenges militating against the implementation of GSPP in STEAM Education (p = 0.714 > 0.05). Finally, the finding on the strategies for overcoming the challenges of GSPP in STEAM Education in senior secondary schools revealed no significant difference in the mean responses of male and female teachers (p = 0.924 > 0.05). The study concluded that GSPP are essential in STEAM education in senior secondary schools because they foster equity among students, inclusivity, critical thinking and better learning outcomes for all students regardless of gender. It was recommended that senior secondary teachers should adopt inclusive teaching techniques that allow full participation of students in STEAM education**.** Senior secondary school teachers should also be encouraged to create learning environments for students that support GSPP in STEAM education.

Keywords: Assessing, gender-sensitive, pedagogical practices and STEAM education.

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Introduction

In the modern world, both art and science are essential for comprehending and navigating our complicated environment. Art gives critical analysis, subjective viewpoints, and emotional expressions, whereas science offers objective knowledge and technological breakthroughs. A comprehensive understanding of the world and humans requires both arts and science. The two are becoming more and more entwined in many different professions. A 19th-century photographer, Charles Negre wonderfully noted the complementarity of Arts and Sciences as he wondered about Chemistry behind photography; physics and mathematics that underlie optics, as well as artistic design of camera. According to Tate (2017), science ends where art begins. The term STEAM was coined by a Master's graduate at a Polytechnic Institute and University in the United States of America in 2006. STEAM is an integration of arts into STEM. It involves the inclusion of Art-based skills in Science, Technology, Engineering and Science (STEM). These skills include critical thinking, creativity and design. The inclusion is meant to promote holistic learning. Teaching and learning of STEAM is known as STEAM Education. Aina (2022) posited that the characteristics and aims of STEAM

Education include: real-world application; interdisciplinary approach; holistic learning; collaboration; practical and hands-on skills; 21st-century skills; empathy, personal expression; social relevance; creativity; problem-solving skills; and effective communication of scientific ideas. Miracle Recreation (2023) asserted that the steps to take for effective implementation of STEAM Education in schools include creation of STEAM club; establishment of STEAM camp; investment in technology; encouragement of questioning attitude in learning; hands-on learning; learners' freedom to make decisions on the projects they are assigned to carry out; inclusion of real-world problem-solving activities; field trips; getting learners immersed in nature; and community involvement.

In Nigeria, STEAM Education has a place in the policy and practice of education considering the fact that science, technology, engineering, arts and mathematics are captured at different levels in the National Policy on Education (NPE) (Federal Republic of Nigeria, 2014). However, the combination of these fields in STEAM is still not being fully implemented in schools as the concept is strange to many teachers. As a result, government and many private organizations have continued to build the capacity of teachers in STEAM Education for a holistic development of learners (Anaduaka, 2024).

The importance of STEAM to quality living cannot be overemphasized in any human endeavour. STEAM plays a crucial role in healthcare system, Information and Communication Technology (ICT) services, agriculture and educational activities. Its activities are drivers of economic growth. However, many challenges affect effective implementation and smooth operation of STEAM Education. These include gender disparities, insensitivity and inequality. There seems to be absence of gender inclusivity, equity and diversity in schools. It has been observed that the female gender is under-represented in STEAM. Akinbobola (2015) as well as Ezeudu and Ezeudu (2018) claimed that the gender-related problems in STEAM Education have root in social, cultural and pedagogical factors in Nigeria. UNESCO (2020) also reported that only 35% of the female gender are STEAM students worldwide. One of the ways to promote gender equality, sensitivity and inclusivity in STEAM Education could be an adoption of gender sensitive pedagogical practices (GSPP).

GSPP involve the use of inclusive language in teaching; providing role models from both genders; adoption of collaborative strategies in learning (Schiebinger, 2014). Salami (2016) opined that the effectiveness of these pedagogical practices is to reduce gender biases experienced in STEAM Education. Stressing further, Ogunleye (2019) identified the major challenges militating against GSPP. These include inadequate teacher training, cultural biases, and lack of institutional support. The researchers' preliminary interaction with teachers and senior secondary school students in FCT has shown that STEAM Education seems to face several challenges. It is against this background that the study is designed to assess GSPP in STEAM Education among Senior Secondary Schools in FCT, Nigeria.

Statement of the Problem

Despite the importance attached to STEAM Education in preparing students for the challenges and opportunities of the 21st century; fostering problem-solving; critical thinking; assuring collaborative skills; making students more innovative and adaptable, there are challenges of proper implementation of the programme. These problems retard effective acquisition of skills required for students' success after graduation. One of the major challenges is gender disparities that exist in STEAM Education. This challenge persists as a result of social, cultural and pedagogical factors. In an attempt to resolve these challenges and allow both male and female students to fully participate in STEAM Education, there is need to place emphasis on GSPP in the school system. Thus, this study examined the extent, benefits and challenges of GCPP in STEAM Education. The study also ascertained the strategies for overcoming the challenges in GSPP.

Purpose of the Study

The main objective of this study was to investigate GSPP in STEAM Education in senior secondary schools in Gwagwalada Area Council of Federal Capital Territory, Nigeria. Specifically, the study sought to:

1. investigate the teachers and students' perception on the extent of use of GSPP in STEAM education in senior secondary schools;
2. identify the benefits of GSPP in STEAM Education to senior secondary students;
3. identify the challenges that militate against implementation of GSPP in senior secondary schools; and
4. recommend strategies for enhancing the implementation of GSPP in STEAM Education.

Research Questions

The following research questions guided this study:

1. What is the perception of teachers and students on the extent of use of GSPP in STEAM Education in senior secondary schools?
2. What are the benefits of GSPP in STEAM Education as perceived by students in senior secondary schools?
3. What are the challenges that militate against implementation of GSPP in STEAM Education as perceived by teachers in senior secondary schools?
4. What are the strategies for enhancing the implementation of GSPP in STEAM Education?

Hypotheses

The following null hypotheses were tested at 0.05 level of significance:

- **H_{01}:** There is no significant difference in the perception of students and teachers on the use of GSPP in STEAM Education.
- **H_{02}:** There is no significant difference in the benefits students derive from GSPP in STEAM Education based on students' gender.
- **H_{03}:** There is no significant difference in the challenges militating against the implementation of GSPP in STEAM Education based on teachers' gender.
- **H_{04}:** There is no significant difference in the strategies for enhancing the implementation of GSPP in STEAM Education based on teachers' gender.

Review of Related Literature

Many educational academics from around the world have taken a keen interest in the STEAM concept. Through the use of e-

learning resources in the classroom, the International Society for Technology in Education (ISTE) mandates that educational institutions adjust to the rapid advancements in technology and equip students to compete globally (Utaminingsih et al., 2023). Students can comprehend the significance of merging multiple subjects through the use of STEAM education. Additionally, Chung and Li (2021) posited that students can enhance their ability to reason logically and give them ample opportunity to develop their thinking abilities. Li, Wang, and Zhang (2023) stressed that through STEAM education, learners get to balance the technical and creative dimensions of problem-solving cognitively. Akhigbe and Adeyemi (2023) submitted that the creation of a Gender Responsive Collaborative Learning Strategy (GR-CLS) enhances students' learning. In the strategy, both male and female students exposed to GR-CLS demonstrated notable improvements in achievement and attitude toward science in virtual and hands-on laboratory environments, according to their quasi-experimental study, which involved 218 secondary school students. However, students from same-sex schools benefited more than those from mixed-sex schools, indicating that school context and gender dynamics influence the effectiveness of gender-sensitive pedagogical strategies.

The digital divide among Nigerian educators is a significant problem, as male educators also exhibit greater digital literacy than female educators. Due to this disparity, female teachers are less able to use contemporary pedagogical tools to effectively teach STEAM content (Adeoye, 2023). Gender-inclusive classroom practices are further hampered by limited access to resources like training programs, teaching aids, and internet connectivity. The degree to which teachers and students engage in gender-sensitive pedagogical practices in secondary school STEAM education is revealed by empirical research from Nigeria and other nations.

According to Ngwu et al. (2024), there is underrepresentation of women in STEM education in Nigeria. The author suggested creative teaching techniques like peer tutoring, concept mapping, blended learning, games, and simulations. Adeoye (2023) found that male educators were more engaged in teaching STEAM subjects and had greater digital literacy than their female counterparts. Time constraints, lack of internet access, and a lack of school support were found to be obstacles preventing the use of digital skills in STEAM education. The adoption of gender-sensitive pedagogical practices in secondary school STEAM education has been hampered by a number of challenges. According to Adeoye (2023), addressing the biases of STEAM education may be facilitated by offering professional development programs to teachers that incorporate gender-sensitive teaching techniques. All students should have equal opportunities to participate in STEAM activities because teachers who received this kind of training were more likely to use equitable practices.

Methodology

This study employed a descriptive survey research design. This design was considered suitable because the data collected described the characteristics or facts about the population under study. The population of the study comprised 82 teachers and 417 students of 13 private secondary schools in Gwagwalada Area Council of FCT. Teachers and students of Senior Secondary Two (SS2) were involved in the study. Simple random sampling technique, specifically, balloting was used to select three secondary schools. All the 62 teachers who teach STEAM subjects and 180 senior secondary two students in the sampled schools were involved in the study, making a total sample size of 242 respondents.

The instruments used for the study were two structured questionnaires to elicit information from teachers and students. The questionnaires had restricted response options of Always (A), Often (O), Rarely (R), Never (N), and then, Strongly Agree (SA), Agree (A), Disagree (D), Strongly Disagree (SD) with corresponding values of 4, 3, 2 and 1 respectively.

The instruments were validated by three experts; one from the Department of Science and Environmental Education and the other from the Department of Statistics, University of Abuja and the third from the Mathematical Sciences Education Programme, National Mathematical Centre, Abuja. To ensure that the instruments accurately assess GSPP in STEAM Education, pilot testing was conducted using a different school to ensure clarity, relevance and ascertain the internal consistency of the items. Cronbach's alpha was used to analyse the data and reliability coefficients of 0.70 and 0.79 were obtained for teachers and students' instruments respectively. These values were considered acceptable for the study according to Ahmad et al (2024).

The instruments for this study were administered on the sample and 230 copies were retrieved. The data collected were analysed using descriptive and inferential statistics. Mean was used to answer the research questions. The bench mark for acceptance was 2.50. The decision rule was: any item with a mean value of 2.50 or above was regarded as 'accepted' while any item with a mean value of less than 2.50 was taken as 'not accepted'. Inferential statistics (independent t-test) was used to test the hypotheses at 0.05 level of significance. The scale data collected was converted to one unit through transformation. The reason for the conversion was to facilitate comparisons and interpretation of the results.

Informed consent was obtained from all participants, ensuring confidentiality and the right to withdraw from the study at any point. Ethical approval was sought from relevant educational authorities in the FCT.

Result and Discussion

A total of 242 questionnaires were administered to respondents, out of which 230 were retrieved representing 95% retrieval. The results of data analysed are presented in Tables.

Research Question One

What is the perception of teachers and students on the extent of use of GSPP in STEAM Education in senior secondary schools?

Data for answering research question 1 is presented in Table 1.

Table 1. Mean and Standard Deviation of Teachers and Students on the Extent of Students' Extent of Participation in GSPP in Senior Secondary Schools (N = 230)

S/N	Item Statement	$\underline{x}_1$	$\underline{x}_2$	$\underline{x}_c$	SD_1	SD_2	SD_C	Decision
1	To what extent do you participate in Science, Technology, Engineering, Arts and Mathematics (STEAM) activities in your school	3.63	3.77	3.70	.647	0.51	0.58	Always
2	To what extent do teachers equally encourage both boys and girls to ask questions during STEAM lessons	3.79	3.73	3.76	.415	0.45	0.43	Always
3	To what extent do teachers use both male and female names in citing examples in the class	3.50	3.38	3.44	.659	0.64	0.65	Always
4	To what extent have you been discouraged from taking part in any STEAM activity because of your gender	2.00	1.65	1.83	1.25	0.94	1.09	Rarely
5	To what extent do you have equal access to lab equipment, computers, and other resources	3.33	3.15	3.24	0.87	0.61	0.74	Always
6	To what extent has your school developed initiatives that actively encourage girls to pursue STEAM subjects	3.33	3.38	3.36	0.87	0.64	0.75	Always
	Grand Mean	**3.26**	**3.18**	**3.22**	**0.79**	**0.63**	**0.71**	

$\underline{x}_1$= Mean of teachers, $\underline{x}_2$ = Mean of students, $\underline{x}_C$ = Combined mean, SD_1 = Standard deviation of teachers, SD_2 = Standard deviation of students and SD_C = Combined standard deviation

Table 1 shows that in all the 6 items, teachers' mean values ranged from 3.05 to 3.49 while the mean values of students ranged from 2.90 to 3.81. The cumulative mean values ranged from 2.97 to 3.67 and were above the bench mark of 2.50. This shows that teachers and students both perceived the extent of use of GSPP in STEAM Education in senior secondary schools as high.

Research Question Two

What are the benefits of GSPP in STEAM Education as perceived by students in senior secondary schools?

Data for answering research question 2 is presented in Table 2.

Table 2. Mean and Standard Deviation of Respondents on the Benefits of GSPP in STEAM Education to Senior Secondary School Students (N = 180)

S/N	Item Statement	$\underline{x}_1$	$\underline{x}_2$	$\underline{x}_c$	SD_1	SD_2	SD_C	Decision
1	Equal participation in classroom activities	3.45	3.51	3.48	0.82	0.75	0.78	Agree
2	All students have open mind to learning	3.21	3.27	3.24	0.95	0.91	0.93	Agree
3	I perform better in tests and examinations	3.41	3.32	3.37	0.75	0.75	0.75	Agree
4	I have boldness to answer questions	3.12	3.01	3.07	0.95	0.95	0.95	Agree
5	I think critically in expectation of being called to answer questions	3.05	2.90	2.97	0.92	0.91	0.91	Agree
6	It encourages friendliness between male and female students	3.21	3.29	3.25	1.02	0.94	0.98	Agree
7	My relationships with my teachers are better	3.05	3.14	3.10	0.97	0.89	0.93	Agree
8	I feel free to express my opinions	3.17	3.06	3.12	1.00	0.92	0.96	Agree
9	The classroom environment becomes enjoyable while learning	3.13	3.37	3.25	0.95	0.81	0.88	Agree
10	I understand what is taught better	3.30	3.33	3.32	0.91	0.77	0.84	Agree
11	I can see that both boys and girls can be leaders	3.54	3.74	3.64	0.89	0.59	0.75	Agree
12	I am sure that I can be successful in any career	3.52	3.81	3.67	1.02	0.64	0.83	Agree
	Grand Mean	**3.26**	**3.31**	**3.29**	**0.93**	**0.82**	**0.88**	

$\underline{x}_1$= Mean of male students, $\underline{x}_2$ = Mean of female students, $\underline{x}_C$ = Combined mean, SD_1 = Standard deviation of male students, SD_2 = Standard deviation of female students and SD_C = Combined standard deviation

Table 2 shows that for all the 12 items, the mean values of male students ranged from 3.05 to 3.49, while that of their female counterparts ranged from 2.90 to 3.81. The cumulative mean values ranged from 2.97 to 3.67. These values were above the bench mark of 2.50. This showed that both male and female respondents agreed that all the items listed were the benefits of GSPP in STEAM Education.

Research Question Three

What are the challenges that militate against implementation of GSPP in STEAM Education as perceived by teachers in senior secondary schools?

Data for answering research question 3 is presented in Table 3.

Table 3. Mean and Standard Deviation of Respondents on the Challenges that Militate against Implementation of GSPP in Senior Secondary Schools (N = 50)

S/N	Item Statement	$\underline{x}_1$	$\underline{x}_2$	$\underline{x}_c$	SD_1	SD_2	SD_C	Decision
1	Problem of integration of arts into STEM	2.75	2.81	2.78	1.07	0.94	1.01	Agree
2	Insufficient STEAM teachers	2.63	2.73	2.68	1.31	1.28	1.29	Agree
3	Poor teachers' readiness to implement STEAM education	2.46	2.00	2.23	1.18	0.89	1.04	Disagree
4	Poor students' interest toward the STEAM Education	2.46	2.23	2.34	1.02	0.77	0.89	Disagree
5	Institutional constraints in STEAM application such as poor motivation from management	2.88	2.54	2.71	0.99	1.03	1.01	Agree
6	Irregular training of teachers on STEAM	2.58	2.69	2.64	1.28	1.12	1.20	Agree
7	Inadequate technical know-how of teachers	2.42	2.65	2.54	1.10	0.79	0.95	Agree
8	Classroom-related issues such as overcrowding	2.21	2.46	2.33	0.98	0.95	0.96	Disagree
9	Insufficient learning infrastructures	2.17	2.00	2.08	0.87	0.80	0.83	Disagree
10	STEAM Education misconceptions	2.17	2.46	2.31	0.96	0.99	0.98	Disagree
11	Teaching of STEAM by unqualified teachers	2.08	2.46	2.27	1.06	1.03	1.04	Disagree
12	Inadequate funding of STEAM	2.17	2.62	2.39	1.17	0.94	1.05	Disagree
13	Insufficient instructional resources such as books, desk-bench, technological tool	2.38	2.42	2.40	1.01	0.95	0.98	Disagree
14	Disconnection between classroom practices and real-world experience	2.25	2.58	2.41	1.11	1.07	1.09	Disagree
	Grand Mean	**2.40**	**2.48**	**2.44**	**1.08**	**0.97**	**1.02**	

$\underline{x}_1$= Mean of male teachers, $\underline{x}_2$ = Mean of female teachers, $\underline{x}_C$ = Combined mean, SD_1 = Standard deviation of male teachers, SD_2 = Standard deviation of female teachers and SD_C = Combined standard deviation

Table 3 reveals that out of the 14 items assessed, only 4 items had mean scores above the benchmark of 2.50 for male teachers, while female teachers recorded mean scores above 2.50 on 7 items. Additionally, only 5 items had cumulative mean scores exceeding the 2.50 benchmark. This implies that the implementation of GSPP in STEAM education faces certain challenges, as perceived by both male and female teachers.

Research Question Four

What are the strategies for enhancing the implementation of GSPP in STEAM Education?

Data for answering research question 4 is presented in Table 4.

Table 4. Mean and Standard Deviation of Respondents on the Strategies to Enhance the Implementation of GSPP in STEAM Education (N = 50)

S/N	Item Statement	$\underline{x}_1$	$\underline{x}_2$	$\underline{x}_c$	SD_1	SD_2	SD_C	Decision
1	Conducting regular training for teachers	3.38	3.38	3.38	0.77	0.69	0.73	Agree
2	Use of variety of learner-centered methods in delivering STEAM content	3.54	3.50	3.52	0.59	0.58	0.59	Agree
3	Promoting gender inclusivity	3.38	3.62	3.50	0.77	0.57	0.67	Agree
4	Improving resource accessibility	3.63	3.65	3.64	0.58	0.49	0.53	Agree
5	Proper motivation of STEAM teachers	3.58	3.62	3.60	0.58	0.49	0.54	Agree
6	Regular supervision of STEAM teachers	3.46	3.62	3.54	0.72	0.57	0.65	Agree
7	Encouraging teachers to improve technical know-how of STEAM	3.54	3.65	3.60	0.51	0.49	0.49	Agree
8	Integrating real-world applications of concepts	3.42	3.54	3.48	0.58	0.51	0.55	Agree
9	Assigning of STEAM subjects to only qualified teachers	3.46	3.62	3.54	0.66	0.49	0.58	Agree
10	Encouraging early STEM exposure	3.58	3.62	3.60	0.58	0.49	0.54	Agree

			5	2		9	3	
11	Improving funding of STEAM education		3.4	3.5		0.7	0.6	
		3.67	2	4	0.57	0	3	Agree
12	Proper planning of content preparations		3.6	3.7		0.4	0.4	
		3.83	5	4	0.38	9	3	Agree
13	Fostering students' engagement		3.3	3.4		0.6	0.7	
		3.54	8	6	0.78	9	4	Agree
14	Encouraging students to develop positive attitude toward STEAM		3.5	3.6		0.7	0.6	
		3.67	4	0	0.57	1	4	Agree
15	Recruitment of adequate number of STEAM teachers in schools		3.5	3.5		0.5	0.5	
		3.63	4	8	0.58	1	4	Agree
16	Provision of technological applications		3.6	3.7		0.4	0.4	
		3.83	9	6	0.38	7	3	Agree
17	Leveraging on technology applications		3.3	3.4		0.8	0.7	
		3.58	8	8	0.65	0	3	Agree
18	Creating collaborative learning platforms for students		3.6	3.6		0.4	0.5	
		3.63	9	6	0.65	7	6	Agree
	Grand Mean	**3.57**	**3.56**	**3.57**	**0.61**	**0.57**	**0.59**	

$\underline{x}_1$= Mean of male teachers, $\underline{x}_2$ = Mean of female teachers, $\underline{x}_C$ = Combined mean, SD_1 = Standard deviation of male teachers, SD_2 = Standard deviation of female teachers and SD_C = Combined standard deviation

Table 4 shows that the mean values of male and female teachers' responses to all the 18 items listed were above the benchmark of 2.50. This showed that the teachers all agreed that the 18 items listed are strategies to enhance the implementation of GSPP in STEAM Education in senior secondary schools.

Test of Hypotheses

Hypothesis One

There is no significant difference in the perception of students and teachers on the use of GSPP in STEAM Education.

Data for testing hypothesis 1 is presented in Table 5.

Table 5. *t*-Test of Teachers and Students' Perception on the Extent of Use of GSPP in STEAM Education

	Levene's Test for Equality of Variances		t-test for Equality of Means						
								95% Confidence Interval of the Difference	
	F	Sig.	T	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Equal variances assumed	11.023	.001	-81.723	228	.000	-5.97926	.07316	-6.12343	-5.83509
Equal variances not assumed			-110.723	142.806	.000	-5.97926	.05400	-6.08601	-5.87251

Table 5 reveals a p-value of 0.000 which is less than the *alpha* value of 0.05. This means that the difference between teachers and students' responses is significant. Therefore, the null hypothesis which states that there is no significant difference in the mean responses of teachers and students on the extent of use of GSPP in STEAM Education is rejected. This implies that significant difference exists in the teachers and students' perception of the extent of use of GSPP and students' participation in GSPP in STEAM education.

Hypothesis Two

There is no significant difference in the benefits students derive from GSPP in STEAM Education based on students' gender.

Data for testing hypothesis2 is presented in Table 6.

Table 6. t-Test on the Benefits of GSPP in STEAM Education in Senior Secondary Schools

	Levene's Test for Equality of Variances		t-test for Equality of Means						
								95% Confidence Interval of the Difference	
	F	Sig.	T	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Equal variances assumed	1.350	.247	2.296	178	.023	.18126	.07894	.02516	.33736
Equal variances not assumed			2.257	111.038	.026	.18126	.08030	.02213	.34038

Table 6 reveals a *p*-value of 0.023 which is less than the *alpha* value of 0.05. This result is significant. Therefore, the null hypothesis which states that there is no significant difference in the mean responses of male and female students on benefits of GSPP

in STEAM in Education in senior secondary schools is not accepted. This is an indication that the opinions of male and female students are significantly different on the benefits of GSPP in STEAM Education in senior secondary schools.

There is no significant difference in the challenges militating against the implementation of GSPP in STEAM Education based on teachers' gender

Data for testing hypothesis 3 is presented in Table 7.

Hypothesis Three

Table 7. t-Test of Male and Female Teachers' Responses on the Challenges Militating against Implementation of GSPP in STEAM Education

	Levene's Test for Equality of Variances		t-test for Equality of Means						
								95% Confidence Interval of the Difference	
	F	Sig.	T	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Equal variances assumed	.039	.845	-.369	48	.714	-.07791	.21141	-.50298	.34716
Equal variances not assumed			-.367	46.554	.715	-.07791	.21223	-.50497	.34915

Result in Table 6 reveals a *p*-value of 0.714 which is greater than the *alpha* value of 0.05. This result is not significant. Therefore, the null hypothesis which states that there is no significant difference in the mean responses of male and female teachers on the challenges militating against implementation of GSPP in STEAM Education is not rejected. This is an indication that the perception of male and female teachers did not significantly differ on the challenges militating against implementation of GSPP in STEAM Education.

Hypothesis Four

There is no significant difference in the strategies for enhancing the implementation of GSPP in STEAM Education based on teachers' gender.

Data for testing hypothesis 4 is presented in Table 8.

Table 8. t-Test of Male and Female Teachers on the Strategies for Enhancing the Implementation of GSPP in STEAM Education

	Levene's Test for Equality of Variances		t-test for Equality of Means						
								95% Confidence Interval of the Difference	
	F	Sig.	T	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Equal variances assumed	.168	.684	.096	48	.924	.00997	.10438	-.19990	.21985
Equal variances not assumed			.096	47.763	.924	.00997	.10433	-.19983	.21978

Result in Table 8 reveals a *p*-value of 0.924 which is greater than the *alpha* value of 0.05. This result is not significant. Therefore, the null hypothesis which states that there is no significant difference in the mean responses of male and female teachers on the male and female teachers on the strategies for enhancing the implementation of GSPP in STEAM Education is not rejected. This is an indication that the perception of male and female teachers did not significantly differ on the strategies for enhancing the implementation of GSPP in STEAM Education.

Discussion of Findings

The findings of the study revealed that the teachers and students perceived the extent of use of GSPP in STEAM education in senior secondary schools as high. Specifically, the respondents agreed that STEAM activities are conducted; teachers equally encourage both boys and girls to ask questions during STEAM lessons; teachers use both male and female names in citing examples in the class; teachers do not discourage them from taking part in any STEAM activity because of gender, computers, or other resources; and initiatives are developed to encourage girls to pursue STEAM subjects. The finding agrees with a report by Moletsane (2020), which found that in schools, over 75% of science teachers who had taken part in the Gender Equity Training Programme (GETP) regularly used gender-sensitive teaching strategies, such as using examples from real-world situations that were applicable to both genders, ensuring equal participation in laboratory activities, and purposefully including female scientists and engineers in instructional materials. Also, the result is in contrast to that of Anyango and Ouma (2023), who discovered that just 28% of teachers consciously employed gender-inclusive practices. The finding also differs from that of Nugent et al. (2022), who discovered that less than 20% of STEAM teachers regularly used gender equity initiatives.

Furthermore, finding revealed that students highly benefit from GSPP in STEAM education in senior secondary schools. The students agreed that they participate equally in classroom activities, have an open mind to learning, perform better in tests and examinations, express boldness to answer questions, think critically in expectation of being called to answer questions, make their classroom environment enjoyable while learning, understand what is taught better, and are sure that they can be successful in any career of their choice when GSPP is used in STEAM

education. This finding agrees with the work of Akhigbe and Adeyemi (2023) that found out that exposing students to a gender-responsive collaborative learning strategy (GR-CLS) demonstrated notable improvements in achievement and attitude toward science in virtual and hands-on laboratory environments.

Another finding of the study revealed that there are some challenges affecting the implementation of STEAM education in senior secondary schools. These include problem of integration of arts into STEM; insufficient STEAM teachers; institutional constraints in STEAM application such as poor motivation from management; irregular training of teachers on STEAM; and inadequate technical know-how of teachers. However, the respondents disagreed that other challenges exist. These challenges include poor teachers' readiness to implement STEAM education; poor students' interest in STEAM education; classroom-related issues such as overcrowding; STEAM education misconceptions; use of unqualified teachers; inadequate funding; insufficient instructional resources such as books, desk-bench, technological tools; disconnection between classroom practices and real-world training programs; and poor internet connectivity. The test of hypothesis three also revealed no significant difference in the mean responses of male and female teachers on the challenges militating against implementation of GSPP in STEAM education in senior secondary schools. The finding agrees with Adeoye (2023), who found that gender-sensitive pedagogical practices in STEAM education at the secondary school level face a number of obstacles. The digital divide among Nigerian educators is a significant problem, as male teachers tend to exhibit greater digital literacy than female educators. Due to this disparity, female teachers are likely less able to use contemporary pedagogical tools to effectively teach STEAM content. Also, gender-inclusive classroom practices are further hampered by limited access to resources.

Finding also shows that the teachers agree that the strategies are needed for overcoming the challenges and enhancing the implementation of GSPP in STEAM education in senior secondary schools. These strategies include promotion of gender inclusivity; regular supervision of STEAM teachers, encouraging teachers to improve the technical know-how of STEAM, integration of real-world applications of concepts, and assignment of STEAM subjects to only qualified teachers. Other strategies include fostering students' engagement; encouraging students to develop positive attitudes toward STEAM; recruiting an adequate number of STEAM teachers in schools; and providing technological applications. Another finding revealed no significant difference in the mean responses of male and female teachers on the strategies for enhancing the implementation of STEAM education. This finding is different from a report by Adeoye (2023) who found that the biases of STEAM education are facilitated by offering professional development programmes to teachers that incorporate gender-sensitive teaching techniques. This agrees with Soto (2023), who reported that the presence of female role models in STEAM fields has a significant impact on female students' participation and interest in these subjects.

Conclusion

This study has established that GSPP in STEAM education are veritable and important strategies that foster students' equity, inclusivity, and better learning outcomes for all students, regardless of gender. Also, the study affirms that as teachers make use of gender-sensitive pedagogical practices in STEAM education, the students in turn participate in gender-sensitive pedagogical practices in STEAM education in senior secondary schools. The study also identified the challenges that affect the smooth implementation of these practices in STEAM education.

Recommendations

Based on the findings of the study, the following recommendations are made:

1. Senior secondary teachers should adopt inclusive teaching techniques that allow full participation of students in STEAM education.
2. Secondary school administrators should address and eliminate biased attitudes among teachers to prevent gender discrimination in STEAM education.
3. Senior secondary school teachers should create a supportive learning environment for students to benefit from STEAM education.
4. Secondary school administrators should ensure that qualified teachers are assigned to teach STEAM subjects.

References

1. Adeoye, M. A. (2023). Gender differences in Teachers' Digital Literacy Skills in Teaching STEAM. *Journal of Education Technology*, 7(3), 462-469. https://ejournal.undiksha.ac.id/index.php/JET/article/view/66847
2. Ahmad, N., Alias, F.A., Hamat, M., Mohamed, S.S. (2024). *Reliability analysis: Application of Cronbach's Alpha in research instruments*. Special Interest Groups (SIG): e- https://appspenang.uitm.edu.my/sigcs
3. Aina, J. (2022). *STEM education in Nigeria: Development and challenges*. Retrieved on 13th November 2023 from https://www.researchgate.net.3584....
4. Akhigbe, J. N., & Adeyemi, A. E. (2023). Using Gender Responsive Collaborative Learning Strategy to Improve Students' Achievement and Attitude towards Learning Science in Virtual and Hands-On Laboratory Environment. *International Journal of Pedagogical Research*. Retrieved from https://www.ijopr.com/article/using-gender-responsive-collaborative-learnin93g-strategy-to-improve-students-achievement-and-attitude-8703
5. Akinbobola, A. O. (2015). Gender inequality in science education in Nigeria. *Journal of Education and Practice*, *6*(19): 75-79.
6. Anaduaka, U.S. (2024). *STEAM education*. Presentation on foundation postgraduate course on current trends in STEAM education: Gender, access, learning and assessment. National Mathematical Centre, Abuja. 13th October –25th October, 2024
7. Anyango, L. & Ouma, P. (2023). Integrating gender-sensitive approaches in STEAM classrooms: Strategies and outcomes. *International Journal of STEAM Education*, 5(1), 15-29
8. Ezeudu, F. O. and Ezeudu, S. A. (2018). Gender sensitivity in science education: A necessity for sustainable development. *Nigerian Journal of Curriculum Studies, 25*(2), 103-111.

9. Li, X., Wang, X., & Zhang, X. (2023). Gender equity in STEM: The role of STEAM education in bridging the gender gap. *International Journal of STEM Education*, 10(2): 58-65. https://doi.org/10.1186/s40594-023-00347-6
10. Miracle Creation (2023). *How schools can encourage STEAM education*. Retrieved on 14thNovember, 2023 from https://www.miracle-recreation.com>
11. Moletsane, R. (2020). Gender-sensitive pedagogical practices in STEAM education: A critical analysis. *Journal of Gender Studies in Education*, 12(3), 245-260
12. Ngwu, A. N., Ugwu, C. B. A., & Ukah, I. V. (2024). Gender Mainstreaming: Innovative Instructional Strategies for Promoting Gender Equality in STEM Education. *SAPIENTIA Foundation Journal of Education, Sciences and Gender Studies*. Retrieved from https://www.sfjesgs.com/index.php/SFJESGS/article/view/464
13. Nugent, G., Barker, B., Grandgenett, N. & Adamchuk, V. (2022). *Play as a pedagogical vehicle for supporting gender-inclusive engagement in informal STEAM education*. Museum Management and Curatorship, 37(2), 123-140.
14. Ogunleye, A. O. (2019). Gender issues in education: Challenges and prospects. *African Journalof Educational Research, 13*(1), 89-99.
15. Salami, O. O. (2016). Enhancing gender equity in STEAM education. *International Journal of Educational Research, 2*(3), 45-53.
16. Schiebinger, L. (2014). Gendered innovations in science and engineering. *Stanford University Press*.
17. Soto, C. (2023). Towards a Gendered STEAM Education Approach: Building a Comprehensive Model to Strengthen Girls' and Students with Non-Conforming Gender Identities' STEAM Trajectories in Chilean Public Schools. *London Review of Education*, 22(6). https://journals.uclpress.co.uk/lre/article/pubid/LRE-22-6/
18. Tate, G. (2017). *From STEAM to STEM. The lost A (Art) and why it's important*. Retrieved on 13th November 2023 from https://www.primotoys.com>steam...
19. UNESCO. (2020). *Global Education Monitoring Report: Gender Report 2020*. Paris: UNESCO.