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Status of the Implementation of the K to 12 Science Technology Engineering Mathematics (STEM) Curriculum in the Division of Sultan Kudarat

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Abstract: - **This study was conducted to assess the status of the implementation of Science, Technology, Engineering and Mathematics (STEM) curriculum in Sultan Kudarat, Region XII, Philippines. Respondents included 4 principals, 44 teachers, 42parents, 4 science laboratory in-charge, 4 librarians and 173 students of the public schools. Mean was the major statistical tool employed to provide good analysis and interpretation of the results.Findings revealed that parents' involvement is high in terms of student learning activities, decision-making and financial support. Yet, their participation in the planning and preparations for STEM curriculum-related programs is low. STEM curriculum in terms of instructional supervision is very well implemented. Teaching strategies, curriculum, financial allocations and expenditures and administrative support are moderately implemented. Overall, STEM curriculum in Sultan Kudarat is moderately implemented. Gaps such as insufficient laboratory rooms, inadequacy of library resources, very poor internet connection, limited playground, inadequacy of computer units and other ICT equipment, lack of toilets, and poor lighting and ventilation in the classrooms and laboratories are observed.It is hereby recommended that Department of Education (DepEd)-Sultan Kudarat Division should fast track the provision of laboratory rooms and learning resources. They should hasten the delivery of the tools and equipment for STEM curriculum. Most importantly, good quality of library building should be provided.**

Key words— Implementation, Science, Technology, Engineering and Mathematics (STEM) Curriculum

I. INTRODUCTION

The continuing reform program in the Philippine educational system is driven by a global competitiveness. This curriculum development aims to raise the standards of teaching-learning opportunities to cope with the needs of the 21st century learners. Achieving a sustainable quality education in the face of both gradual and abrupt educational change is one of the most significant challenges confronting the Department of Education (DepEd) particularly in Science and Mathematics education (DepEd, 2018).

In response to the global challenges, the DepEd has exerted remarkable efforts to improve Science education so that Filipino graduates will be at par with the rest of the world. Recently, it has implemented the Science, Technology, Engineering and Mathematics (STEM) curriculum wherein the instruction involves the interdisciplinary integration of science, technology, engineering and mathematics into rigorous lessons that connect the students to real world careers and issues. STEM curriculum employs a cohesive learning paradigm based on real-world applications that develop students' literacy and ability to compete in the world of economy (DepEd Order No. 71, s. 2012).

DepEd Order No. 25,s. 2002 and Basic Education Curriculum Guide (2002) stressed that the main factors which can be cited to account for the low performance of students in Science include lack of science culture and deficiencies in the teaching-learning process, instructional resources and teacher trainings. Lacorte (2014) also emphasized that parents' involvement has a strong and positive effect on the implementation of the curriculum. In addition to this, Magsino (2015) stressed that to make the learning opportunities more accessible to every child; the implementation of the curriculum must be equipped with functional physical facilities and equipment, competent teachers, a well-designed curriculum and full support of the parents. She further stressed that the most influential stimulus to make every child ready to learn is the effective delivery of instruction so that he could be responsive to the needs of the modern society. However, Abdullah (2020) found out that lack of school buildings, insufficiency of laboratory equipment and inadequacy of learning resources are the top problems of the public schools in Sultan Kudarat.

One of the major thrusts of former President Benigno S. Aquino's government was the implementation of the DepEd K to 12 curriculum which aims to develop lifelong learners who will be prepared for higher education, employment and entrepreneurship. Its implementation has caught the attention of many researchers. There were studies conducted to evaluate the new program and it appeared that similar issues came out. In Sultan Kudarat, STEM curriculum has been implemented since 2015. So far, there is no study conducted yet to evaluate its implementation.

Hence, this study is prompted.

Conceptual Framework

Trends in International Mathematics and Science Study (TIMSS) revealed that the Philippines is at the bottom ranking compared to other countries in terms of Science learning. In fact, the Philippines ranked 43rd out of 48 participating countries in Second Year High School Science. For Grade 4, it ranked 23rd out of 25 countries. In 2008, even with only the Science High Schools participating in the Advanced Mathematics and Science category, the Philippines ranked lowest among 10 countries (The Manila Times, 2014).

The implementation of Engineering and Science Education Program (ESEP), now Science, Technology and Engineering (STE), is the immediate response to the country's deteriorating result in science achievement for secondary education to cater to intellectually inclined junior high school students in Science and Mathematics. The STE curriculum envisions highly responsible, morally upright, globally competitive, and work-ready learners from schools offering relevant and innovative Science, Technology and Engineering program. Committed to its vision, the STE high schools shall be the centers of excellence in Science, Technology and Engineering education in the schools division that aims to develop the full potential of students along these areas (DepEd Order No. 41, s. 2004; DepEd Order No. 36, s. 2012).

In a world that's becoming increasingly complex and where success is driven not only by what people know, but by what they can do with what they know, it's more important than ever for the young generations to be equipped with the knowledge and skills to be used to solve tough problems, gather and evaluate evidence, and make sense of information. These are the types of skills that students learn by the implementation of Science, Technology, Engineering, and Mathematics (STEM) curriculum in the senior high school. The current status of Science education in the country, particularly in the basic education level, is not at par with that of the other countries, as seen in the results of Programme for International Student Assessment (PISA) and the Trends in International Mathematics and Science Study (TIMSS). The Philippine education system had a low performance among peers in East Asia and the Pacific. The Philippines' scores during the 2003 PISA and TIMSS were below 400-level. Since then, Philippines didn't participate in the said international competitions. Yet, it has the plan to participate in the said contests this 2019 (The Manila Times, 2014).

Top-performing schools spend efficiently and effectively on infrastructure and teachers' competence and benefits (Abdullah, 2020). Teachers' qualifications in terms of educational background, teaching experience and related trainings are major components in the implementation of the STEM curriculum. Likewise, internal and external stakeholders play a significant role in the realization of the school's goals and objectives. The level of parents' involvement in terms of student learning process, financial support, planning and preparation and decision-making was determined to maximize the support of all the stakeholders in the implementation of the STEM curriculum. Teachers' qualifications and parents' involvement were evaluated to enhance what needs to be improved.

The extent of the implementation of STEM curriculum relative to curriculum, instructional supervision, physical plant and facilities, equipment, learning resources, teaching strategies, utilization of library resources, financial allocation and expenditures and administrative support was determined to enhance further the teaching-learning process.

The following conceptual framework depicts the variables that play a significant role in the successful implementation of K to 12 STEM curriculum of the senior high schools in Sultan Kudarat. The four problems of the research such as teachers' qualifications, parents' involvement, senior high school STEM curriculum and the gaps observed in the implementation of senior high school STEM curriculum are illustrated in the diagram.

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Vol 5, Issue 7, July 2020

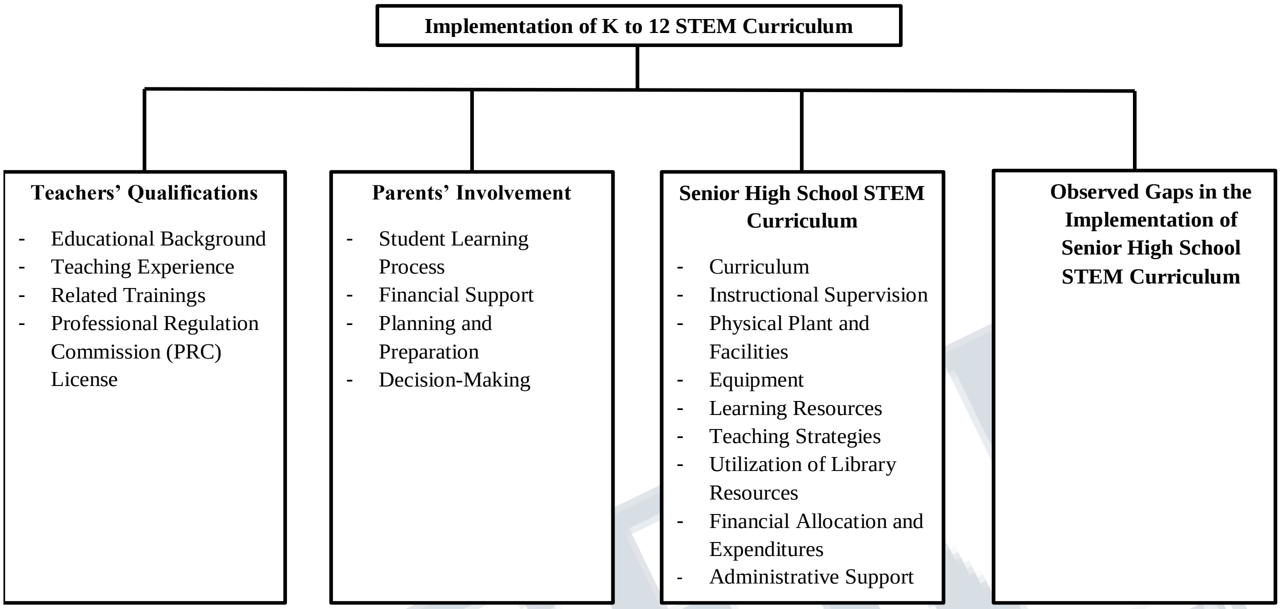

Figure 1. Research Paradigm

Statement of the Problem

This study generally aimed to describe the of implementation of the K to 12 Science, Technology, Engineering and Mathematics (STEM) curriculum of the public senior high schools in the Division of Sultan Kudarat, Region XII, Philippines. Specifically, it sought to answer the following questions:

What are the qualifications of Science, Technology, Engineering and Mathematics (STEM) teachers in terms of:

Educational Background;
Teaching Experience;
Related Trainings; and
Professional Regulation Commission (PRC) License?

What is the level of parents' involvement in the implementation of the Science, Technology, Engineering and Mathematics (STEM) curriculum in terms of:

Student Learning Process;
Financial Support;
Planning and Preparations; and
Decision-Making?

What is the extent of the implementation of the Science, Technology, Engineering and Mathematics (STEM) curriculum along with the following:

Curriculum;
Instructional Supervision;
Physical Plant and Facilities;
Equipment;
Learning Resources;
Teaching Strategies;
Utilization of Library Resources;
Financial Allocation and Expenditures; and
Administrative Support?

What are the observed gaps in the implementation of the Science, Technology, Engineering and Mathematics (STEM) curriculum?

METHODOLOGY

Research Resign

This study used quantitative-descriptive research paradigm. It utilized checklist in determining the qualifications of Science, Technology, Engineering and Mathematics (STEM) teachers as well as the gaps observed in the implementation of STEM curriculum. It also employed survey questionnaire in determining the level of parents' involvement and extent of the implementation of STEM curriculum.

Locale of the Study

This study was conducted in the four public high schools of Sultan Kudarat, Region XII. Sultan Kudarat was chosen as the locale of the present study since it is one of the 110 pilot implementers of the Science and Technology (S&T) curriculum way back in 1994 was in Sultan Kudarat Division.

ISSN (Online) 2456 -1304

International Journal of Science, Engineering and Management (IJSEM)
Vol 5, Issue 7, July 2020

Respondents of the Study

There were 173 STEM students, 44 teachers, 42 parents, 4 laboratory in-charge, 4 school librarians and 4 school administrators, a grand total of 271 respondents of the study for the School Year 2018-2019. Sample of STEM students was computed using Slovin's equation (1960) as cited by Abdullah (2020). Individual student-respondent was chosen using simple random sampling specifically lottery method. STEM school administrators, teachers, laboratory in-charge and librarians of the 4 respondent-schools were totally enumerated. Purposive sampling technique was employed to choose parents who were very active in the school programs and activities.

Research Instrument

A researcher-made instrument was designed to get accurate data needed in the study. The indicators of the major variables involved were drawn from the DepEd Orders and related researches in the implementation of STEM curriculum. It was composed of four (4) parts. Part I determined the qualifications of STEM teachers. Part II determined the level of the parents' involvement in the implementation of STEM curriculum. Part III elicited the responses of the respondents on the extent of the implementation of STEM curriculum in four schools. Part IV identified the gaps in the implementation of STEM curriculum.

Analysis of Data

The quantitative data gathered from the respondents were analyzed using frequencies, percentages and weighted means. Qualifications of the STEM teachers and gaps observed in the implementation of STEM curriculum were described using frequencies and percentages. To describe the level of parents' involvement and the extent of the implementation of STEM curriculum, weighted mean was employed.

RESULTS AND DISCUSSION

Qualifications of STEM Teachers

Qualifications of STEM teachers included educational background such as baccalaureate degrees earned and post-graduate education;teaching experience; relevant trainings attended and Professional Regulation Commission (PRC) license. Tables 1 through 5 present the qualifications of STEM teachers.

Table 1.Qualifications of STEM Teachers in Terms of Baccalaureate Degrees

	BACCALAUREATE DEGREES	Schools				Total	%
		A	**B**	**C**	**D**		
1	BSEd – English	2	3	3	1	9	20.46
2	BSEd – Biology	2	3	1	2	8	18.18
3	BSEd – Filipino	2	2	2	1	7	15.92
4	BSEd – Mathematics	2	1	0	2	5	11.36
5	BSEd – TLE	0	0	3	0	3	6.82
6	BSEd – Physics	1	1	0	1	3	6.82
7	BSEd – PE/MAPEH	2	1	0	0	3	6.82
8	BSEd – Chemistry	1	0	0	0	1	2.27
9	BSEd – Social Studies	1	0	0	0	1	2.27
10	BS – Information Technology	0	1	0	0	1	2.27
11	BS – Political Science	0	1	0	0	1	2.27
12	BS – Pharmacy	1	0	0	0	1	2.27
13	BS – Management Accounting	1	0	0	0	1	2.27
TOTAL		**15**	**13**	**9**	**7**	**44**	**100**

ISSN (Online) 2456 -1304

International Journal of Science, Engineering and Management (IJSEM)
Vol 5, Issue 7, July 2020

Table 1 presents the qualifications of STEM teachers in terms of baccalaureate degrees earned. As shown, there are 44 total number of STEM teachers in the four different STEM curriculum implementers in Sultan Kudarat. Out of this number, 20.46% are BSEd – English majors, 18.18% of them earned BSEd – Biology and 15.92% finished BSEd – Filipino. There are 11.36% of them who finished BSED – Mathematics, 6.82% are BSEd – Physics majors, 6.82% obtained BSEd – PE/MAPEH and 6.82% obtained BSEd – TLE. BSEd – Chemistry majors comprise 2.27% of the STEM teachers, 2.27% finished BSEd – Social Studies, 2.27% obtained BS – Information Technology, 2.27% earned BS – Pharmacy and 2.27% obtained BS – Management Technology.

More specifically, data show that over population of English teachers is evident in School C as it has only one STEM section with 3 English teachers. In School A, English teachers are insufficient as it has five STEM sections with only 2 English teachers. There is no Mathematics teacher in School A. Mathematics teachers are not sufficient in School A and School B. Only School A has a teacher who is a major in Physics.

This finding indicates that there is inadequate number of Filipino teachers. Insufficient number of specialized teachers in Chemistry, Social Studies, Technology and Livelihood Education (TLE), MAPEH and Mathematics is also manifested. This also means that there are teachers assigned to teach subjects not related to their field of specialization. This is being confirmed by the study of Abdullah (2018) who stated that some teachers are forced to teach subjects not related to their baccalaureate degrees as the number of specialized teachers in other subjects is lacking.

In relation to this finding, Rabacal and Alegato (2017) emphasized that if the qualifications of the teachers are low, students' academic performance can be sacrificed. Abdullah (2020) added that STEM teachers need in-depth knowledge of their subject and will invariably need to study subjects assigned to them since most of their students are academically inclined. No one can deny the fact that both related and up-to-date qualifications are very important in the practice of the teaching profession. They added that those teachers who pursue their post-graduate education are those who really want to improve their teaching pedagogy.

Table 2.Qualifications of STEM Teachers in Terms of Post-Graduation Education

POST-GRADUATE EDUCATION	Schools				Total	%
	A	**B**	**C**	**D**		
1 With MA Units Vertical to their Baccalaureate Degrees	9	4	5	3	21	47.73
2 No MA Units	0	3	2	2	7	15.90
3 With MA Units Not Vertical to their Baccalaureate Degrees	2	2	1	1	6	13.64
4 MA Graduate Vertical to their Baccalaureate Degrees	3	2	0	1	6	13.64
5 With Doctoral Units	1	2	1	0	4	9.09
TOTAL	**15**	**13**	**9**	**7**	**44**	**100**

Table 2 shows the educational background of STEM teachers in terms of post-graduate education. Out of 44 STEM teachers, 47.73% of them earned Master's units related to the baccalaureate degrees they obtained in college. There are still 15.90% of them who didn't even earn Master's units. Only 13.64% finished Master's degrees vertical to their baccalaureate degrees. Out of 44, 13.64% earned Master's units not aligned with their baccalaureate degrees. Only 9.09% earned Doctoral units and none of them obtained Doctoral degrees.

In particular, most of the teachers who have Master's units vertical to their baccalaureate degrees come from School A. In School A too, there are three teachers who finished their Master's degrees related to their field of specialization. There are three teachers in School B, two teachers in School C and two teachers in School D who have no Master's units. There was no teacher from School A who did not earn Master's units. This implies that in terms of educational background, teachers from School A are more qualified to teach STEM classes compared with the other three schools.

ISSN (Online) 2456 -1304

International Journal of Science, Engineering and Management (IJSEM)
Vol 5, Issue 7, July 2020

Data also signify that only very few STEM teachers finished Master's degrees vertical to their field of specialization. There is a need to encourage the STEM teachers to pursue their post-graduate education related to the major subject they earned in college so that their competence and skills in teaching STEM subjects will be enhanced. Those identified teachers who did not yet take up their post-graduate education are strongly encouraged to upgrade themselves through attending curriculum workshops or pursuing Master's education.

In support to this finding, Tuvillal (2013) stressed that in today's world, it simply is not enough to just earn a bachelor's degree and expect to make a real difference in the lives of the students. He added that teachers who earn their advanced degrees show a deep level of understanding and commitment to the position, allowing them to modify curriculum goals, adjust teaching methods, and enter leadership positions to enact the system-wide changes in education they wish to see. Greater understanding of the subject matter leads to better teaching practices.

Further, the study of Velasquez (2017) found out that students whose teachers held master's degree performed better in reading and writing tests. He also noted that advanced degree programs give teachers insight into the theoretical and practical backgrounds that drive their professions. Teachers who have higher educational qualifications are very aware of how knowledge of education theory positively impacts their teaching practices. By applying theory to teaching methods, they gain the benefit of seeing their students excel in the classroom.

Table 3.Qualifications of STEM Teachers in Terms of Teaching Experience

TEACHING EXPERIENCE		Schools				Total	%
		A	B	C	D		
1	Less than 3 years	1	6	2	3	12	27.27
2	3 – 6 years	7	3	0	3	13	29.56
3	7 – 10 years	2	2	4	1	9	20.45
4	11 – 14 years	1	1	0	0	2	4.55
5	15 – 18 years	2	0	2	0	4	9.09
6	19 – 22 years	2	0	0	0	2	4.54
7	23 years or more	0	1	1	0	2	4.54
TOTAL		**15**	**13**	**9**	**7**	**44**	**100**

Table 3 clearly shows that most of the STEM teachers are just new in the teaching profession. Only few of them are seasoned teachers whose teaching experience exceeds 10 years. This means that seasoned teachers from junior high school were not motivated to apply in the senior high school curriculum to teach STEM classes. This implies that most of the newly hired teachers are very young in the service.

In relation to this finding, Ejiwale (2013) stated that teachers do continue to improve in their teaching effectiveness as they gain experience in the teaching profession. He stressed that teaching experience, on average, is positively associated with student performance. Yet, he argued that variation in teaching effectiveness exists at every stage of the teaching career – not every inexperienced teacher is, on average, less effective, and not every experienced teacher is more effective. There are other factors of teaching effectiveness such as commitment to the work, physical facilities of the school and instructional materials.

Kini and Podoslsky (2016), as cited by Abdullah (2020), stated that the benefits of teaching experience will be best realized when teachers are carefully selected and well prepared at their point of entry into the teaching workforce, as well as intensively mentored and rigorously evaluated prior to receiving tenure. This will ensure that those who enter the professional tier of teaching have met a competency standard from which they can continue to expand their expertise throughout their careers. He added that teachers who have repeated experience teaching the same grade level or subject area to improve more rapidly than those whose experience is in varied grade levels or subjects.

ISSN (Online) 2456 -1304

International Journal of Science, Engineering and Management (IJSEM)
Vol 5, Issue 7, July 2020

Table 4.Qualifications of STEM Teachers in Terms of Number of Hours of Attendance to Related Trainings

Number of Hours of Related Trainings		Schools				Total	%
		A	B	C	D		
1	No Trainings Attended	0	2	4	3	9	20.45
2	8 – 24 hours	1	1	1	0	3	6.82
3	32 – 48 hours	3	5	0	1	9	20.45
4	56 – 72 hours	0	0	1	1	2	4.54
5	80 – 96 hours	3	0	1	0	4	9.09
6	104 hours and above	8	5	2	2	17	38.65
TOTAL		**15**	**13**	**9**	**7**	**44**	**100**

Table 4 shows that 38.65% of the 44 STEM teachers have attended 104 hours or above related trainings and 20.45% have attended 32 to 48 hours related trainings. There are still many of the STEM teachers (20.45%) who are not yet exposed into related trainings. These teachers are just only newly hired in the DepEd. Further, out of 44 STEM teachers, 9.09% attended related trainings of 80 to 96 hours, 6.82% have attended 8 to 24 hours and only 4.54% have attended 56 to 72 hours of related trainings.

Taking the data singly, most of the teachers in School A have attended various trainings or seminars relevant to their fields of specialization. Majority of the teachers in School C and School D have not yet attended trainings or seminars. In connection with this, the DepEd – Sultan Kudarat should design a training matrix for the STEM teachers so that their teaching competence will be improved and it will be the students who will directly benefit from the good qualifications of the teachers.

This finding implies that most of the STEM teachers in School A and School B are exposed to several trainings or workshops related to their field of specialization for the past three years. This means that they are very confident and that they can give the best learning opportunities for the STEM students. Yet, there is still a need to send the new STEM teachers into trainings or seminars to make them more knowledgeable and competent in the content and teaching pedagogy as many STEM students are academically inclined since many of them are honor students in their junior high school education.

Jackson et al. (2009) support this present study when they emphasized that teachers who receive relevant trainings are more able to perform in their teaching jobs. The training will give them greater understanding of their responsibilities as molders of the youth, and in turn build their confidence. This confidence will enhance their overall performance and this can only benefit the students. Teachers who are very competent and on top of the changing curriculum standards help the school hold a prestige as a leader school and strong competitor during academic and non-academic competitions.

Table 5.Qualifications of STEM Teachers in Terms of Professional Regulation Commission (PRC) License

	PRC License	FREQUENCY	%
1	Licensed Professional Teachers	44	100
2	Non-Licensed Professional Teachers	0	0
	TOTAL	**44**	**100**

As shown in Table 5, 100% of the STEM teachers have Professional Regulation Commission (PRC) license. This means that all of them have permanent positions assuring quality in the teaching force.

In support to this finding, Tuvillal (2013) stressed that in today's world, it simply is not enough to just earn a bachelor's degree and teachers' license to make a real difference in the lives of the students. He added that teachers who earn their advanced degrees show a deep level of understanding and commitment to the position, allowing them to modify curriculum goals, adjust teaching methods, and enter leadership positions to enact the system-wide changes in education they wish to see. Greater understanding of the subject matter leads to better teaching practices.

Further, the study of Velasquez (2017) found out that students whose teachers held master's degree performed better in reading and writing tests. He also noted that advanced degree programs give teachers insight into the theoretical and practical backgrounds that drive their professions. Teachers who have higher educational qualifications are very aware of how knowledge of education

ISSN (Online) 2456 -1304

International Journal of Science, Engineering and Management (IJSEM)
Vol 5, Issue 7, July 2020

theory positively impacts their teaching practices. By applying theory to teaching methods, they gain the benefit of seeing their students excel in the classroom.

Parents' Involvement in the Implementation of STEM Curriculum

Parents' involvement means the participation of parents in regular, two-way, and meaningful communication involving student academic learning and other school activities. It includes their student learning process, decision-making, financial support and planning and preparations. Table 6 presents the summary of level of parents' involvement in the implementation of STEM curriculum.

Table 6. Level of Parents' Involvement in the Implementation of STEM Curriculum

	INDICATORS	MEAN/DESCRIPTION			Total Mean (n = 259)	Description
		Teachers (n = 44)	Parents (n = 42)	Students (n = 173)		
1	Student Learning Process	3.19 High	3.15 High	3.06 High	3.10	High
2	Decision-Making	3.35 Very High	2.48 Low	2.54 High	2.67	High
3	Financial Support	2.82 High	2.41 Low	2.60 High	2.61	High
4	Planning and Preparations	2.75 High	2.43 Low	2.43 Low	2.48	Low
	GRAND MEAN	**3.03 High**	**2.62 High**	**2.66 High**	**2.72**	**High**

Legend: 3.26 – 4.00 – Very High; 2.51 – 3.25 – High; 1.50 – 2.50 – Low; 1.00 – 1.75 – Very Low

As shown in Table 6, parents' involvement in the implementation of STEM curriculum is rated "High" at 2.72. In particular, parents' involvement in relation to student learning process garnered the highest rating of 3.10 interpreted as "High". "Decision-making" obtained the second highest rating of 2.67 also interpreted as "High". The third highest mean of 2.61 also described as "High" indicates that parents' financial support is evident particularly in realizing PTA projects needed to make the STEM classrooms conducive for learning. Unfortunately, parents are rarely involved in the planning and preparations of the STEM-related programs. This is revealed by the lowest mean of 2.48 described as "Low".

In relation to this research finding, Hoppock (2013) stressed that parents are important in planning for their child's future. They can help the teachers learn about their child's strengths and needs and are active and knowledgeable participants in transition planning.

Johnson and Hull (2014) highlighted that in all transition planning models used, parents and school personnel should collaborate in order to develop and implement an effective transition program. Parents should have key decisions in transition planning and team meetings as they are equal partners in achieving the goals of the program. In transition planning, most parents are eager to participate in their child's education if they are just only properly consulted.

Implementation of the K to 12 STEM Curriculum

Effective implementation of the STEM curriculum depends on the extent of the curriculum, instructional supervision, physical plant and facilities, equipment, learning resources, teaching strategies, utilization of library resources, financial allocations and expenditures and administrative support.

Table 7.Extent of Implementation of the K to 12 STEM Curriculum

	INDICATORS	MEAN/DESCRIPTION			Total Mean (n = 259)	Description
		Teachers (n = 44)	Parents (n = 42)	Students (n = 173)		
1	Instructional Supervision	3.51 VWI	3.39 VWI	3.18 MI	3.27	Very Well Implemented
2	Teaching Strategies	3.50 VWI	3.18 MI	3.10 MI	3.18	Moderately Implemented
3	Curriculum	3.33 VWI	2.98 MI	2.97 MI	3.03	Moderately Implemented

4	Financial Allocation and Expenditures	3.05 MI	2.77 MI	2.75 MI	2.80	Moderately Implemented
5	Administrative Support	2.90 MI	2.84 MI	2.52 MI	2.64	Moderately Implemented
6	Learning Resources	2.65 MI	2.77 MI	2.34 PI	2.46	Poorly Implemented
7	Equipment	2.50 PI	2.44 PI	2.39 PI	2.42	Poorly Implemented
8	Utilization of Library Resources	2.42 PI	2.39 PI	2.30 PI	2.33	Poorly Implemented
9	Physical Plant and Facilities	2.36 PI	2.36 PI	2.14 PI	2.21	Poorly Implemented
	GRAND MEAN	**2.92 MI**	**2.79 MI**	**2.64 MI**	**2.71**	**Moderately Implemented**

Legend: 3.26 – 4.00 – Very Well Implemented (VWI); 2.51 – 3.25 – Moderately Implemented (MI); 1.50 – 2.50 – Poorly Implemented (PI); 1.00 – 1.75 – Not Implemented (NI)

As shown in Table 7, STEM curriculum of the public high schools in Sultan Kudarat is "Moderately Implemented" as revealed by the grand mean of 2.71. In particular, the indicator "Instructional Supervision" acquired the highest mean of 3.27 described as "Very Well Implemented". Remarkably, teaching strategies (Mean = 3.18), curriculum (Mean = 3.03), financial allocations and expenditures (Mean = 2.80) and administrative support (Mean = 2.64) are all "Moderately Implemented". In contrast, physical plant and facilities (Mean = 2.21), utilization of library resources (Mean = 2.33), equipment (Mean = 2.42) and learning resources (Mean = 2.46) are all "Poorly Implemented". These data imply that various problems on school facilities, library resources, equipment and learning resources are observed. Lack of laboratory rooms, poor lightings and ventilation, limited playgrounds for physical activities and laboratory facilities are evident by the lowest mean obtained by "Physical Plant and Facilities."

This study is similar with the finding of Abdullah (2020) when he assessed the implementation of senior high school curriculum in Sultan Kudarat. He found that unavailability of buildable space for instructional rooms, insufficiency of potential school sites, lack of transportation and access roads and lack of space for playgrounds were evident both in private and public high schools in Sultan Kudarat. Yet, he still found out that the full implementation of senior high school curriculum was somewhat effective. He added that effective implementation of senior high school curriculum was attributed to the fact that DepED – Sultan Kudarat really did its very best to guide all the private and public schools on the full implementation of the senior high school curriculum.

Gaps Observed in the Implementation of the K to 12 STEM Curriculum

Despite the full efforts extended by the DepEd-Sultan Kudarat to implement the STEM curriculum, several gaps had been observed. Respondents were tasked to put an ex (X) to confirm their disagreement to the indicators in the checklist distributed to them. They were also required to put a check (√) to affirm that the indicators are evident in their school. Only the number of ex's (X's) were counted to identify the frequency of respondents who marked X on each item of the questionnaire. Table 8presents the result.

Table 8.Gaps Observed in the Implementation of the K to 12 STEM Curriculum

	INDICATORS	T (n = 44)	P (n = 42)	LI (n = 4)	SL (n = 4)	SA (n = 4)	S (n = 173)	F (n = 271)	%
1	There are sufficient Senior High School Science laboratory rooms.	44	42	4	4	4	173	271	100
2	School administration provides internet connection for the students and teachers (for research purposes).	44	42	4	4	4	170	268	98.89

ISSN (Online) 2456 -1304

International Journal of Science, Engineering and Management (IJSEM)
Vol 5, Issue 7, July 2020

3	Enough playgrounds are available.	44	42	4	4	4	168	266	98.15
4	There are adequate computer units for the laboratory activities and other practical exercises of STEM students.	44	42	4	4	4	166	264	97.42
5	Toilets are enough for the students and teachers.	44	42	4	4	4	165	263	97.05
6	The computer laboratories are sufficiently equipped.	44	42	4	4	4	164	262	96.68
7	The school is equipped with projectors and other ICT equipment (Desktop and tablet computers) for instructional purposes.	44	40	4	4	4	164	260	95.94
8	There is a proper lighting and ventilation in the STEM classrooms and Science and Computer laboratories.	43	40	3	3	3	163	255	94.10
9	Video collections, DVD's and videocassettes are available any time for teaching-learning activities.	44	42	4	4	4	155	253	93.36
10	Books are sufficient for the teachers and students.	44	42	4	4	4	155	253	93.36
11	STEM students are given time by the teachers to utilize the magazines and journals in the library.	44	42	4	4	4	155	253	93.36
12	Updated newspapers are evident and they are utilized by the STEM students and teachers to get updated with the current events.	44	42	4	4	4	155	253	93.36
13	Encyclopedias and dictionaries are available.	44	42	4	4	4	155	253	93.36
14	Models and measuring devices/tools are sufficient.	40	39	4	4	4	136	227	83.76
15	There is adequate and functional laboratory equipment for STEM curriculum.	39	38	3	3	3	134	220	81.18
16	Laboratory tables are sufficient.	37	36	4	3	3	137	220	81.18
17	Localized instructional materials such as workbooks and activity sheets are available.	35	40	3	3	3	116	200	73.80
18	Flexibility in the STEM curriculum is implemented.	29	24	3	3	3	78	140	51.66

Legend:

T – Teachers
SL – School Librarians
P – Parents
SA – School Administrators
LI – Laboratory In-Charge
S – Students
F – Frequency

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Table 8 indicates that out of 47 standard indicators in the implementation of STEM curriculum, 18 were the observed gaps. In particular, 271 or 100% of the respondents confirmed that gap on the availability of Science laboratory room really prevails in the public high schools. School administration does not provide internet connection for the students and teachers and this is affirmed by the 268 or 98.89% of the respondents. Limited playground for physical activities of the students is among the gaps encountered and 266 or 98.15% confirmed it. Inadequacy of the computer units for the huge number of schools is manifested and this is agreed by 264 or 97.42% of the respondents. Limited number of toilets is also a major gap and this is indicated by 263 or 97.05% of the respondents.

There are 262 or 96.68% of the respondents who stressed that computer laboratory rooms have inadequate equipment and facilities. Inadequacy of projectors and other ICT equipment such as desktop and table computers is observed by 260 or 95.94% of the respondents. Problem on lighting and ventilation in the STEM classrooms and laboratory room exists and this is affirmed by 255 or 94.10% of the respondents. Library resources such as video cassettes, DVDs, books, magazines, journals, newspapers encyclopedias and dictionaries are really lacking as confirmed by 253 or 93.36% of the respondents.

There is an absence of models and measuring devices as confirmed by 227 or 83.76% of the respondents. Science laboratory equipment and tables are not sufficient as agreed by 220 or 81.18% of the respondents. Teachers do not develop contextualized workbooks and activity sheets and this is according to 200 or 73.80% of the respondents. Flexibilities in the offering of the STEM subjects are not manifested in some public high schools and this is based from the responses of 140 or 51.66% of the respondents.

This finding is supported by Bala (2017) who emphasized that insufficient instructional materials and unavailability of the teacher's manuals are some of the major gaps in the implementation of the K to 12 curriculum. He added that some classrooms are already congested or there is a lack of available classroom for the growing number of students. Abdullah (2018) also stressed that although many of the teachers are highly knowledgeable in the subject matter, they need to develop their teaching skills and the different pedagogical approaches. He added that teachers should be expert in contextualizing workbooks or modules so that, aside from answering the shortage of books, students will be more interested if the abstract topics are concretized in their local needs.

Further, BusinessMirror.com.ph (2017) published that 80% of the public high schools in the Philippines have no internet connection. The country will likely miss its goal of providing digital literacy, due to the absence of a government policy to equip public schools with internet access. Limited internet connection in the school campus is one of the biggest barriers of the poor performing students.

CONCLUSIONS

The two biggest number of STEM teachers are registered by English majors and Biology majors. English and Biology teachers are sufficient in numbers. There is an inadequacy of teachers in Filipino, Chemistry, Social Studies, TLE, MAPEH and Mathematics. Many STEM teachers have earned Master's units only vertical to their Baccalaureate degrees in college, have been in the teaching profession for quite few years; have attended few trainings relevant to their fields of specialization and all have Professional Regulation Commission (PRC) license.

Parents' involvement is high in the implementation of STEM curriculum. Their participation to the learning activities of their children, decision-making and financial support is satisfactory. Yet, their involvement in the planning and preparations for STEM curriculum-related programs and activities is low.

STEM curriculum in Sultan Kudarat Division is moderately implemented. Instructional supervision is very well implemented. Teaching strategies, curriculum, financial allocations and expenditures and administrative support are moderately implemented. However, learning resources, equipment, utilization of library resources and physical plant and facilities are poorly implemented.

Gaps are observed in the implementation of STEM curriculum such as insufficient Science laboratory rooms, very poor internet connection, inadequacy of library resources, limited playground, inadequacy of computer units, lack of toilets, insufficient computer laboratory equipment, lack of projectors and other ICT equipment and poor lighting and ventilation in the classrooms and laboratories.

RECOMMENDATIONS

Based on the findings, conclusions and the educational implications arising throughout the study, following recommendations were formulated:

Moderate implementation of STEM curriculum of public senior high schools in Sultan Kudarat should be improved. Poorly implemented areas such as learning resources, equipment, utilization of library resources, physical plant and facilities and poor internet connection should be prioritized.

The DepEd – Sultan Kudarat should do something to fast track the provision of Science laboratory rooms and learning resources. They should also hasten the delivery of the tools and equipment for the laboratory apparatuses and equipment for STEM curriculum.

The DepEd should provide each school with a separate building for library purposes. This school library should be equipped with adequate resources such as books, magazines, periodicals, journals and updated newspapers and equipment particularly ICT devices and very strong internet connection wherein teachers and students can freely utilize them for research purposes.

The DepEd should empower STEM teachers with well-developed teaching resources; more exposure to technology by providing them enough computer units or laptops and giving them trainings on how they can improve their skills in integrating technology and contextualizing learning materials in their teaching activities. Proper monitoring of the program should be done.

Parents should be involved in the planning and preparations of the program and activities related to STEM curriculum.

This study should be replicated in other Senior High School track particularly in the Technical-Vocational-Livelihood (TVL) track.

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