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Exploring effective approaches for science and technology education in public high schools: A case study of Samar Division, Philippines

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Abstract

This case study explores the effectiveness of approaches for Science and Technology education in public high schools within the Samar Division, Philippines. The study examines the profile of teachers, including their teaching experience, educational qualifications, and training attended. The findings indicate that while teachers are still in their productive years, there is a need for improvement in teaching competence, as many teachers lack extensive experience and relevant training. Career development opportunities, such as reaching the Master Teacher level, are potential areas for growth. The study also examines the teaching approaches used by teachers, revealing that traditional methods are commonly employed. However, innovative approaches such as pedagogical, constructivism, transmission, and differentiated approaches remain relatively unfamiliar. Despite various factors influencing teaching competence, the study demonstrates that most teachers are competent in delivering instruction. Nonetheless, continuous improvement is essential to enhance student learning outcomes. Both teachers and administrators perceive teachers' competence positively, emphasizing the commitment and dedication of educators to provide quality education. To adapt to the evolving education landscape, teachers must continually enrich their teaching skills to enhance overall educational quality. In conclusion, this study sheds light on the importance of effective teaching approaches in Science and Technology education in public high schools. It highlights the need for continuous professional development and career advancement opportunities for teachers to improve their competence. By embracing these innovative strategies, educators can enhance the effectiveness of biosciences instruction and better prepare students for the complexities and challenges of the biosciences field in the 21st century.

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Introduction

Over the years, schools have strived to provide effective teaching and learning experiences for students. To achieve this goal, teachers are expected to possess a comprehensive understanding of good teaching criteria, subject matter mastery, and various teaching approaches and strategies. Moreover, teachers must be equipped to impart knowledge, skills, techniques, and positive attitudes to empower students to overcome obstacles and excel in their educational journey.

Section 4 of the Education Act underscores the importance of a broad general education that helps individuals in their unique societal context to attain their potential, enhance participation in society, and become versatile citizens. Therefore, teaching competence is essential to fulfill this educational mandate. Effective teaching goes beyond mere knowledge transmission; it involves a teacher's personal influence in fostering basic skills, understanding, work habits, attitudes, values, and personal adjustment in learners. A teacher's role is complex, demanding a variety of human traits, abilities, and competencies.

In the realm of Science and Technology education, the importance of early training and its role as a basic discipline have been increasingly emphasized (Educating Americans for the 21st Century, 2007). Learning science contributes to broader educational goals by providing students with a scientific understanding of the natural world, modes of inquiry, the scientific enterprise, and its historical and societal contexts (Cruz, 2011). Scientific literacy, the ability to apply scientific knowledge to daily life, is vital in the 21st century (Educating Americans for the 21st Century, 2007).

The significance of this study to the biosciences subject is crucial as it addresses the effectiveness of teaching approaches in Science and Technology education. Biosciences encompass various disciplines related to living organisms, and effective teaching in this subject is essential to foster a deep understanding of biological concepts, scientific methods, and problem-solving skills among students. Science education in secondary schools plays a crucial role in developing positive attitudes, curiosity, and an awareness of the relationship between science, technology, and society. Students can enhance their higher-order thinking skills, cognitive abilities, and psychomotor skills through engaging in scientific research projects, which go beyond the traditional classroom setup. As science and technology become more prevalent in the modern world, scientific literacy and research skills are increasingly vital for secondary school students.

Achieving excellence in education has garnered significant attention, prompting curriculum evaluation and standardization. Despite these efforts, some students still graduate with minimal academic skills, indicating the need for a closer examination of instructional competence and teaching approaches. Science, with its ever-evolving nature, necessitates ongoing research to redefine concepts and effective teaching methods.

In light of the National Diagnostic Test results, which revealed deficiencies in students' skills, instructional competence and teaching approaches emerge as crucial factors influencing student performance. To harness students' potential, teachers must not limit themselves to a few approaches and competencies. Instead, they should consider a comprehensive array of teaching approaches, such as discovery, inquiry, cooperative, interactive, transmission, process skills, pedagogical, science-technology-society, problem-solving, differentiated, reflective, and project-based approaches.

To address these educational challenges and enhance Science and Technology teaching, the present study investigates the approaches used in teaching science and technology and the competency needs of secondary school teachers in this area. By exploring a diverse range of teaching approaches and competencies, the study aims to contribute to the improvement of Science and Technology education in

public high schools. Through this research, we hope to advance the quality of teaching and, in turn, optimize student performance in the field of Science and Technology.

The general objectives of science instruction include the development of the scientific method as a way of thinking and solving problems, the development of an understanding of the child's environment and his scientific attitudes and fundamental skills in communicating and manipulating science equipment; and development of interests for leisure time activities (William and Herman, 2002). Several studies have highlighted the importance of using active learning strategies in biosciences teaching. For example, a study by Freeman *et al.* (2014) compared student performance in traditional lecture-based classes with those in classes using active learning strategies, and they found that students in active learning classes achieved better learning outcomes.

In addition to active learning, the integration of technology has also been a significant trend in biosciences teaching. Studies have shown that incorporating technology, such as virtual labs, simulations, and online resources, can enhance students' learning experiences and improve their understanding of complex biological concepts (Crippen & Earl, 2017; Kyei-Blankson & Ntuli, 2017). Furthermore, the importance of promoting scientific literacy in biosciences teaching has been emphasized. Students need to not only understand biological concepts but also be able to critically analyze and apply scientific knowledge to real-world situations. This includes understanding ethical considerations in biosciences and the impact of scientific advancements on society (Liu *et al.*, 2016).

The status of biosciences teaching is moving towards more interactive, technology-integrated, and application-focused approaches. However, it is essential to keep in mind that the field of education is dynamic, and new studies and developments may have emerged since my last update. To get the most up-to-date information, I recommend consulting recent literature and educational research databases.

This shift from traditional factual learning to inquiry-based approaches in science classes has been supported by various studies in the field (Salandanan, 2005; Bybee, 2015; Loucks-Horsley *et al.*, 2016). As a result, teachers are now seen as skillful facilitators, moving away from content-centric instruction to become more effective in guiding children's learning activities (Bybee, 2015; Loucks-Horsley *et al.*, 2016). This change in educational goals and objectives has broadened the concept of teaching methods, giving rise to new innovative approaches and instructional practices designed to enhance the teaching-learning process (Bybee, 2015; Loucks-Horsley *et al.*, 2016). Teachers are encouraged to adopt diverse strategies that can cater to the unique needs and learning styles of their students, recognizing the importance of individual differences in the learning process (Loucks-Horsley *et al.*, 2016).

The literature consistently highlights the idea that there is no one-size-fits-all approach to teaching and learning (Bybee, 2015; Loucks-Horsley *et al.*, 2016). Instead, teachers must be flexible in their program planning and activity selection, considering the varying learning conditions and needs of their students to create a stimulating and conducive learning environment (Bybee, 2015; Loucks-Horsley *et al.*, 2016). This notion aligns with the learner-centered pedagogy, which emphasizes tailoring instruction to accommodate the diverse backgrounds, interests, and abilities of students (Loucks-Horsley *et al.*, 2016). Recent studies have shown that learner-centered approaches lead to better engagement and deeper understanding of scientific concepts among students (Bybee, 2015; Loucks-Horsley *et al.*, 2016).

Moreover, the role of the teacher, child, and curriculum in the educative process has been extensively studied and reaffirmed in recent research (Lardizabal, 2010; Bybee, 2015; Loucks-Horsley *et al.*, 2016). Teachers are viewed as critical actors in the learning process, with their ability to effectively facilitate learning experiences directly impacting student outcomes (Loucks-Horsley *et al.*, 2016). The child's centrality in the learning process is now more pronounced, with researchers acknowledging the

significance of personalized learning experiences tailored to individual students (Bybee, 2015; Loucks-Horsley *et al.*, 2016). Furthermore, the curriculum is recognized as a powerful tool for shaping the values and experiences of students in society (Bybee, 2015). Recent studies advocate for curricula that promote critical thinking, problem-solving, and real-world application of scientific knowledge (Bybee, 2015; Loucks-Horsley *et al.*, 2016).

Objectives of the study

This study aimed to determine the different approaches used in teaching Science and Technology in public high schools of Samar Division with the end view of designing enrichment activities in Science and Technology teaching: (1) What approaches in teaching Science and Technology are commonly used by the teachers?; (2) What is the competence of teachers in teaching Science and Technology as perceived by the teachers?; (3) Is there significant relationship between the profile of teachers and their competence in teaching Science and Technology?; (4) Is there a significant difference on the perception of the two groups of respondents on the competence of the teachers in teaching Science and Technology?; (5) Based on the findings of the study, what enrichment activities in teaching Science and Technology can be designed.

Materials and methods

Research design

This study utilized the descriptive method of research using comparative and correlative analysis through the survey questionnaire as an evaluation instrument. From the different approaches stated in the questionnaire was evaluated through the perception by the two groups of respondents as to what approaches in teaching are commonly used by teachers in teaching Science and Technology. The competencies stated were compared to the personal profile of the teachers teaching in science and Technology if there is relationship between the two variables. Furthermore, the extent of effectiveness and competencies of the teaching approach and teaching competence were elicited from the two groups of respondents: the administrators and the teachers themselves whereby their perceptions were compared and significant differences were determined. The perceived effectiveness and competent of the approaches and competencies by the respondents were associated with their personal characteristics to ascertain if relationship existed between the two variables. The data gathered through the survey questionnaire was tabulated, organized and analyzed with the used of descriptive and inferential statistics, namely: frequency count and percentages, arithmetic mean and standard deviation, weighted mean, Pearson-produce movement coefficient correlation, and analysis of variance (ANOVA).

Respondents and Sampling Procedure of the Study

The study was conducted in the Samar Division, comprising of one (1) division with fifty five (55) Public High Schools of Samar Division. The study utilized the teaching approaches and competencies of teachers teaching in Science and Technology. The respondents of the study were the school administrators and the Science and Technology teachers of the Public High Schools of the Samar Division, Philippines. The study included all the Public High Schools in the Division of Samar. The entire public high schools was considered respondents of the study. For the School Administrators and Science and Technology Teacher universal sampling were resorted for determining the sample size, so all of them were given a survey questionnaire. To provide a basic understanding of the respondents of the study, their profiles in terms of various specific variables like age, sex and civil status were determined which were further tested whether they establish certain significant relationships in terms of their competence. As can be gleaned from the table, profiles in terms of age, sex and civil status were presented using frequency and percentage distribution.

Table 1. Frequency and Percentage Distribution on the Profile of Science and Technology Teachers According to Age, Sex, Civil Status and Educational Qualification

Profile	Science and Technology Teachers	
	f	%
Age Group		
20 – 25	13	15.48
26 – 30	15	17.86
31 – 35	12	14.29
36 – 40	17	20.24
41 – 45	12	14.29
46 – 50	2	2.38
51 – 55	7	8.33
56 – 60	4	4.76
61 – 65	2	2.38
Total	84	100
SEX		
Male	26	30.95
Female	58	69.05
Total	84	100
CIVIL STATUS		
Single	32	38
Married	49	58.33
Separated	2	2.33
Widowed	1	1.19
Total	84	100
EDUCATIONAL QUALIFICATION		
Doctoral Degree Holder	1	1.19
With Doctoral Units	2	2.38
Master's Degree Holder	4	4.76
Bachelor's Degree w/ MA Units	44	52.38
Bachelor's Degree Holder	33	39.29
Total	84	100

The table shows that in terms of age, majority of the teacher-respondents belonged in the age bracket of 36-40 years old having a frequency of 17 or 20.24 percent out of the total number of respondents. This age bracket was followed by ages 26-30 with 15 respondents comprising 17.86 percent and 31-35 and 41-45 having the same frequencies (12 or 14.29 percent). All the rest of the age brackets showed minimal results in terms of frequency. This data imply that most respondents were still in their productive years considering that their age suggest that they were still relatively young and therefore have the physical capabilities to perform their tasks as teachers in the high school level. The lowest age range which is 61-65 has only 2 respondents which imply that mostly, when teachers reached this age level, mostly were having already administrative positions and thus no longer devoting their time to teaching per se or if not, have opted for retirement.

Instrumentation and Method of Data Collection

The study use two (2) sets of questionnaire, namely: A survey questionnaire for the school administrator and another questionnaire for the Science and Technology teacher. The first set of survey questionnaire for the school administrators. The questionnaire consists of three main parts. The first part was the profile of respondents such as age, sex, civil status, and educational qualification, field of specialization, position/designation, and administrative experience in years, performance rating and number of relevant trainings attended. The second part consists of approaches in teaching Science & Technology which are commonly used by the teachers. The third part is the competencies of teachers teaching Science and Technology. In this part the perception of the school administrator was measured. The second set of survey questionnaire was framed for the Science and Technology Teachers. The questionnaire consists also of three main parts. The first part was the profile of the respondents such as age, sex, civil status, educational qualification, field of specialization, position/designation, work/ teaching experience in years, performance rating, number of subjects taught other than Science and Technology; and number of relevant trainings attended. The second part consists of approaches in teaching Science & Technology which are commonly used by the teachers. The third part is the competencies of teachers teaching Science and Technology.

Validation of Instrument

Survey questionnaire had undergone the different validation process: First, the questionnaire was presented to the panel of examiners for the qualitative evaluation of the contents and format of the questionnaire.

After some revisions, a copy for the try out was prepared. Second, the research wrote a letter of request to the Schools Division Superintendent of Calbayog City stating her intent of conducting the dry run in Calbayog City High School. The research handed personally the letter of request to the School Principal. Without second thought, the request was approved. The approved letter of request was handed in to the principal of Calbayog City High School together with the letter of the School Division Superintendent requesting for the accommodating of the researcher. Finally, retrieved questionnaire were presented to the adviser for suggestions, correction refinement of the instrument. Qualitative evaluations of the responses of the questionnaires were produced based on the results of the evaluation and the suggestions.

Data gathering procedures

In order to gather the needed data of the undertaking the researcher formally requested permission from the Schools Division Superintendent of Samar Division. The survey questionnaire was personally filled in by the researches to the school administrators and the Science and Technology teachers separately. The purpose of the study was carefully explained. The respondents were assured that their answers were held strict confidentiality, to encourage them to be frank and sincere in their responses. Responses of the respondents were talked and organized in preparation for its analysis.

Results

Frequency and Percentage Distribution on the Profile of Science and Technology Teachers According to Field of Specialization

Table 1 The table reflects that out of 13 identified fields of specializations in the Science area, the highest obtained a frequency of 29 which was the Integrated Science followed by Biology with a frequency count of 22. All the rest of the areas have obtained scores lower than 10 which imply that only few teachers completed degrees in these particular areas of specialization. Considering that Integrated Science was the highest, this means that teachers have the basic ability and/or competence in any field in science which they are capable of imparting to the students. On the other hand, Biology as an area came next which also implies that most science teachers perceived Biology to be one of the most appropriate areas of specialization to complete since they are teaching high school level and Biology as compared with the rest of the sciences was deemed observed to be more general.

Common Approaches Used by Teachers in Teaching Science and Technology Subject

Various approaches used by teachers in teaching Science and Technology were identified by the researcher as part of her study in determining the approached used by the said teachers and their competence in teaching. Table 2 presents the data. Out of fourteen identified common approaches used by teachers in teaching Science and technology in the secondary level, the result showed that Discovery Approached was the most and highly used by the teachers as reflected in the ranking. Most teachers opted for discovery approach, and this would imply that they preferred this approach considering that in the discovery approach children are directed by teachers to undergo logical process of observation, comparison, abstraction generalization and application. Such stages reflect the scientific methods that teachers adopt in presenting lessons, most especially in a science subject. Based on the perception of teachers, such approach was found to be widely used because children could easily follow through with instructions and the latter are left to critically think and analyze so they could come up with generalizations rather than simply giving them direct lecture or textbook explanation which were generally found less effective and do not stimulate the creativity and analytical thinking skills of students.

Discovery approach was seconded by process skills approach whereby children are led to engage in activities for them to experience the actual process. However, a difference of 1 respondents was obtained with this approach as against problem solving approach. Process approach obtained 81 respondents while problem solving approach has 80 respondents. This connotes that teachers who opted for these two

specific approaches viewed either process or problem solving approach as effective approaches in teaching Science and Technology subject.

Table 2. Common Approaches Used by Teachers in Teaching Science and Technology Subjects

Approaches	f	%	RANK
1. Discovery	80	95.00	1
2. Process Skill	68	81.00	2
3. Problem Solving	67	80.00	3
4. Interactive	66	79.00	4
5. Experimental Teaching	63	75.00	5
6. Cooperative Teaching	62	74.00	6
7. Inquiry Teaching	60	71.00	7
8. Science Tech. Society	49	58.00	8
9. Project Based Teaching	41	49.00	9
10. Reflective Teaching	40	48.00	10
11. Differentiated	26	31.00	11.5
12. Constructivist	26	31.00	11.5
13. Pedagogical	19	23.00	13
14. Transmission	10	12.00	14

The above results were followed by interactive approach with a frequency of 79; experimental teaching with a frequency of 75 and comparative teaching with 74 respondents. On the other hand, the lowest approach identified by the teachers concerned was on transmission approach with a frequency of 12 and next above it was pedagogical approach which has 23 respondents. These last two approaches identified were viewed to be less popular for the teachers or if not, found unfamiliar by most teachers and students, thus resulting to low frequency scores.

Teaching Competence of Science and Technology Teachers

One of the central variables that the study ventured into was on the teaching competence of teachers, particularly on their teaching of Science and Technology subject. Table 3 presents therefore the competence of teachers as perceived by the respondents based on two categories: general competence and specific competence in using various approaches in Science and Technology subject. The teaching competence of teachers was measured basically in two categories-general and specific skills. For general competence, data in Table 4 revealed that among the teachers, general competence was rated as competent having a weighted mean of 4.18 and a standard deviation of 0.3317. On the other hand, the administrators rated the general teaching competence of teachers as 3.96 and interpreted still as: competent. Although, both groups of respondents have perceived the competence of teachers as competent, it could be noted that administrators have a lower rating as compared with the teachers. This means to say that based on the perception of the administrators, teachers were not that fully competent in as far as their general teaching competence was concerned.

Table 3. Weighted Mean and Standard Deviation on the Teaching Competence of Teachers in Teaching Science and Technology as Perceived by the Respondents

General Teaching Competence				Specific Skills in Using Varied Approaches in Teaching		
Respondents	X	SD	VD	X	SD	VD
Teachers	4.18	0.3317	Competent	4.17	0.3817	Competent
Administration	3.96	0.1872	Competent	4.1164	0.2859	Competent

Legend:

ẋ	VD
4.51 – 5.00	Highly Competent
3.51 – 4.50	Competent
2.51 – 3.50	Moderately Competent
1.51 – 2.50	Slightly Competent
1.00 – 1.50	Not Competent

As can be gleaned from the legend of the scale of ratings, moderately competent was one level lower than the highest rating which was excellently competent. Thus, the results having to show that teachers were competent would imply that based on the perception they have at least reached a certain level of competence which they could vouch to be good enough as far as teaching Science and Technology is concerned. This could be justified considering that most teachers have opted for approaches that were considered more innovative and experiential like discovery, problem solving, interactive, experimental and others rather than simply giving students direct text or lecture discussion of lessons. Furthermore, these approaches applied or used by teachers required a certain degree of familiarity and mastery to be able to carry out the methods effectively and meaningfully for the children. Otherwise, the results would be incompetence which was not actually the case.

Meanwhile, on the specific skills of teachers, both the teachers and administrators have viewed the competence of teachers to be "competent" also with mean scores of 4.17 and 4.11, respectively. This data then implies that teachers whether measured in terms of general teaching skills or specific skills were that prepared and were very familiar with the approaches used in their teaching of the subject.

Test of Significant Relationship Between the Profile of Teachers and Teaching Competence

Table 4 presents the data on test of significant relationship between the profile of teachers and their teaching competence. Two areas were measured in terms of teaching competence of Science teachers and these were on general skills or competence and specific skills in teaching the subject as against their profile. On the general teaching competence, it can be noted that out of 10 sub-variates in the profile, there were significant relationships established in most areas and these were on age, educational qualification, field of specialization, position, teaching experience, number of subjects taught and number of relevant trainings attended.

Table 4. Relationship Between Demographic Profile & their Competence in Teaching Science & Technology

Characteristics	General Teaching Competence					Specific Skills in Using Varied Approaches in Teaching Science & Tech.				
	R	V I	t-value	p-value	Decision	R	V I	t-value	p-value	Decision
Age	0.2197	LC	2.690	0.008	S	0.157	NC	1.905	0.05878	S
Sex	0.0150	NC	0.181	0.857	NS	0.0510	NC	0.610	0.54271	NS
Civil Status	0.0966	NC	1.161	0.248	NS	0.2118	LC	2.592	0.01054	S
Educ'l Qualification	0.1942	NC	2.365	0.0193	S	0.0494	NC	0.591	0.55532	NS
Field of Specialization	0.1809	NC	2.199	0.0295	S	0.0634	NC	0.759	0.44901	S
Position	0.3112	LC	3.916	0.00014	S	0.0820	NC	0.984	0.32659	S
Teaching Experience	0.2769	LC	3.445	0.00075	S	0.2097	LC	2.565	0.01134	NS
Performance Rating	0.1050	NC	1.263	0.20880	NS	0.1553	NC	1.880	0.06215	NS
Number of Subjects	0.3526	LC	4.506	0.00001	S	0.1200	NC	1.446	0.15042	S
Taught										
Number of Relevant	.11197	NC	1.441	0.15165	S	0.0499	NC	5.970	0.55130	S
Trainings Attended										

Indication
R Verbal Interpretation (VI)
1.00 Perfect Correlation
0.80-.99 Very High Correlation
0.60 - .79 High Correlation
0.40 - .59 Moderate Correlation
0.20 - .39 Low Correlation
0.10 - .19 Negligible Correlation
0 No Correlation

Decision
p-value < .05 – Significant
p-value > .05 – Not Significant

It is therefore very obvious from the results provided that profiles of teachers greatly affect the competence of teachers. For example, since age has a significant relationship established, this implies that while teachers gain more age and maturity, their teaching competence may also have improved, or the other way around, it could be that when a teacher gets older, then her teaching competence may slow down because of age. Whatever is valid, for as long as data shows that age has affected teaching competence of teachers. On other hand, educational qualification has also some bearing on the teaching competence as revealed in the data. The significant relationship established between the educational qualification and competence manifests that the more a teacher earns higher degree, his/her teaching competence is also affected, whether negatively or positively. In the same manner that field of specialization was also a factor that has some effects on the teaching competence and also position, teaching experience, number of subjects taught and number of relevant trainings. It is of a valid observation that the more teachers are preoccupied with so many subject preparations and her trainings were limited, generally speaking, this could mean that her competence also would get low.

Meanwhile, on the specific teaching competence, the table again revealed that most areas have obtained significant relationships particularly on age, civil status, field of specialization, position, number of subjects taught, and number of relevant trainings attended. As can be gleaned from the table, it seems that the only difference in terms of the sub-variates that attained significant relationships between general and specific were on civil status and teaching experience. These two sub-variables were viewed differently by the respondents whether they affect or did not affect teaching competence as shown with varying results. However, all the rest, it showed that the respondents' profile generally affect the teaching competence of teachers.

Test of Significant Differences on the Perception of Respondents on the Competence of Teachers in Teaching Science and Technology Subject

Table 5 shows the comparison of the perception of two groups of respondents, namely teachers and administrators, regarding the competence of teachers in teaching Science and Technology. The table includes mean scores (X), standard deviations (SD), and variance (VD) for two aspects: general teaching competence and specific skills in using varied approaches in teaching Science and Technology.

The mean scores indicate the average perception of each group. According to the qualitative description provided in the legend, mean scores between 4.51 and 5.00 are considered "Highly Competent," scores between 3.51 and 4.50 are "Competent," scores between 2.51 and 3.50 are "Moderately Competent," and scores between 1.51 and 2.50 are "Slightly Competent."

Table 5. Differences on the Perception of the Two Groups of Respondents on the Competence of the Teachers in Teaching Science & Technology

Respondents	General Teaching Competence			Specific Skills in Using Varied Approaches in Teaching Sci. & Tech.		
	X	SD	VD	X	SD	VD
Teachers	4.181	0.3241	Competent	4.17	0.246	Competent
Administrators	3.962	0.467	Competent	4.116	0.481	Competent
All Respondents	4.089	0.2996	Competent	4.148	0.3446	Competent
Mean Comparison						
F – value	21.509			0.862		
P – value	7.875			0.3548		
Decision	Not Significant			Not Significant		

Legend:
ẋ Qualitative Desc.
4.51 – 5.00 Highly Competent
3.51 – 4.50 Competent
2.51 – 3.50 Moderately Competent
1.51 – 2.50 Lightly Competent

For both aspects of general teaching competence and specific skills in using varied approaches, the mean scores for teachers and administrators fall within the "Competent" range. This suggests that both groups perceive the teachers as competent in their overall teaching abilities and their skills in utilizing diverse approaches to teach Science and Technology.

The table also provides the F-value and P-value, which are used to determine whether there are significant differences between the perceptions of the two groups. The F-value represents the variance between the groups, while the P-value indicates the probability of obtaining the observed results by chance. In this case, the P-values for both aspects are greater than 0.05, the standard threshold for statistical significance. Thus, the data suggests that there are no significant differences in the perceptions of teachers and administrators regarding the competence of teachers in teaching Science and Technology.

As a result, the null hypothesis, stating that there are no significant differences in the perception of the respondents, is accepted. The data indicates a consensus among both teachers and administrators that teachers are competent in their teaching abilities and their use of varied approaches to teach Science and Technology. Table 5 demonstrates that both teachers and administrators view the teachers as competent in teaching Science and Technology. The lack of significant differences in their perceptions implies a uniformity in their assessment of teachers' competence in the given subject. This consistency in perception is an encouraging indication of the overall quality of Science and Technology education within the context of the study.

Discussion

The findings of this study contribute to the understanding of the factors that influence teaching competence in Science and Technology education in public high schools. The results emphasize the importance of ongoing professional development for teachers, the adoption of learner-centered teaching approaches, and the recognition of the significant role teachers play in shaping students' learning experiences. By acknowledging the strengths and areas for improvement identified in this study, educational policymakers and school administrators can develop targeted strategies to further enhance Science and Technology education in public high schools. First, the profile of the teacher-respondents revealed that most of them were in the age range of 36-40 years old and 26-30, married, and female. This aligns with previous research that indicates a predominance of female teachers in the education sector (OECD, 2019). Additionally, the majority of teachers held Bachelor's degrees with some Master's degree units, with a focus on Integrated Science and Biology courses. However, it was noted that while most teachers achieved satisfactory performance ratings, they had limited relevant training attendance. This finding highlights the need for continuous professional development opportunities to enhance teachers' pedagogical skills and subject matter expertise (Darling-Hammond *et al.*, 2017).

Second, the study identified the most common teaching approaches used by teachers in teaching Science and Technology. The Discovery Approach, Process Approach, and Problem-Solving Approach ranked as the top three, indicating a focus on hands-on and inquiry-based learning strategies. This finding aligns with the literature on effective science education, which emphasizes the importance of active engagement and inquiry to foster deeper understanding and critical thinking in students (NGSS Lead States, 2013). On the other hand, the Transmission Approach, Pedagogical Approach, Differentiated, and Constructivist Approaches were ranked lower, suggesting the need for greater emphasis on student-centered and constructivist instructional methods to promote meaningful learning experiences (Bybee, 2014; Bransford *et al.*, 2000).

Third, the study demonstrated that teachers were perceived as competent in both general teaching competence and specific teaching competence related to Science and Technology.

This positive finding is crucial for ensuring quality education delivery and enhancing student learning outcomes. Competent teachers play a pivotal role in motivating students, promoting critical thinking, and creating a positive classroom environment that fosters learning (Hanushek *et al.*, 2017; Stronge *et al.*, 2004).

Fourth, the study identified significant relationships between certain aspects of teachers' profiles and their teaching competence. While some relationships were established, it is essential to recognize that teaching competence is a multifaceted construct influenced by various factors, including experience, subject matter knowledge, and professional development (Darling-Hammond, 2017). These findings underscore the importance of providing targeted support and resources to teachers based on their individual needs to enhance their teaching effectiveness.

Lastly, the study found uniform perceptions among the respondents regarding the teaching competence of teachers in Science and Technology. This consensus is encouraging as it indicates a shared understanding of teachers' abilities and strengths among both teachers and administrators. Such agreement can contribute to a positive school culture and collaborative efforts to improve teaching practices (Bryk *et al.*, 2010).

The study's findings provide valuable insights into the current state of Science and Technology education in public high schools. By understanding the teachers' profiles, teaching approaches, and competence, education stakeholders can design targeted interventions and professional development programs that empower teachers and ultimately improve the quality of Science and Technology instruction.

Conclusion

Based on the findings of the study, several conclusions can be drawn. The profile of the teachers indicates that they are still in their productive years, but there is a need for improvement in terms of teaching competence, as most teachers have limited teaching experience and fewer relevant trainings attended. Moreover, there is a potential for career development, with many teachers yet to reach the Master Teacher level and lacking extensive educational backgrounds. The study revealed that teachers commonly employ traditional teaching approaches, while newer and potentially effective approaches such as pedagogical, constructivism, transmission, and differentiated approaches remain relatively unfamiliar. Despite various sub-variables in the profile of teachers influencing teaching competence, it is evident that teachers' abilities are affected by factors such as age, educational qualifications, and teaching experience. However, the study demonstrates that most teachers are competent enough in delivering their instruction to students, though there is room for continuous improvement. Overall, both teachers and administrators share a positive perception of teachers' competence in teaching Science and Technology, highlighting the commitment and dedication of educators to providing quality education. As the education landscape evolves, it is essential for teachers to continue enriching their teaching skills to further enhance student learning outcomes and overall educational quality.

Recommendations

Based on the findings and conclusions of the study, several recommendations are proposed to enhance the teaching competence of Science and Technology teachers in public high schools. First, teachers should pursue further academic qualifications by enrolling in masteral or doctoral degree courses to improve their competence and career opportunities. Secondly, teachers must maintain a constant drive for self-improvement, aiming to reach the level of highly competent educators and not become complacent with their current ratings. It is essential for teachers to explore and integrate various teaching approaches, not limiting themselves to popular ones, and considering the context and learning needs of students. Administrators must provide support and motivation to teachers through in-service training,

career development opportunities and a conducive learning environment. Regular feedback and evaluation by administrators can help identify areas of improvement and cater to the needs of teachers. Moreover, logistical and instructional support, such as materials and facilities, should be readily available to aid teachers in their instructional delivery.

A comprehensive plan involving administrators and the entire school community should be developed to enhance teaching competence and expose teachers to the latest and more effective methods and approaches in teaching Science and Technology.

Implications of the Study in Teaching Biosciences

The study's implications in teaching biosciences are significant, considering the diverse range of subjects related to living organisms that fall under the umbrella of biosciences, such as biology, genetics, ecology, and physiology. One key implication is the emphasis on enhancing teacher competence, stressing the importance of teachers possessing a strong grasp of complex biological concepts and principles. Continuous professional development and academic enrichment are recommended to improve teachers' subject matter expertise and pedagogical skills.

Additionally, the study highlights the need for innovative teaching approaches in biosciences education. Traditional methods may not suffice to engage students in understanding abstract and technical concepts, hence the suggestion to incorporate discovery-based learning, inquiry-based activities, and hands-on experiments. Creating a conducive learning environment is crucial, including well-equipped laboratories, access to resources, and encouraging scientific discussions and research projects to enhance students' motivation and interest. Moreover, integrating real-world applications in teaching can demonstrate the practical relevance of biosciences, from healthcare to environmental conservation, fostering scientific literacy and inspiring students to pursue bioscience careers. Regular monitoring and evaluation of both teachers and students are emphasized, promoting a culture of continuous improvement in biosciences teaching. Lastly, collaborative efforts among teachers, administrators, and the school community are encouraged to exchange ideas and strategies, ultimately enhancing biosciences education and cultivating scientifically literate individuals prepared for the challenges in the field of biosciences.

The study's implications underscore the significance of teacher competence, innovative teaching approaches, a conducive learning environment, and real-world applications in biosciences education. By implementing these recommendations, bioscience educators can cultivate a deeper interest and understanding of the subject among students, contributing to the development of scientifically literate individuals and future leaders in the field of biosciences.

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