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Pursuing Stem Careers: Challenges of Senior High School Students during Distance Learning

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ABSTRACT: The COVID-19 pandemic required the educational sector to implement countermeasures in order to continue educating students amidst the pandemic, this may have resulted in a gap in the number of people entering the STEM (Science, Technology, Engineering, and Mathematics) field. This study determined the challenges of senior high school students in learning in STEM through distance learning. The respondents were 85 Grade 12 STEM students from the six (6) selected public and private educational institutions in the province of Zambales who were chosen through stratified random sampling. Results revealed that STEM 12 students often encountered challenges in terms of Learning Environment (LEC), Student Isolation (SIC), and Workload, simultaneously, it was noted that they sometimes encountered challenges in terms of Self-Regulation (SRC), Technological Sufficiency (TSC), and Technological Literacy and Competency (TLCC).Statistically significant differences were noted on the challenges encountered by Senior High School Students during distance learning in terms of school and age, but there were no significant differences that were noted regarding the other profile variables. The study suggests that the education sector should create program interventions to address the challenges such as curriculum development, to encourage or institutionalize special training courses in mathematics and science, and to develop learning continuity plans to empower teachers and students.

BACKGROUND

The World Health Organization (WHO) has classified the 2019 corona virus disease, also known as COVID-19, as a global pandemic. This had an impact on the global education system in addition to the economy. According to the United Nations Educational, Scientific and Cultural Organization, 1.5 billion students are impacted and 165 countries closed all of their schools because to the COVID-19 pandemic (UNESCO, 2020). In order to continue educating pupils in the face of the epidemic, the educational sector had to take preventative measures. This may have resulted in a gap in the number of people entering the STEM (Science, Technology, Engineering, and Mathematics) field.

For innovation and productivity to increase, STEM graduates and employment are essential (Peri et al., 2015). Future STEM specialists are required because of catastrophes like the pandemic. It is widely accepted that Australia's productivity and prosperity depend on its workforce having more STEM-related skills, knowledge, and workforce to compete worldwide (Siekmann & Korbel, 2016). Relatively, United States and Malaysia give focus to STEM-related industries and developed plans and directives to modify students' indifference to science related works. On contrary to the demand, there are only small proportions of STEM students that pursue science, technology, and mathematics aligned occupations (Dasgupta & Stout, 2014). According to the study of Anito, Morales and Palisoc (2019), there are not enough STEM graduates resulting to insufficient working scientists in the Philippines with only 189 scientist per million, compared to UNESCO's standard of 380 per million, is extremely low. This low figure of scientists is due to the low enrollees and graduates of STEM-related career. As reported by Brillantes et al. (2019), STEM ranks third as most popular academic strand and the completion rate in STEM field is only 21.9% (Morales et al., 2020). In addition to the nation's poor performance in the 2018 Program for International Student Assessment (PISA), COVID-19 impose challenges that influence how students learn in the STEM field and the use of remote education this pandemic is filled with difficulties for a developing country like the Philippines (Rotas & Cahapay, 2020).

Therefore, the purpose of this study is to ascertain the difficulties SHS students have when learning STEM subjects through distant education. To give students a more full and superior educational experience and to clarify the professional route of individuals who study STEM, it is important to comprehend and address these issues.

METHODOLOGY

The study utilized a Descriptive-research survey design. The quantitative approach to information gathering focuses on describing a trend or phenomenon across a more significant number of participants, allowing for summarizing characteristics across groups or relationships. Subsequently, the descriptive design were used in order to get a data collection tool by asking some descriptive questions since the researcher are determined to know the challenges of Senior High School from STEM strand during distance learning.

The respondents of this study are Grade 12 STEM students in six public and private education institution in Central Luzon, Philippines (Table 1). The respondents were chosen through stratified random sampling with a purpose. A population is divided into uniform subpopulations by researchers based on certain traits in a stratified sample, including racial or gender identity, place of residence, etc. (Thomas, 2020).

Table 1. Distribution of Respondents

School	Classification	No. of Frequency	Percent
SEI A	Private SEI	18	21.2
SEI B	Private SEI	16	18.8
SEI C	Public SEI	11	12.9
SEI D	Public SEI	15	17.6
SEI E	Private SEI	12	14.1
SEI F	Private SEI	13	15.3
Total		**85**	**100**

Where SEI: Secondary Education Institution. As shown, the study involved four institutions from private secondary educaton institution and two public secondary education institution.

Table 2 shows the profile of the STEM 12 students.The profile of the respondents are determined to provide a comprehensive background of their school, age, sex, and financial status.

Table 2. Frequency and Percent Distribution of the Respondents' Profile

	Profile	Frequency	Percentage %
School	Public	26	30.59
	Private	59	69.41
	Total	**85**	**100**
Age	15 and below	0	0
	16	6	7.06
	17	63	74.12
	18	15	17.65
	19 and above	1	1.18
	Total	**85**	**100**
Sex	Male	39	45.88
	Female	46	54.12
	Other	0	0
	Total	**85**	**100**
Financial Status	Below 5, 000	29	34.12
	5, 000 – 9, 9999	22	25.88
	10, 000 – 14, 999	9	10.59
	15, 000 – 19, 999	2	2.35
	20, 000 & above	23	27.06
	Total	**85**	**100**

**Multi response*

As shown in the table 2, most of the respondents are from Private Schools (59, 69.41%). The respondents are mostly 17 years old (63, 74.12%). Almost half of the respondents are female (46, 54.12%). The majority of the respondents have a financial status of below ₱5,000.00 (29, 34.12%).

The challenges faced by Grade 12 senior high school students in learning in STEM during distance learning survey questionnaire developed by the researchers served as the main instrument in gathering the data. The survey tool is an adopted-modified

questionnaire from Students' online learning challenges during the pandemic and how they cope up with them: The case of the Philippines, Barrot et al. (2021); Challenges encountered by junior high school students in learning science: Basis for action plan, Sadera et al. (2020); STEM Education from Asia, Teng (n.d.); Interrelationship between changes of concern and technological pedagogical, and content knowledge: A study on Taiwanese senior high school in-service teachers, Chen & Jang (2014); and COVID-19 and distance learning: Effects on Georgia State University school of public health students, Armstrong-Mensah et al. (2020).

Validity tests were conducted on the survey questionnaire's concept and content. To examine the items in each variable's consistency, three experts were called upon. For the survey's pilot testing, ten STEM 12 students who weren't involved in the study were asked to respond. The responses were analyzed, and a reliability test was run on them. The questionnaire's Cronbach alpha ranged from 0.80 to 0.99, indicating a good level of reliability that permitted its use in the study.

After developing the research questionnaire and validation of four experts, the researchers asked permission from school administrators of the six secondary education institutions to conduct the survey.All the STEM 12 students were involved in the data gathering and the informed consent was secured before they answered the questionnaires. The research survey was floated to 85 STEM 12 students. Retrieval of the survey tools was done on the same day.

The data processing was carried out using SPSS version 20 and MS Excel 2013. Frequency count, percent, weighted mean, and analysis of variance (ANOVA) were the statistical techniques that were employed in the study and interpretation of the data and hypotheses.

The names of the senior high school students were omitted from all aspects of this research. The students were not harmed emotionally or physically as a result of their participation in the study. Coding scheme was used in identifying the respondents. To ensure and promote copyright laws, proper document sourcing or referencing of materials was performed.

RESULTS AND DISCUSSION

Table 3 shows the summary of the six challenges of STEM 12 students during distance learning.

Table 3. Challenges Encountered by Senior High School Students during distance learning

Variables	Weighted Mean	SD	Description
Self-Regulation Challenges (SRC)	3.26	0.78	Sometimes
Technological Sufficiency Challenges (TSC)	2.64	0.88	Sometimes
Technological Literacy and Competency Challenges (TLCC)	2.62	0.75	Sometimes
Student Isolation Challenges (SIC)	3.66	0.90	Often
Learning Environment Challenges (LEC)	3.73	0.85	Often
Workload	3.51	0.74	Often
Average weighted mean	**3.24**	**0.82**	**S**

The respondents sometimes encounter challenges in distance learning with the overall mean mean of 3.24 and standard deviation of 0.82. The highest means were obtained in the following indicators: Learning Environment Challenges (LEC) (M= 3.73, SD= 0.85, Rank=1), Student Isolation Challenges (SIC) (M= 3.51, SD= 0.90, Rank= 2), and Workload (M= 3.51, SD= 0.74, Rank= 3). This prove that STEM 12 students often encounter challenges in learning environment, isolation, and workload.

The lowest means were acquired in the following indicators: Self-Regulation Challenges (SRC) (M=3.26, SD= 0.78, Rank= 4), Technological Sufficiency Challenges (TSC) (M= 2.64, SD= 0.88, Rank= 5), and Technological Literacy and Competency Challenges (TLCC) (M= 2.62, SD= 0.75, Rank= 6). This implies that the STEM 12 students sometimes experience challenges in all dimensions cited.

Table 4. Independent Sample t-test for the Respondents' challenges in distance learning by School

Challenge	School	Mean	SD	t-value	df	p-value	Decision/ Interpretation
Self-Regulation Challenges	Public	3.35	0.75	0.668	83	0.731	Accept H_0/ Not Significant
	Private	3.23	0.79				
Technological Sufficiency Challenges	Public	2.76	0.96	0.825	83	0.150	Accept H_0/ Not Significant
	Private	2.58	0.85				
Technological Literacy and Competency Challenges	Public	2.63	0.75	0.037	83	0.397	Accept H_0/ Not Significant
	Private	2.62	0.76				

Student Isolation Challenges	Public	3.65	0.85	-0.054	83	0.422	Accept H_0/ Not Significant
	Private	3.67	0.93				
Learning Environment Challenges	Public	3.94	0.76	1.658	83	0.112	Accept H_0/ Not Significant
	Private	3.63	0.88				
Workload	Public	3.50	0.76	-0.048	83	0.204	Accept H_0/ Not Significant
	Private	3.51	0.74				

**Significant at p<0.050* **equal variances assumed*

Table 4 shows the independent sample t-test for the respondents' challenges during distance learning by school.

As seen in the table, there is no statistically significant difference between the challenges encountered by private/public STEM 12 students.

It can be noted that STEM 12 students from public have greater challenges (M= 3.35) than the private schools (M= 3.23) in terms of Self-Regulation. It can be noted that the STEM 12 students from public have greater challenges (M= 2.76) than their private counterparts (M= 2.58) in terms of Technological Sufficiency. It can be noted that the respondents from public have greater challenges (M= 2.63) than their private counterparts (M= 2.62) in terms of Technological Literacy and Competency. It can be noted that STEM 12 students from private schools have greater challenges (M= 3.67) than their public counterparts (M= 3.65) in terms of Student Isolation. It can be noted that STEM 12 students from public have greater challenges (M= 3.94) than their private counterparts (M= 3.63) in terms of Learning Environment. It can be noted that students from private schools have greater challenges (M= 3.51) than their public counterparts (M= 3.50) in terms of Workload.The results show that there is no significant difference between private and public school in terms of challenges in the variables cited.

Table 5 shows the One-way analysis of variance of the Respondents' challenges encountered during distance learning by age.

Table 5. One-way Analysis of Variance of the Respondents' Challenges During Distance Learning by Age

	Source	**SS**	**df**	**MS**	**F**	**Sig.**	**Decision/ Interpretation**
Self-Regulation Challenges	Between Groups	2.148	3	0.716	1.189	0.319	Accept H_0/ Not Significant
	Within Groups	48.762	81	0.602			
	Total	50.910	84				
Technological Sufficiency Challenges	Between Groups	5.470	3	1.823	2.464	0.068	Accept H_0/ Not Significant
	Within Groups	59.929	81	0.740			
	Total	65.399	84				
Technological Literacy and Competency Challenges	Between Groups	1.382	3	0.461	0.808	0.493	Accept H_0/ Not Significant
	Within Groups	46.146	81	0.570			
	Total	47.528	84				
Student Isolation Challenges	Between Groups	2.677	3	0.892	1.105	0.352	Accept H_0/ Not Significant
	Within Groups	65.412	81	0.808			
	Total	68.088	84				
Learning Environment Challenges	Between Groups	1.140	3	0.380	0.517	0.672	Accept H_0/ Not Significant
	Within Groups	59.563	81	0.735			
	Total	60.703	84				
Workload	Between Groups	2.866	3	0.955	1.788	0.156	Accept H_0/ Not Significant
	Within Groups	43.261	81	0.534			
	Total	46.127	84				

**Significant at p<0.050* **equal variances assumed*

The computed p-value for Self-Regulation Challenges (0.319), Technological Sufficiency Challenges (0.068), Technological Literacy and Competency Challenges (0.493), Student Isolation Challenges (0.352), Learning Environment Challenge (0.672), and Workload (0.156) are higher than (>) 0.050 level of significance, thus the null hypothesis is accepted. Hence, there is no statistically significant difference at the 0.050 level of significance in the rating mean scores of the respondents' age. However, the study of Xu and Jaggars (2013) reported that older students adopted more easily than younger students in online learning.

Table 6. ***Independent Sample t-test for the Respondents' challenges during distance learning by Sex***

	Sex	Mean	SD	t-value	df	p-value	Decision/ Interpretation
Self-Regulation Challenges	Male	3.21	0.77	0.668	83	0.395	Accept H_0/ Not Significant
	Female	3.30	0.79				
Technological Sufficiency Challenges	Male	2.63	1.00	0.825	83	0.699	Accept H_0/ Not Significant
	Female	2.64	0.78				
Technological Literacy and Competency Challenges	Male	2.53	0.76	0.037	83	0.530	Accept H_0/ Not Significant
	Female	2.70	0.75				
Student Isolation Challenges	Male	3.62	0.88	-0.054	83	0.518	Accept H_0/ Not Significant
	Female	3.70	0.93				
Learning Environment Challenges	Male	3.60	0.85	1.658	83	0.739	Accept H_0/ Not Significant
	Female	3.84	0.84				
Workload	Male	3.49	0.74	-0.048	83	0.653	Accept H_0/ Not Significant
	Female	3.52	0.74				

**Significant at p<0.050* **equal variances assumed*

Table 6 shows the sample t-test for the respondents challenges encountered during distance learning by sex.

As seen on the table above, there is no statistically significant differences between the means of the challenges of STEM 12 students by sex. However, it can be noted that female respondents (M= 3.30) faced the greatest challenges while male respondents (M= 3.21) faced the least challenges in terms of Self-Regulation. In terms of Technological Sufficiency Challenges female respondents (M= 2.64) faced the greatest challenge while male respondents (M= 2.63) faced the least challenge. In terms of Technological Literacy and Competency female respondents (M= 2.70) faced the greatest challenges while male respondents (M= 2.53) faced least challenge. In terms of Student Isolation Challenges female respondents (M= 3.70) faced the greatest challenges while male respondents (M= 3.62) faced least challenge. In terms of Learning Environment Challenges it can be noted that female respondents (M= 3.84) faced the greatest challenges while male respondents (M= 3.60) faced least challenge. In terms of Workload female respondents (M= 3.52) faced the greatest challenges while male respondents (M= 3.49) faced least challenge.

In relation, Newsome et al. (2022) concluded that in terms of in instructor behavior, assessment and evaluation, and tools and technologies, male students have more positive perception than females. During the pandemic, adolescent girls than boys showed greater negative impacts in both well-being and behavioral change that is linked to decreased communication with peers and family members through phone or social media (Halldorsdottir et al, (2021).

Table 7. ***One-way Analysis of Variance of the Respondents' Challenges During Distance Learning by Financial Status***

	Source	**SS**	**df**	**MS**	**F**	**Sig./ p-value**	**Decision/ Interpretation**
Self-Regulation Challenges	Between Groups	2.612	4	0.653	1.082	0.371	Accept H_0/ Not Significant
	Within Groups	48.298	80	0.604			
	Total	50.910	84				
Technological Sufficiency Challenges	Between Groups	0.735	4	0.184	0.227	0.922	Accept H_0/ Not Significant
	Within Groups	64.664	80	0.808			
	Total	65.399	84				
	Between Groups	1.097	4	0.274	0.472	0.756	Accept H_0/ Not Significant

Technological Literacy and Competency Challenges	Within Groups	46.431	80	0.580			
	Total	47.528	84				
Student Isolation Challenges	Between Groups	1.283	4	0.321	0.384	0.819	Accept H_0/ Not Significant
	Within Groups	66.805	80	0.835			
	Total	68.088	84				
Learning Environment Challenges	Between Groups	0.453	4	0.113	0.150	0.962	Accept H_0/ Not Significant
	Within Groups	60.250	80	0.753			
	Total	60.703	84				
Workload	Between Groups	1.972	4	0.493	0.893	0.472	Accept H_0/ Not Significant
	Within Groups	44.155	80	0.552			
	Total	46.127	84				

**Significant at p<0.050* **equal variances assumed*

Table 7 shows the One-way analysis of variance of the Respondents' challenges encountered during distance learning by financial status.

The computed p-value for Self-Regulation Challenges (0.371), Technological Sufficiency Challenges (0.922), Technological Literacy and Competency Challenges (0.756), Student Isolation Challenges (0.819), Learning Environment Challenge (0.962), and Workload (0.472) are higher than (>) 0.050 level of significance, thus the null hypothesis is accepted. Hence, there is no statistically significant difference at the 0.050 level of significance in the rating mean scores of the respondents' financial status. In the study of Cortez (2020) it is discovered that students' perception in their ability in e-Learning is not affected by financial status.

CONCLUSIONS

The majority of the students involved in the study are currently studying at private schools, 17 years old, and female with financial status of below ₱5,000.00. The greatest challenge of Senior High School STEM 12 students during Distance Learning is the Learning Environment (LEC); the least is the Technological Literacy and Competency (TLCC). Grade 12 STEM students sometimes encounter challenges during distance learning. The STEM 12 students disagreed to encounter challenges during distance learning. There is a significant difference on the variable challenges encountered by Senior High School Students during Distance Learning in terms of school and in terms of age. On the other hand, there is no significant difference on the other variable challenges encountered by Senior High School Students.

RECOMMENDATION

The study suggests that the education sector should create program interventions to address the challenges such as curriculum development, to encourage or institutionalize special training courses in mathematics and science, and to develop learning continuity plans to empower teachers and students.

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