(RESEARCH ARTICLE)

Needs analysis of add-ons science, technology, engineering and mathematics (STEM) curriculum in public secondary schools: Basis for intervention

CRISTOPER T. CARILLO *

Sto. Domingo National Trade School – Schools Division Office of Nueva Ecija – Region III - Department Of Education

Carillo, Cristoper T., (2025). Needs Analysis and Adds-Ons Science and Technology and Engineering (STEM) Curriculum in Public Secondary Schools: Basis for Intervention.

Abstract

This study utilized a descriptive correlational design in order to describe and examine needs of teachers in Science and Technology and Engineering (STEM) Curriculum among public secondary schools in the Congressional District 1 within the Schools Division of Nueva Ecija. It was participated by 70 STEM teachers who were purposively drawn by the researcher. Developed-survey-questionnaire was utilized. Results reveal that there is reliance on computers and smartphones which emphasize the importance of accessibility in education which provides essential access to information, online resources and communication platforms that enhance learning. In addition, it found out that there are critical aspects of STEM education which put emphasis on the need for comprehensive content, innovative instructional strategies, and well-prepared educators. Further, educational strategies should focus on developing these skills through active, inquiry-based learning approaches, thereby preparing students to tackle complex scientific challenges and fostering a deeper understanding of the subject matter. Also, there was a significant correlation between instructional designs and science process skills highlights the need for innovative teaching strategies that actively engage students in inquiry-based learning.

Keywords: Needs; Science and Technology and Engineering; Curriculum; Learners; Intervention

1. Introduction

Teaching and learning science is one of the fundamental disciplines which teachers and learners must put into strong emphasis because problem solving and critical thinking skills are honed. In this line, the development of critical and problem solving skills of learners are apparently, critical to harness because these require intensive preparations and impactful teaching and learning design that emphasize relevance and creativity. Science and Technology and Engineering (STEM) strand is one of the academic tracks that is formulated due to the imposition and effectivity of Enhanced Basic Education Program or otherwise known as the "K-12 Program." One of the national educational goals is the development of scientific thinking skills of Filipino learners along with the highly progressive education. Teachers utilized different instructional strategies that are responsive to contents of each subject under the Science and Technology and Engineering (STEM) Curriculum. Students learn to engage in scientific argumentation to develop their scientific reasoning and critical thinking skills where teachers are expected to build up certain students' skills to better their performance in Science and other subjects (Farillon, 2022).

Meanwhile, subjects under Science and Technology and Engineering Curriculum under the Senior High School Program are interconnected as the K-12 Curriculum is structured through Spiral Progression Approach. The continuity and expansion of each subject is directly headed from basic to complex topics. Sequential arrangement of subjects are formulated under the STEM Curriculum which enabled teachers and learners comprehensively effected meaningful and

---

* Corresponding author: CRISTOPER T. CARILLO

retentive learning experiences. However, because of rapidly changing environment specifically in the societal system, variations of positive and negative outcomes have heavily implicated the education sector. One of the most obvious and apparent considerations, is the relevance and practicality of the subjects being offered under the STEM Curriculum. As observed by the researcher, current subject offerings under the STEM Curriculum may not be relevant anymore as the subjects are drawn more than ten (10) years already. In line with this, subjects offered appeared to be repetitive where contents are taught repetitively with other subjects. Large amount of time is invested covering repetitions of content. In addition, teachers use similar approaches that are irrelevant to properly execute effective instructions among the subjects contained under STEM curriculum. In addition, activities are also outdated for these have been crafted for more than ten (10) years also. Teachers and administration suggest that preparation in integrated STEM is considerable to rethink and redesign pre-service courses and in-service workshops (Shernoff et al.,2017).

Several studies lacked on comprehensive analysis to the actual needs of both teachers and learners in consideration of redesigning and restructuring the subjects based on the contextualized needs of teachers and learners under the STEM strand. They only focus on the effectiveness and impact of teaching under STEM strand and largely fail to consider the concurrent needs of teaches and learners for the potential modifications and enhancements to the current STEM Curriculum. This paper analyzed the needs of teachers to comprehensively arrive to a potential restructuring and redesigning of subjects under STEM Curriculum in the Senior High School Programs among schools in Congressional District 1 within the Schools Division of Nueva Ecija.

2. Literature Review

Perhaps, in the study of Badlon and Gempes (2018) which entitled Educational Philosophies and Management Styles of Administrators in Selected Universities and Colleges in Davao City aimed to determine the significant relationship between educational philosophies and management styles of directors, deans, supervisors, principals and heads from government and non-government colleges and universities in Davao City for SY 2005-2006. Employing descriptive-correlation method as research design, two types of standardized questionnaire as instruments, with frequency, percentage, mean, likelihood ratio and chi-square as statistical tools, results showed that there was significant relationship between educational philosophies and management styles. It is therefore recommended that administrators should adopt a combination of workable management styles that best fit the work environment. The study may also be used by a prospective administrator as a baseline data in measuring one's educational philosophy as an early indicator of the person's management style.

In the study of Sario (2018) which entitled *A Discourse on Educational Praxis Model of Development Education* which argued that there is a need to have an (alternative) model for developmenteducation, a holistic conception of education that is not confined in instruction, classroom, and educational system. Such model encompasses the impact of development education on community, democracy, and citizenship in the framework of educational praxis. The paper extrapolated some major points of an educational praxis model of development education. These are educational praxis as the process of critical pedagogy (transformative education) towards community development (cultural transformation); educational praxis as anchored on experiential learning and progressive education; educational praxis as an educational philosophy; educational praxis as the internal measure of quality standards in higher education; and educational praxis as political liberalism. Once educational praxis was affirmed as political liberalism, such model exemplifies its radical progressive role given liberal democratic framework. Hence, educational praxis as a political conception rests on basic rights and liberties, promotes cooperative political virtues, advocates social cooperation and shared responsibility, values reflective equilibrium, facilitates public reason, enriches public political culture, challenges particularistic cultural traditions, and upholds objective political dialogue.

Meanwhile, as Siraji (2019) revealed in her study which entitled *Conflict Management Styles of Educational Managers in Selected Higher Educational Institution in Sulu: Vis-à-vis Teaching Performance* discussed that Conflict is inevitable in life and the challenge is how leaders can precisely manage it. In this respect, for pragmatic and academic purposes and to provide useful information on conflict management styles for the harmonious and globalized working environment this study determined the appropriate conflict management styles to address specific organizational related conflicts in HEIs of Sulu. To obtain the needed data, the researcher employed the purposive random sampling method, using twenty-five (25) educational managers in Higher Educational Institutions (HEIs) of Sulu includes 230 faculty members to determine the most common organizational-related conflict and the most effective management styles. Employed descriptive-survey method 0.192 is greater than 0.05 confidence levels that provide evidence to say conflict management styles of educational managers are not significant predictor to the teaching performance of the faculty in HEIs. Educational managers in HEIs should initiate an action plan to improve the programs of managing conflict to approximately make these styles uniform in HEIs being the people belong to common tribe and lifestyles. Moreover, mentoring the workers

through the experience managers should be encouraged at the workplace. Finally, the study on conflict is highly recommended to scrutinize the effect on the faculty.

In the study of Sabio (2021) which entitled *Difficulties and Ease of Philippine Students in Studying Management Science: The Case of St. Scholastica's College Manila, Philippines* which discussed that management Science is concerned with developing and applying mathematical models and concepts that help to illuminate management issues and solve managerial problems. In most cases, it involves quantitative business analysis that is normally applied in operations management. Management Science or Quantitative Techniques in Business is one of the general education subjects under the Bachelor of Science in Business Administration (BSBA) course in the Philippine BSBA curriculum as prescribed by the Commission on Higher Education (CHED) under CHED Memorandum Order (CMO) 39 series of 2006. This paper will look into the difficulties and ease in taking Management Science as a general business education subject in BSBA course under the following six (6) majors: Business Information System Management, Business Management, International Business Economics and Diplomacy, Financial Management, Entrepreneurship and Franchise Management, and Marketing Management. The sample will be taken from the students taking Business Administration course at St. Scholastica's College – Manila, enrolled during the first and second semester of SY2010-2012. Findings of this research may be useful in coming up with appropriate teaching/ learning methodologies and materials that aptly responds to student's need. Further, the difficulties encountered by the student in studying Management Science subject will be properly addressed by providing a more learner-centered approach in teaching mathematical/quantitative business analysis, models and equations.

Thus, the study of Chaves (2017) which entitled *Mainstreaming the Management of Innovation in the Curriculum: A Review on Cebu, Philippines Universities' Business and Management Programs* which discussed that innovation has become an imperative in driving and sustaining businesses in today's hypercompetitive environment characterized by complex market structures, shorter product life cycles, and the ubiquity of digital technology solutions. A corollary to this is the expected increase in demand for innovation champions and leaders competent to lead and manage industry innovation projects. Academic institutions are relied upon to educate future entrepreneurs and managers not only on the intricacies of innovation, but also on the managerial processes involved in the conduct of innovation projects. This paper investigates the currency of forty (40) undergraduate business and management programs among eight (8) higher educational institutions (HEIs) in Cebu City, Philippines, on whether the course "management of innovation" had already been included in their programs' curricula. The curriculum prospectus data of the business programs were accessed from the HEIs' available documents and websites, if available. Using the innovation management process framework of Morris (2011), the content analysis revealed the absence of a stand-alone course on "management of innovation," or its equivalents. The study concludes the pressing need for HEIs to revitalize their programs, cognizant of the responsibility of business and management education to prepare students to the management of innovation. The study recommends to policymakers and HEIs some modes to mainstream and integrate the "management of innovation" in business and management programs to ensure relevance and responsiveness to industry requirements.

In addition, in the study of Juanzo (2021) which entitled *Lived Experiences of Campus Directors as Managers in a Philippine State University* which he revealed that the 21st century has introduced new challenges to the educational managers from the same sources of variables brought by the fast-changing world. It always a puzzle on how educational managers perform their tasks amidst these unwritten obligations. Thus, the objective of this study is to explore the lived experiences of campus directors as managers in a Philippine state university. This study utilized the qualitative-descriptive research design using a one-on-one interview. The participants of the study comprised of seven campus directors from the different campuses in Romblon. Using qualitative content analysis, three themes emerged. The first theme was experience on becoming a campus. Most of the campus directors shared their experiences before assumption, their adjustment period, and learning the ropes of management. The second theme was challenges in becoming a manager. It showed that most of them dealt with their managerial roles, managing the employees, students, facilities and the stakeholders The third theme was self-concept as a manager. The essence of being a campus director disclosed that management/leadership can be developed and expanded over time. Managing an educational institution in today competitive world is a complex task. This is true whether it is in the basic education, tertiary or graduate studies. The 21st century had introduced various challenges in the lives of the educational managers. Multifaceted managerial roles and tasks, multigenerational workforce, millennial students, interculturalism, finances, some of which the educational managers had to face. Beyond these challenges, the educational manager had to establish a strong sense of self. This was considered to be one of the key into transforming an effective organization. This is one of the important aspect that the researcher opted to know in a Philippine State University specifically in Romblon. This study uncovered the lived experiences of campus directors as school managers in their respective campus.

Meanwhile, in the study of Calla (2018) which entitled *Total Quality Management of Notre Dame Educational Association Higher Education Institutions* revealed that quality nowadays is a high priority, and it has become almost the substance

of the education debate. The need to understand how to assure quality in education remains. This study aimed to assess the level of implementation of the Total Quality Management (TQM) of Notre Dame Educational Association Higher Education Institutions in the areas of leadership, curriculum management, human resource management, financial management, performance management, community relations, and research management. Both quantitative and qualitative approaches in research employing the descriptive design via regression method were utilized in this study. The respondents were faculty members and the deans and four presidents as key informants. The TQM index of the school was reported to be statistically significant. The findings revealed that among the seven indicators, four were recorded as significant predictors of the TQM.

Apparently, in the study of Daguman (2020) which entitled *A Regression Model of Teachers Performance as Predicted by Strategic Human Resource Management Practices* was as conducted to determine a regression model of teachers performance as predicted by Human Resource Management (SHRM) Practices. The study used the descriptive-correlational research design with 202 teacher-respondents from President Roxas North Cotabato. The study made use of an adopted and a modified questionnaire developed by Mellenberg, (2008) for the aspect of strategic human resource management practices in terms of recruitment and selection, training and development, compensation and benefits, performance management, and employer relation. For the aspect of teachers performance, and adopted and modified questionnaire developed by James H. Stronge, Ph. D (2011); from PINDICS of the Department of Teacher Education National Council of Educational Research and Training (2013) and IPCRF based on the Civil Service Commission Memorandum Circular No. 06 series of 2012. The descriptive data were analyzed using the mean, Pearson r, and multiple regression. Pearson r was used for correlational analysis to determine the relationship between the independent variable and the dependent variable. Multiple regression was applied to test the explanatory and predictive power of the indicators of an independent variable to the dependent variable. The study revealed that public elementary school teachers in President Roxas North Cotabato possess a high level of Strategic Human Resource Management Practices and Teachers Performance. It also denotes that public elementary schools in President Roxas North Cotabato are highly implementing SHRM Practices. Moreover, the study revealed that there is a positive significant correlation between strategic human resource management practices and teachers performance. Furthermore, it is shown that model number 3 which includes performance management, recruitment and selection, and training and development came out as the strong and high influenced teachers performance. Performance management revealed as the strongest and most influenced among the three predictors.

In the study Glodo-unico (2017) which entitled *People Management Organizational- Success Indicators of Family Owned Higher Education Institutions (FHEIs) in the Second District of Laguna: Basis for Model Development* discussed that family-owned higher education institutions (FHEIs) strive to attract and retain well- equipped and engaged employees. This undertaking was conducted to explore the FHEIs people management practices and organizational-success indicators. To design the people management model, the study assessed the people management practices, job satisfaction, and the work commitment of teaching and non-teaching staff. The study used the combined quantitative and qualitative approaches. The use of questionnaires and interview was systematically combined to generate data needed. The study revealed that the people management practices as assessed by the department heads and teaching and non-teaching staff were moderately effective. There were numerous issues and challenges identified, and the actions taken were also presented. The teaching and non-teaching staff were satisfied with their job and moderately committed to their work. The FHEIs HR professionals should start taking a strategic role to help FHEIs respond effectively to the challenges and issues of contemporary educational institution.

In addition, in the study of Rodado and Oliva (2013) which entitled *Standards for Educational Leaders as Correlate to Strategic Adaptation of Elementary School Heads* discussed that school heads should engage their tasks under conditions and policies that aid them in meeting expectations. It is essential for school heads to take into account factors such as intending leaders, early career and mid and late career and, dimensions of the program. The purpose of the study was to determine the relationship standards for educational leaders to strategic adaptation of elementary school heads. The study utilized the descriptive-correlational method, validated questionnaires, mean and Pearson r. Results of the study revealed a high level of standards for educational leaders and a high level of school heads strategic adaptation in areas of inviting change, collaborative planning and problem solving. The study further revealed a significant relationship between standards for educational leaders and strategic adaptation of school heads and among the standards for educational leaders included in the study, the ethics and integrity was found to be most manifested by the school heads. With the said result, the school management should adopt some measures to improve the level of their educational standards in relation to their strategic adaptation practices. Teachers should continue to evaluate regularly the strengths and weaknesses of their school heads.

Moreover, Linao and Gosadan (2019) which entitled Meeting our Commitment: School Based Management System in the Lens of School Performance discussed that advocates of school-based management believe that school performance

will improve if educational management is focused on the school-level rather than on the division level. Tis paper aimed to find out if the school-based management system level of implementation significantly inï¬‚uences the school performance. The findings of the study reveal that the level of implementation of the school-based management system of the administrators in the elementary schools of Makilala Districts was in the developing and maturing level. Most of the administrators school performance was meeting the standards in the NAT average rating. School-based management system level of implementation in terms of leadership and governance, curriculum and instruction, accountability, and continuous improvement and management of resources significantly inï¬‚uence school performance. All of these indicators are the best significant predictors of school performance. These results further indicate that the higher is the administrators level of implementation on leadership and governance, curriculum and instruction, accountability and continuous improvement, and management of resources, the higher is the level of school performance.

In the study of Buaraphan (2021) which entitled *Multiple Perspectives on Desirable Characteristics of Science Teachers for Educational Reform* discussed that teachers appear as an essential component of education. Teacher characteristics are highly relevant to effective teaching and learning. This study explored the perspectives of 830 students, 107 science teachers, and 95 school administrators regarding desirable characteristics of science teachers for educational reform. A free essay method was employed to collect data. A constant comparative method revealed four major categories concerning desirable characteristics of science teachers for educational reform, i.e., knowledge, teaching skill, personality, and moral and ethics. Science teachers for educational reform were commonly viewed as persons who possess good content and general knowledge; use hands-on activities and have communication skill; are polite and have sense of humor; and are honest, fair, and compassionate.

In the study of Belencion which entitled *Management Action and Organizational Performance of Public Elementary Schools* aimed to ascertain relationships among management action and organizational performance of public elementary schools in Barotac Nuevo, Philippines. Further, it ascertained which among the elements of management action predicted organizational performance. Respondents of the study include 24 administrators and 168 teachers as respondents with the latter selected through stratified random sampling. Two data gathering instruments were used: (1) Management Action Questionnaire, to measure the level of respondents management action; and (2) OPCRF, a standardized instrument used by DepEd in measuring school performance. For descriptive statistics, frequency counts, percentage analyses, means, and standard deviations were employed, while for inferential statistics, t-test for independent samples, standard multiple regression, and Pearson r were utilized. Results revealed that when respondents were taken as a whole and classified according to position, their level of management action in terms of decision-making style was high in rational/collegial or high in autocratic/ political decision making style, high in problem solving, exceptionally good in human relations, and exceptionally good in communication. Meanwhile, organizational performance was very satisfactory. When classified according to position, their level of management action in terms of decision making differ significantly; while their management action in terms of problem solving, human relations, and communications did not differ significantly. Further, organizational performance did not differ significantly. The variable management action (decision making) was a significant predictor of organizational performance.
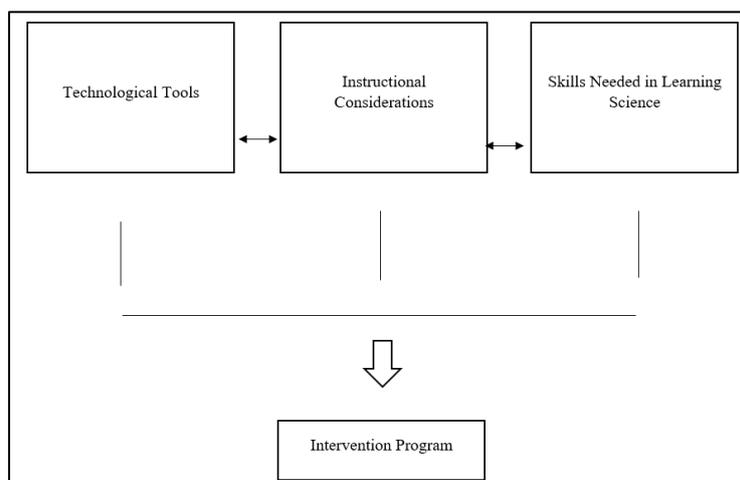
2.1. Research Paradigm

Figure 1 Research Paradigm

This study described and examined the needs of teachers in Science and Technology and Engineering (STEM) Curriculum among public secondary schools in the Congressional District 1 within the Schools Division of Nueva Ecija. The use of descriptive correlational research was made. The study described technological tools, instructional considerations and skills needed in learning Science. Thus, it also examined if there would be significant relationship between these three (3) variables. Apparently, output of the study is the proposed intervention program leading to the creation and development of subjects needed to be added in teaching STEM strand in Senior High School Program within the Congressional District 1 in SDO-Nueva Ecija.

2.2. Research Problem

This study described and examined the needs of teachers in Science and Technology and Engineering (STEM) Curriculum among public secondary schools in the Congressional District 1 within the Schools Division of Nueva Ecija. Specifically, it answered the following questions:

- How may the technological tools used in teaching and learning STEM subjects be described?
- How may instructional considerations on teaching science and engineering subjects be described?
- How may the skills needed in learning science and engineering subjects be described?
- Is there a significant relationship between the instructional considerations and skills needed in learning science and engineering subjects?
- What intervention program may be proposed?

2.3. Hypothesis

Ho1: There is no significant relationship between the instructional considerations and skills needed in learning science and engineering subjects.

2.4. Scope and Limitation

This study described and examined the needs of teachers in Science and Technology and Engineering (STEM) Curriculum among public secondary schools in the Congressional District 1 within the Schools Division of Nueva Ecija. It used descriptive correlational research where it was participated by 70 Science teachers in the district. Apparently, it used a developed survey-questionnaire which was validated and pretested. Thus, study is limited in describing the technological tools used in teaching and learning STEM subjects, describing the instructional considerations on teaching science and engineering subjects. Also, the study is limited in describing the skills needed in learning science and engineering subjects and examining if there would a significant relationship between the instructional considerations and skills needed in learning science and engineering subjects. Also, purposive sampling was utilized to select the participation of the respondents.

2.5. Significance of the Study

This present undertaking will be beneficial and will induce greater importance to the following:

- **Policy Makers**. Findings of the study will provide credible and relevant data in relation with the school leaders' supervisory and managerial actions in line with the add on subjects based on the needs examined. The data to be provided may be used as logical basis and scholarly reference to develop educational policies, amendments and revisions to the present provisions in relation to the subject offering in the STEM strand.
- **School Heads**. Results of the study will provide pertinent data and framework as to the governance and management of school leaders with their respective schools. Thus, the results of the study may also be used to profound their individualized supervisory plans along with the possible amendment and additions to the subjects under STEM subject.
- **Teachers.** Findings of the study will provide data that may be utilized for the development of more inclusive and highly impactful teaching instructions with regard to the needed subjects based on learners' needs and intereters.
- **Students.** Results of the study may provide them with sound and efficient instruction through adding subjects which are practical and highly engaging. Thus, the result will also provide them wide array of learning opportunities as the same results can initially present fundamental subjects that are needed based on their needs.

3. Methodology

3.1. Research Design

This study utilized a descriptive correlational design in order to describe and examine needs of teachers in Science and Technology and Engineering (STEM) Curriculum among public secondary schools in the Congressional District 1 within the Schools Division of Nueva Ecija. Apparently, the study identified the technological tools used in teaching and learning STEM subjects and described and examined the instructional considerations on teaching science and engineering subjects and described the skills needed in learning science and engineering subjects. Also, the study examined if there would be a significant relationship between instructional considerations and skills needed in learning science and engineering subjects.

3.2. Locale of the Study

The study was conducted among public secondary schools in Congressional District 1 of Nueva Ecija.

3.3. Population and Sample

The study also selected the participation of 70 science and engineering teachers among public secondary schools in Congressional District 1. The study used purposive sampling technique where it established the following criteria: (1) those who hold regular permanent position under Senior High School Program, (2) those who teach science and engineering subjects and (3) those who are willing to participate in the study.

3.4. Data Gathering Instrument

The study utilized a researchers-made survey questionnaire as the main research instrument. On the other hand, the survey-questionnaire was developed based on the study of Bautista et.al. (2014).

3.5. Description of the Instrument

The questionnaire was divided into three (3) segments. For part I it contained information on the technological tools in teaching and learning science and engineering subjects. Meanwhile, part II contained items relating to the instructional considerations of STEM teachers in terms of subject matter, instructional design and teachers' knowledge while part III contained items relating to the skills needed in learning science in terms of science process skills and other skills. The survey-questionnaire used 4-Likert Scale such as: 4-Strongly Agree, 3-Agree, 2-Disagree and 1-Strongly Disagree.

3.6. Validity and Reliability of the Instrument

The developed survey-questionnaire was subjected to reliability test which items under part II obtained a Cronbach Alpha result of .817 which signified that the items were reliable and acceptable while items on part III obtained a Cronbach Alpha result of .918 which signified that the items were reliable and acceptable.

3.7. Data Gathering Procedure

The researcher created a letter for the subject respondents which contained the nature and objective of the study. Upon the receipt of the approval through verbal expressions made by the respondents, the researcher personally floated the questionnaire to the respondents individually by using Google Forms. Before the actual data gathering, the researcher conducted short briefing and discussion to the respondents which significantly stated the purpose, nature and potential contributions of the study. Thereafter, the respondents personally answered survey-questionnaires through Google Forms. Thus, verbal consents were provided by the respondents through the distributed informed consents prepared by the researcher.

3.8. Data Analysis Technique

- The process of data analysis in this study involved descriptive statistics and inferential statistics to measure the quantitative nature of the undertaking. Following were the appropriate statistical tools used in this paper:
- Frequency and percentage in order to identify the technological tools used in teaching and learning STEM subjects
- Mean, standard deviation and overall mean were used in order to describe teachers' instructional considerations on teaching science and engineering subjects and skills needed in learning science and engineering subjects

- Pearson R was utilized in order to examine if there would be significant relationship between instructional considerations and skills needed in learning science and engineering subjects.

3.9. Ethical Concerns

Quality and authenticity of this paper were highly emphasized, briefing and unstructured discussions were executed. Concerned authorities and other related officials were informed that the selected participants are to be requested to participate in the study. Information conveyed to answer the questionnaire and the responses expressed by the respondents were treated with utmost confidentially.

4. Results and discussions

Technological Tools Used in Teaching and Learning STEM subjects

Table 1 Technological tools used in teaching and learning STEM subjects

Technological Tools Used	f	%
Tablet	20	28.57
Computer/Laptop	70	100
Smart Phone	70	100
Lesson Videos	45	64.28
Multimedia Technologies	31	44.28
Experiment Kits	56	80.00
Virtual Lab	22	31.42

*Multiple Response

As shown in Table 1, findings show that the highest reported usage is for computers/laptops and smartphones, both at 100%, indicating that every respondent utilizes these devices, which suggests their essential role in STEM education. In contrast, only a small portion of respondents (28.57%) use tablets, indicating that while they may be useful, they are not as prevalent as other devices. A significant number of users (64.28%) engage with lesson videos, highlighting the value of visual and auditory learning aids in STEM education. Multimedia technologies show moderate usage at 44.28%, suggesting that while not universally adopted, these resources still play an important role in the learning process. Furthermore, the high percentage of usage for experiment kits (80.00%) indicates that hands-on learning tools are popular and likely effective in enhancing understanding in STEM subjects. However, the virtual lab has the lowest usage among those listed at 31.42%, which may suggest barriers to access or a lack of familiarity among educators and students. The result shows that reliance on computers and smartphones emphasize the importance of accessibility in education which provides essential access to information, online resources and communication platforms that enhance learning. Apparently, these technological tools are of greater emphasis in redesigning and restructuring of subjects under STEM Curriculum. New technologies do not actually emerge in sociocultural vacuum and that more attention needs to be been given to sociocultural aspects of technological innovation in science classrooms (Oliveira et al., 2019).

4.1. Instructional Considerations on Teaching Science and Engineering Subjects

Table 2 Instructional considerations on teaching science and engineering subjects

Items	wm	Verbal Description
Subject Matter		
Intensive content elaboration on Physical events such as teaching force and motion	3.56	Strongly Agree
Furtherance of instruction in teaching sounds, properties and transmission of electricity	3.67	Strongly Agree
Deepen instructional implementation of living beings and life systems	3.45	Strongly Agree
Focus largely on the discussion of matter and nature	3.71	Strongly Agree

Widen comprehensive discussions on numbers, calculations and measurements specially practical application of theories and concepts	3.46	Strongly Agree
Overall Mean	3.57	Strongly Agree
Instructional Designs		
Creative and innovative instructional strategies are to be given readily for teachers	3.56	Strongly Agree
Use of simulations and modern applications are needed	3.61	Strongly Agree
Scientific journals in print or online are needed	3.72	Strongly Agree
Research-based discussions and modelling are needed	3.67	Strongly Agree
Realistic illustrations and samples are core part of the instructional content	3.58	Strongly Agree
Overall Mean	3.62	Strongly Agree
Teachers' Knowledge and Skills		
Articulate in discussing scientific and engineering concepts	3.62	Strongly Agree
Knowledgeable in the provision of practical activities highly related in science and engineering	3.45	Strongly Agree
Can provide specific and clear feedback on learners' accomplishment	3.61	Strongly Agree
Research enthusiast and active in other form of scholarly writing	3.73	Strongly Agree
Creative and innovative in instructional design and development	3.54	Strongly Agree
Overall Mean	3.59	Strongly Agree

Legend: 4.00-3.25-Strongly Agree (SA), 3.24-2.50-Agree (A), 2.49-1.75-Disagreee (D), 1.00-1.74-Strongly Disagree (SDA

As shown in Table 2, instructional considerations in teaching and learning science and engineering subjects in terms of subject matter obtains an overall mean of 3.57 suggests that respondents strongly agree on the importance of intensive content elaboration, particularly regarding physical events like force and motion (3.56) and the transmission of electricity (3.67). Additionally, there is a consensus on deepening instructional implementation concerning living beings and life systems (3.45), focusing on matter and nature (3.71), and widening discussions on numbers and practical applications (3.46). This indicates a strong emphasis on comprehensive and engaging content that enhances students' understanding of fundamental scientific principles. On the other hand, in terms of instructional designs, it obtains an overall mean of 3.62 which shows that there is a strong agreement that creative and innovative instructional strategies should be readily available for teachers (3.56). The need for simulations and modern applications (3.61) is also highlighted, along with the importance of scientific journals (3.72) and research-based discussions (3.67). Furthermore, respondents assert that realistic illustrations and samples are essential components of instructional content (3.58). This suggests a recognition of the necessity for dynamic and interactive teaching methods that can effectively engage students and enhance their learning experiences. Lastly, in terms of teachers' knowledge and skills where it obtains an overall mean of 3.59 which indicates a strong belief in the importance of teachers being articulate in discussing scientific concepts (3.62) and knowledgeable in providing practical activities related to science and engineering (3.45). Respondents also emphasized the necessity for teachers to offer specific feedback on learners' accomplishments (3.61) and to be research enthusiasts engaged in scholarly writing (3.73). The ability to be creative and innovative in instructional design (3.54) further underscores the importance of teachers being equipped with the necessary skills to foster an effective learning environment.

The result shows that there are strong agreements among respondents on the critical aspects of STEM education, highlighting the need for comprehensive content, innovative instructional strategies, and well-prepared educators. This alignment suggests that focusing on these areas can significantly enhance the quality of STEM education and better prepare students for future challenges in scientific and engineering areas. The result affirmed the study of Mbarushimana et al. (2023) which suggests that science comprehensive instructional content should be the main focus for deeper and highly critical science and engineering studies.

4.2. Skills Needed in Learning Science and Engineering Subjects

Table 3 Skills needed in learning science and engineering subjects

Items	wm	Verbal Description
Science Process Skills		
Observing is fundamental for learning scientific and engineering concepts	3.53	Strongly Agree
Experimenting is needed to structure scientific concepts	3.38	Strongly Agree
Estimating is basic for generalizing assumptions	3.49	Strongly Agree
Data and Modeling are essential to support application of knowledge and skills	3.63	Strongly Agree
Changing and controlling variables are inquisitive skills of learners during trials and experimentation	3.72	Strongly Agree
Overall Mean	3.55	Strongly Agree
Other Skills		
Interpreting and inferring scientific concepts	3.51	Strongly Agree
Development in cognitive and effective domains for retentive building	3.81	Strongly Agree
Analyzing scientific concepts and principles	3.76	Strongly Agree
Critical and creative thinking for meaningful learning	3.72	Strongly Agree
Problem solving skills apply to situational cases applying scientific and mathematical skills	3.61	Strongly Agree
Overall Mean	3.68	Strongly Agree

Legend: 4.00-3.25-Strongly Agree (SA), 3.24-2.50-Agree (A), 2.49-1.75-Disagreee (D), 1.00-1.74-Strongly Disagree (SDA

Skills needed in learning science in terms of science process skills obtains an overall mean of 3.55 implies that foundational skills are crucial for understanding scientific and engineering concepts. Respondents strongly agreed that observing (3.53) is fundamental to learning, emphasizing the role of careful observation in scientific inquiry. Experimenting (3.38) is recognized as essential for structuring scientific concepts, although it received a slightly lower score, suggesting that while valuable, it may not be as universally practiced. The ability to estimate (3.49) is viewed as basic for generalizing assumptions, highlighting its importance in scientific reasoning. Notably, data and modeling (3.63) are deemed essential for applying knowledge and skills, while changing and controlling variables (3.72) are identified as inquisitive skills that learners should develop during trials and experimentation. This indicates a strong emphasis on hands-on, inquiry-based learning, which is vital for grasping complex scientific principles. On the other hand, in terms of other skills which obtains an overall mean of 3.68 signifies that there is an importance on various cognitive and analytical skills. Respondents strongly agreed that interpreting and inferring scientific concepts (3.51) are crucial for comprehension. The need for development in cognitive and affective domains (3.81) is particularly emphasized, suggesting that emotional and intellectual engagement is key to retaining knowledge. Analyzing scientific concepts and principles (3.76) is also highlighted as a necessary skill, along with critical and creative thinking (3.72), which are essential for meaningful learning experiences. Furthermore, problem-solving skills (3.61) are recognized as vital for applying scientific and mathematical principles to real-world situations, underscoring the necessity for learners to be equipped with practical skills that extend beyond theoretical knowledge.

The result shows that there are strong agreements on the significance of science and mathematical skills need in learning science and other cognitive skills. The alignment suggests that educational strategies should focus on developing these skills through active, inquiry-based learning approaches, thereby preparing students to tackle complex scientific challenges and fostering a deeper understanding of the subject matter. The result affirmed the study of Tolmie (2016) which asserts that science and mathematical skills needed were: (1) accurate observation, (2) the ability to extract and reason explicitly about causal connections and (3) knowledge of mechanisms that explain these connection.

4.3. Relationship Between the Instructional Considerations and Skills Needed in Learning Science and Engineering Subjects

Table 4 Relationship between the instructional considerations and skills needed in learning science and engineering subjects

Instructional Considerations	Skills Needed	
	Science Process Skills	Other Skills
Subject Matter	0.068	0.062
	0.531	0.808
	250	250
Instructional Designs	0.233*	0.334
	0.029	0.175
	250	250
Teachers' Knowledge and Skills	0.204	0.063
	0.057	0.804
	250	250

Legend: **-Correlation is significant at 0.05 level (2-tailed); *-Correlation is significant at 0.01 level (2-tailed)

As shown in Table 4, in examining the relationship between Subject Matter and the skills needed, the correlation coefficients indicate a weak positive relationship with Science Process Skills (r=0.068) and a moderate positive relationship with Other Skills (r=0.531). The latter suggests that effective subject matter instruction is significantly associated with the development of other cognitive skills, emphasizing the importance of comprehensive content delivery in fostering broader skill sets among learners. However, the lack of significance in the correlation with Science Process Skills indicates that simply covering subject matter may not directly enhance these specific skills. Regarding Instructional Designs, a notable correlation is observed with Science Process Skills (r=0.233), p < 0.01), indicating a significant relationship that suggests innovative instructional strategies may effectively enhance students' scientific inquiry abilities. The correlation with Other Skills (r=0.334) also indicates a positive association, although it did not reach statistical significance. This highlights the potential of diverse instructional designs to cultivate both scientific and analytical skills, suggesting that educators should employ varied teaching methods to support comprehensive skill development. When analyzing the Teachers' Knowledge and Skills, the correlation with Science Process Skills (r=0.204shows a moderate positive relationship, though it is not statistically significant. This suggests that while teachers' knowledge may influence students' scientific skills, the connection is not as strong as in other areas. Conversely, the correlation with Other Skills (r=0.063) indicates no significant relationship, suggesting that enhancing teachers' knowledge and skills alone may not suffice in developing students' broader cognitive abilities.

The results imply that significant correlation between instructional designs and science process skills highlights the need for innovative teaching strategies that actively engage students in inquiry-based learning. In contrast, the weaker correlations with teachers' knowledge suggest that additional support or training may be necessary to effectively link instructional practices with skill development. This analysis points to the critical role of well-designed instructional approaches in enhancing both specific scientific skills and broader cognitive competencies among learners. The result affirmed the study of Zhang et al. (2016) which reveals that the nature of preservice science teachers' IDC, a potential for improvement in university teacher education curricula, and a need for further research.

4.4. Proposed Intervention Program

- *Professional Development for Teachers.* There should be a focus on inquiry-based learning leading to the development and design of **subjects which are highly inquisitive in nature**.
- *Collaborative Learning.* Teachers and learners under STEM strand should establish peer mentoring and collaborative planning sessions and technical workshops. This leads to the development of subject relating to **Technical Sessions and Practical Hands-on Activities**.
- *Student-Centered Activities.* Subjects to be tailored should focus more on **immersive activities** where learners can practically apply their absorbed concepts and principles.

5. Conclusions

The highest reported usage is for computers/laptops and smartphones, both at 100%, indicating that every respondent utilizes these devices, which suggests their essential role in STEM education. On instructional considerations in teaching and learning science and engineering subjects, in terms of subject matter obtains an overall mean of 3.57 suggests that respondents strongly agree on the importance of intensive content elaboration. In addition, in terms of instructional designs, it obtains an overall mean of 3.62 which shows that there is a strong agreement that creative and innovative instructional strategies. Also, in terms of teachers' knowledge and skills where it obtains an overall mean of 3.59 which indicates a strong belief in the importance of teachers being articulate in discussing scientific concepts. Hence, the correlation coefficients indicate a weak positive relationship with Science Process Skills (r=0.068) and a moderate positive relationship with Other Skills (r=0.531).

Teaching and learning science and engineering subjects are more intricate as it coins perfect and exact applications of theories and principles based on calculations, measurements and scientific predictions. There is reliance on computers and smartphones which emphasize the importance of accessibility in education which provides essential access to information, online resources and communication platforms that enhance learning. In addition, it found out that there are critical aspects of STEM education which put emphasis on the need for comprehensive content, innovative instructional strategies, and well-prepared educators. Further, educational strategies should focus on developing these skills through active, inquiry-based learning approaches, thereby preparing students to tackle complex scientific challenges and fostering a deeper understanding of the subject matter. Also, there was a significant correlation between instructional designs and science process skills highlights the need for innovative teaching strategies that actively engage students in inquiry-based learning.

Recommendations

Teachers should develop and formulate subjects which are directly characterizing inquiry and practical activities. The application of the proposed intervention program should be applied by teachers considering the contexts and readiness of the learners. Apparently, teachers and school heads should propose subjects that are designed based on inquisitive and immersive aspects so that learners can practically apply what they learned in the teaching and learning process under STEM Curriculum.

Compliance with ethical standards

Statement of ethical approval

This study, "Needs Analysis of Add-Ons Science, Technology, Engineering and Mathematics (STEM) Curriculum in Public Secondary Schools: Basis for Intervention," was conducted following ethical standards for educational research.

Prior to data collection, the researcher sought permission from the appropriate school authorities within Congressional District 1, Schools Division of Nueva Ecija. Approval was granted for the administration of the survey to STEM teachers in participating public secondary schools. The study adhered to ethical guidelines including voluntary participation, respect for persons, confidentiality of responses, and responsible handling of research data.

No part of the study posed physical, psychological, or social risks to the participants. The data gathered were used solely for academic and research purposes.

Statement of informed consent

Participation in this study was entirely voluntary. Prior to answering the survey questionnaire, all participants were informed about the purpose, scope, and objectives of the research. The researcher explained that participation involved completing a Google Forms survey related to technological tools, instructional considerations, and skills needed in teaching and learning STEM subjects.

Respondents were assured that:

1. Their participation was voluntary, and they could withdraw at any time without penalty.
2. No personal identifying information was required; names were optional.
3. All responses would remain confidential and would be reported only in aggregate form.
4. The data collected would be used strictly for academic research and curriculum development purposes.

5. There were no anticipated risks associated with taking part in the study.

By submitting the completed Google Forms questionnaire, participants provided their informed and voluntary consent to be included in the research.

References

[1] Badlon, E. M. & Gempes, G. P. (2018). EDUCATIONAL PHILOSOPHIES AND MANAGEMENT STYLES OF ADMINISTRATORS IN SELECTED UNIVERSITIES AND COLLEGES IN DAVAO CITY. UM Research Journal, 5(1).

[2] Belencion, P. C. (2020). MANAGEMENT ACTION AND ORGANIZATIONAL PERFORMANCE OF PUBLIC ELEMENTARY SCHOOLS. West Visayas State University Research Journal, 9(1).

[3] Buaraphan, K. (2012). Multiple Perspectives on Desirable Characteristics of Science Teachers for Educational Reform. The Asia-Pacific Education Researcher, 21(2).

[4] Chaves, M. F. (2017). Mainstreaming the Management of Innovation in the Curriculum: A Review on Cebu, Philippines Universities' Business and Management Programs. International Journal of Education Research for Higher Learning, 23(2).

[5] Calla, A. B. (2018). Total Quality Management of Notre Dame Educational Association Higher Education Institutions. PAGE CODGE REGION XI (Multidisciplinary Research), 1(1).

[6] Daguman, R. B. (2020). A REGRESSION MODEL OF TEACHERS PERFORMANCE AS PREDICTED BY STRATEGIC HUMAN RESOURCE MANAGEMENT PRACTICES. International Social Science Review, 2(1).

[7] Glodo-unico, M. (2017). People Management Practices and Organizational - Success Indicators of Family-Owned Higher Education Institutions (FHEIs) in the Second District of Laguna: Basis for Model Development. JPAIR Multidisciplinary Research Journal, 28(1).

[8] Linao, R. S. & Gosadan, B. D. (2019). Meeting our Commitment: School-Based Management System in the lens of School Performance. JPAIR Multidisciplinary Research Journal, 38(1).

[9] Juanzo, C. M. (2021). Lived Experiences of Campus Directors as Managers in a Philippine State University. Araneta Research Journal (Indagatio), 43(1).

[10] Sario, A. A. (2018). A DISCOURSE ON EDUCATIONAL PRAXIS MODEL OF DEVELOPMENT EDUCATION. PHAVISMINDA Journal, 11(1).

[11] Siraji, A. D. (2019). Conflict Management Styles of Educational Managers in Selected Higher Educational Institution in Sulu: Vis-à-vis Teaching Performance . JPAIR Multidisciplinary Research Journal, 35(1).

[12] Sabio, R. A. (2021). Difficulties and Ease of Philippine Students in Studying Management Science: The Case of St. Scholastica's College Manila, Philippines. IAMURE International Journal of Business and Management, 3(1). http://dx.doi.org/10.7718/iamure.ijbm.v3i1.275

[13] Rodado, M. E. & Oliva, E. A. (2013). Standards for Educational Leaders as Correlate to Strategic Adaptation of Elementary School Heads . IAMURE International Journal of Multidisciplinary Research, 6(1).

[14] Mae F. Farillon, L. (2022). Scientific reasoning, critical thinking, and academic performance in science of selected Filipino senior high school students. *Utamax : Journal of Ultimate Research and Trends in Education*, *4*(1), 51–63. https://doi.org/10.31849/utamax.v4i1.8284

[15] Oliveira, A., Feyzi Behnagh, R., Ni, L., Mohsinah, A. A., Burgess, K. J., & Guo, L. (2019). Emerging technologies as pedagogical tools for teaching and learning science: A literature review. *Human Behavior and Emerging Technologies*, *1*(2), 149–160. https://doi.org/10.1002/hbe2.141

[16] Shernoff, D. J., Sinha, S., Bressler, D. M., & Ginsburg, L. (2017). Assessing teacher education and professional development needs for the implementation of integrated approaches to STEM Education. *International Journal of STEM Education*, *4*(1). https://doi.org/10.1186/s40594-017-0068-1

[17] Tolmie, A. K. (2016). Social Skills training and assessment with children: A cognitive-social learning approach. *Social Skills Training for Children and Youth*, 69–70. https://doi.org/10.4324/9781315059167-7

[18] Zhang, R., Liu, X., Yang, Y., Tripp, J., & Shao, B. (2017). Preservice Science Teachers' instructional design competence: Characteristics and correlations. *EURASIA Journal of Mathematics, Science and Technology Education*, *14*(3). https://doi.org/10.12973/ejmste/81553

Appendices

- **Assessment Form for the** Needs analysis of add-ons science, technology, engineering and mathematics (stem) curriculum in public secondary schools in congressional district 1-sdo nueva ecija: basis for intervention

Name (optional):	
School of Assignment:	

- **Part I: Technological tools for Teaching and Learning STEM**

Instructions: Please choose relevant and needed technological tools for teaching and learning Stem by putting a checkmark (√) on the space that corresponds with your response.

Tablet	
Computer/Laptop	
Smart Phone	
Lesson Videos	
Multimedia Technologies	
Experiment Kits	
Virtual Lab	

- **Part II: Instructional Considerations on Teaching Science and Engineering Subjects**

Instructions: Please indicate your agreement or disagreement with the benchmark statements given by putting a checkmark (√) on the space that corresponds with your response. Please use the following scale for your assessment:

4	3	2	1
Strongly Agree	*Agree*	*Disagree*	*Strongly Disagree*

Subject Matter	4	3	2	1
1.Intensive content elaboration on Physical events such as teaching force and motion				
2.Furtherance of instruction in teaching sounds, properties and transmission of electricity				
3.Deepen instructional implementation of living beings and life systems				
4. Focus largely on the discussion of matter and nature				
5.Widen comprehensive discussions on numbers, calculations and measurements specially practical application of theories and concepts				
Instructional Designs and Materials	4	3	2	1
1.Creative and innovative instructional strategies are to be given readily for teachers				
2.Use of simulations and modern applications are needed				
3.Scientific journals in print or online are needed				

	4	3	2	1
4. Research-based discussions and modelling are needed				
5.Realistic illustrations and samples are core part of the instructional content				
Subject Matter	4	3	2	1
1.Articulate in discussing scientific and engineering concepts				
2.Knowledgeable in the provision of practical activities highly related in science and engineering				
3. Can provide specific and clear feedback on learners' accomplishment				
4. Research enthusiast and active in other form of scholarly writing				
5. Creative and innovative in instructional design and development				

- **Part III: Skills Needed in Learning Science and Engineering Subjects**

Instructions: Please indicate your agreement or disagreement with the benchmark statements given by putting a checkmark (√) on the space that corresponds with your response. Please use the following scale for your assessment:

4	3	2	1
Strongly Agree	*Agree*	*Disagree*	*Strongly Disagree*

Science Process Skills	4	3	2	1
1.Observing is fundamental for learning scientific and engineering concepts				
2.Experimenting is needed to structure scientific concepts				
3. Estimating is basic for generalizing assumptions				
4. Data and Modeling are essential to support application of knowledge and skills				
5. Changing and controlling variables are inquisitive skills of learners during trials and experimentation				
Other Skills	4	3	2	1
1.Interpreting and inferring scientific concepts				
2.Development in cognitive and effective domains for retentive building				
3.Analyzing scientific concepts and principles				
4.Critical and creative thinking for meaningful learning				
5. Problem solving skills apply to situational cases applying scientific and mathematical skills				