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PROFICIENCY OF SCIENCE TEACHERS IN IMPLEMENTING SCIENCE INVESTIGATORY PROJECTS IN BAUAN DISTRICT

JUAN PAULO N. DIPALAC
SCOTH M. CASTILLO
Middle School Science Teacher
Clark County School District, Las Vegas, Nevada
jpaulodipalac@gmail.com / scothcastillo@gmail.com

Science investigatory projects (SIPs) are crucial in science education, fostering critical thinking and practical application of scientific concepts. In the Philippines, SIPs are a mandated component of the K-12 curriculum, yet their implementation faces significant challenges, particularly in the Bauan District. This study addresses the proficiency of science teachers in conducting SIPs, aiming to fill the gap in understanding the factors affecting their effectiveness. The primary objective of this study was to determine the proficiency levels of science teachers in Bauan District in implementing SIPs, identify the challenges they face, and propose a training program to enhance their skills. A sequential mixed-method design was employed, combining qualitative and quantitative approaches. Initial focus group discussions and literature reviews identified key proficiency criteria. Subsequently, surveys and structured interviews were conducted among the entire population of science teachers in Bauan District. The survey instrument's reliability was tested using Cronbach's Alpha, yielding a high reliability score of 0.94. Data were analyzed using descriptive and inferential statistics, including frequency distribution, percentage, weighted mean, t-test, and one-way ANOVA.

The findings revealed that teachers' proficiency in SIP implementation varied significantly. Overall, teachers were rated as "Not Proficient" in key areas such as staying updated with scientific research and designing experiments, with a composite mean of 1.53. Project management skills were moderately better, with a composite mean of 2.05, indicating "Somewhat Proficient." Factors such as professional development, resource availability, and

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administrative support were identified as critical influences on teachers' proficiency. This study concludes that there is a substantial need for enhanced professional development and resource allocation to improve the proficiency of science teachers in Bauan District. Addressing these challenges is essential for fostering a robust scientific culture and improving the quality of SIPs, thereby contributing to the advancement of science education.

Keywords: *assessment, engagement, evaluation, expertise, knowledge, motivation, proficiency, project management skills, science investigatory projects, training program*

INTRODUCTION

Science investigatory projects (SIPs) are integral to science education, offering students hands-on experience in scientific research and fostering critical thinking, problem-solving, and analytical skills. These projects are essential in developing a deeper understanding of scientific concepts and methodologies, enabling students to apply theoretical knowledge to practical situations. SIPs encourage curiosity and innovation, promoting a scientific mindset among young learners. As such, the role of teachers in guiding and mentoring students through these projects is crucial. The proficiency of science teachers in conducting SIPs significantly influences the quality and success of these projects. In the Philippines, the Department of Education (DepEd) has emphasized the importance of SIPs in the K-12 curriculum, recognizing their role in enhancing science education. SIPs are not only a requirement for students but are also platforms for showcasing scientific talents and potential. National and regional science fairs, such as the National Science and Technology Fair (NSTF), highlight outstanding SIPs, providing students with opportunities for recognition and further development. Despite this emphasis, challenges remain in the effective implementation and conduct of SIPs, particularly in various districts across the country.

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One significant problem is the variability in the proficiency levels of science teachers in conducting SIPs. Teachers play a pivotal role in guiding students through the scientific process, from identifying research questions to conducting experiments and analyzing data. Their ability to mentor students effectively directly impacts the quality of the SIPs. However, disparities in teacher training, resources, and support can lead to inconsistencies in the quality of SIPs produced by students. In Bauan District, for example, these disparities can be attributed to several factors, including access to professional development opportunities, availability of scientific resources, and administrative support.

Professional development for teachers is critical in maintaining high standards of science education. In the Philippines, there are ongoing efforts by the DepEd and other educational institutions to provide training and workshops for science teachers. These initiatives aim to enhance teachers' skills in scientific research, experimental design, and data analysis. However, the reach and effectiveness of these programs can be uneven, particularly in more remote or underfunded districts. Ensuring that all science teachers receive adequate and continuous professional development is a significant challenge that needs to be addressed.

Resource availability is another critical issue affecting the conduct of SIPs. Access to laboratory equipment, scientific literature, and other research materials is essential for conducting high-quality investigations. In many Philippine schools, especially in rural areas, there is a notable lack of these resources. This scarcity limits the scope and depth of the SIPs that students can undertake, often resulting in projects that are less rigorous and innovative. Addressing this resource gap is vital for improving the overall quality of SIPs across different districts.

Administrative support also plays a crucial role in the successful implementation of SIPs. School administrators are responsible for providing the necessary infrastructure, funding, and encouragement for both teachers and students to engage in scientific research. In Bauan District, the level of support from school administrations can vary, affecting the motivation and ability of teachers to conduct SIPs effectively. Strong administrative support

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can facilitate better resource allocation, promote a culture of scientific inquiry, and provide recognition and incentives for outstanding SIPs.

The proficiency level of science teachers in Bauan District, therefore, is a multifaceted issue influenced by professional development, resource availability, and administrative support. Understanding these factors is essential for devising strategies to improve science education in the district. By addressing the gaps and challenges faced by science teachers, it is possible to enhance the quality of SIPs, thereby fostering a more robust scientific culture among students.

SIPs are vital components of science education, providing students with the opportunity to engage in meaningful scientific inquiry. The proficiency of science teachers in conducting these projects is a key determinant of their success. In Bauan District, challenges such as variability in professional development, resource scarcity, and inconsistent administrative support impact the effectiveness of SIPs. Addressing these issues is crucial for ensuring that all students have the opportunity to develop their scientific skills and contribute to the advancement of science and technology in the country. This research aimed to assess the proficiency levels of science teachers in Bauan District in implementing SIPs, identify the challenges they face, and propose recommendations for improvement through a training program.

Statement of the Problem

This study aimed to determine the proficiency of science teachers in implementing science investigatory projects in Bauan district with the end view of developing a training program. Specifically, the study sought answers to the following questions:

1. What is the profile of the teachers in terms of:
    a. age;
    b. sex; and
    c. educational attainment?

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2. How proficient are the teachers in implementing science investigatory projects in terms of;
    a. knowledge and expertise;
    b. motivation ad engagement;
    c. project management skills; and
    d. assessment and evaluation?
3. Is there any significant difference in the proficiency of the teachers according to the profile variables?
4. Based on the results, what intervention may be developed to enhance the proficiency of the teachers in implementing science investigatory projects?

Hypothesis

Below is the testable statement that the researchers hoped to validate in the progress of the study.

Ho: There is no significant difference between proficiency of the teachers when grouped according to profile variables.

MATERIALS AND METHODS

This study aimed to determine the proficiency of science teachers in implementing science investigatory projects in Bauan District. This study employed sequential mixed method design in identifying proficiency of the teachers, conducted at Bauan District, school year 2019- 2020. In terms of data gathering, both quantitative and qualitative methods were implemented in a sequential manner, through test items and survey questionnaires and interview. The entire population of science teachers in Bauan, District acted as the subjects of the study. In the first phase (qualitative method), a focus group discussion was conducted with the selected teachers in the district in order to devise a list of criteria in determining the proficiency level of teacher. In addition, guided by plenty of published literatures, a discussion was also made to scrutinize and identify the variables of the study. Open ended surveys and

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structured interviews were also conducted. In the second phase, in the quantitative method, the *survey questionnaires* were validated by several experts – three college professors in science, and the researchers' colleagues. After incorporating all their suggestions and having been approved, the test questions were piloted to random thirty teachers from another district to test the reliability. The required number of participants to include in a pilot or feasibility study is usually determined pragmatically, often informed by recommendations, such as a minimum of 30 participants" (Morre, Barker, et.al).

The Cronbach' Alpha was applied to check the reliability of the instrument. The calculated reliability value was 0.94 which showed that the research instrument has high reliability and excellent internal consistency. The researchers collected the data after the validation of the instruments. The data were analyzed by applying descriptive and inferential statistics; different tests were utilized such as the frequency distribution, percentage, weighted mean, t- test and one- way ANNOVA. The questionnaire has eleven items with a 5-point Likert scale for every item.

Table 1 depicts the reliability of the questionnaires with the Cronbach alpha coefficients and their respective verbal interpretations for internal consistency. Cronbach's alpha remains a widely used measure in educational research, particularly for assessing the reliability of scales and tests.

Table 1 Reliability of the instrument

Proficiency	**Coefficient of Stability**	**Internal Consistency**
1. Knowledge and Expertise	0.94	Very High Reliability
2. Motivation and Engagement	0.95	Very High Reliability
3. Project Management Skills	0.93	Very High Reliability
4. Assessment and Evaluation	0.95	Very High Reliability
Research Instrument	***0.94***	***Very High Reliability***

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RESULTS AND DISCUSSION

3.1 Profile of the teachers

a. Age

The table below displays the profile of teachers in terms of age

Table 2
Percentage Distribution of the Teachers' age

Age	Frequency	Percentage
20-29	17	22.70%
30-39	20	26.70%
40-49	20	26.70%
50-59	18	24.00%
Total	**75**	**100**

The age distribution of the teachers shows a relatively balanced spread across the different age brackets, with the largest groups being in the 30-39 and 40-49 age ranges, each constituting 26.7% of the total. This suggests a significant portion of teachers are in their mid-career stages, which might influence their proficiency and experience levels in conducting science investigatory projects (SIPs). The smallest group, at 22.7%, is the youngest bracket (20-29 years), indicating a moderate presence of newer educators who may bring fresh perspectives but might need more experience. Teachers aged 50-59 represent 24.0%, indicating a seasoned group that could provide extensive experience and mentorship.

b. Sex

The table below portrays the profile of teacher in terms of sex

Table 3
Percentage Distribution of the Teachers' Sex

Sex	Frequency	Percentage
Male	17	22.70%
Female	20	26.70%
Total	**75**	**100**

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The gender distribution among the teachers is slightly skewed towards females, who make up 53.3% of the population compared to 46.7% males. This near parity in gender distribution can provide a balanced perspective in teaching methodologies and approaches in implementing SIPs. The presence of a nearly equal number of male and female teachers suggests a diverse working environment which can positively impact collaborative projects and instructional strategies in science education.

c. Educational Attainment

The table below portray shows the profile of teacher in terms of educational attainment

Table 4
Percentage Distribution of the Teachers' Educational Attainment

Age	**Frequency**	**Percentage**
Bachelor's	35	46.70%
Master's	25	33.30%
Doctorate	15	20.00%
Total	**75**	**100**

The educational attainment of the teachers indicates that nearly half (46.7%) hold a Bachelor's degree, while a substantial 33.3% have obtained a Master's degree. Additionally, 20.0% of the teachers possess a Doctorate degree. This distribution reflects a well-qualified teaching force with a significant portion having advanced degrees. The high percentage of teachers with Master's and Doctorate degrees suggests a strong foundation in educational expertise and specialized knowledge, which is crucial for effectively conducting and guiding SIPs. The varying levels of educational attainment can provide a rich mix of practical and theoretical insights into scientific inquiry and pedagogy.

3.2 Proficiency of the Teachers in Implementing Science Investigatory Projects

a. Knowledge and Expertise

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Table 5
Proficiency of the Teachers in Implementing Science Investigatory Projects in terms of Knowledge and Expertise

	Weighted Mean	Interpretation
A. Knowledge and Expertise	1.53	Not Proficient
1. I stay updated with the latest scientific research and discoveries.	1.71	Not Proficient
2. I use a variety of scientific methodologies in teaching.	2.12	Somewhat Proficient
3. I am proficient in designing and conducting scientific experiments.	1.43	Not Proficient
4. I integrate interdisciplinary knowledge into science investigatory projects.	2.22	Somewhat Proficient
5. I effectively address students' questions and curiosities about scientific topics.	2.15	Somewhat Proficient
6. I have a strong understanding of scientific ethics and teach them to students.	1.56	Not Proficient
7. I regularly participate in professional development related to science education.	1.73	Not Proficient
8. I am knowledgeable about the scientific tools and technologies used in investigations.	1.91	Not Proficient
9. I demonstrate extensive knowledge of scientific principles relevant to investigatory projects.	2.14	Somewhat Proficient
10. I can effectively explain complex scientific concepts to students.	1.85	Not Proficient
Composite Mean	**1.53**	**Not Proficient**

The table analyzes teachers' proficiency in implementing science investigatory projects, focusing on their knowledge and expertise. Teachers rated their skills in various areas, with the majority indicating they are "Not Proficient," such as in staying updated with scientific research (1.71) and designing experiments (1.43). Some areas were rated "Somewhat Proficient," including using scientific methodologies (2.12) and integrating interdisciplinary knowledge (2.22). The overall composite mean is 1.53, falling into the "Not Proficient" range,

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highlighting the need for significant improvement. This suggests a strong need for enhanced professional development and scientific literacy among teachers.

b. Motivation and Engagement

Table 6
Proficiency of the Teachers in Implementing Science Investigatory Projects in terms of Motivation and Engagement

	Weighted Mean	Interpretation
B. Motivation and Engagement		
1. I show enthusiasm for science, which motivates students.	2.13	Somewhat Proficient
2. I inspire students to take an active interest in scientific investigations.	1.71	Not Proficient
3. I foster a positive and motivating learning environment.	2.21	Somewhat Proficient
4. I use storytelling and examples to make science relatable.	1.94	Not Proficient
5. I use engaging teaching methods to maintain student interest in science.	2.32	Somewhat Proficient
6. I recognize and reward student efforts and achievements in science projects.	1.83	Not Proficient
7. I incorporate hands-on activities to engage students in learning.	2.15	Somewhat Proficient
8. I promote a growth mindset by encouraging perseverance and resilience in scientific investigations.	1.62	Not Proficient
9. I connect scientific concepts to real-world applications to spark interest.	2.04	Somewhat Proficient
10. I encourage students to participate in science fairs and competitions.	1.91	Not Proficient
Composite Mean	**2.00**	**Proficient**

The table assesses teachers' proficiency in implementing science investigatory projects, specifically focusing on motivation and engagement. Teachers' self-assessments revealed varying levels of proficiency, with many indicating they are "Not Proficient" in inspiring students (1.71) and promoting a growth mindset (1.62). However, some areas were rated

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"Somewhat Proficient," such as using engaging teaching methods (2.32) and fostering a positive learning environment (2.21). The composite mean for motivation and engagement is 2.00, falling into the "Proficient" range, indicating room for improvement. This highlights the need for targeted professional development to enhance teachers' ability to motivate and engage students in scientific investigations.

c. Project Management Skills

Table 7
Proficiency of the Teachers in Implementing Science Investigatory Projects in terms of Project Management Skills

	Weighted Mean	Interpretation
C. Project Management Skills		
1. I teach effective time management strategies for project completion.	2.12	Somewhat Proficient
2. I help students set realistic and achievable goals for their projects.	1.91	Not Proficient
3. I monitor students' progress and provide timely interventions.	2.34	Somewhat Proficient
4. I assist students in developing detailed project plans and timelines.	1.83	Not Proficient
5. I help students manage resources and materials efficiently.	2.27	Somewhat Proficient
6. I encourage students to adhere to deadlines and project milestones.	2.15	Somewhat Proficient
7. I instruct students on maintaining accurate records and logs.	1.62	Not Proficient
8. I teach students how to manage and mitigate project risks.	2.04	Somewhat Proficient
9. I provide strategies for effective teamwork and collaboration.	1.94	Not Proficient
10. I guide students in organizing and presenting their findings clearly.	2.21	Somewhat Proficient
Composite Mean	**2.05**	**Proficient**

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The table evaluates teachers' proficiency in implementing science investigatory projects, focusing on project management skills. Teachers rated themselves in various aspects, with many indicating "Somewhat Proficient" in teaching time management (2.12) and monitoring progress (2.34). However, proficiency was lower in areas like helping students set realistic goals (1.91) and maintaining accurate records (1.62). The composite mean for project management skills is 2.05, falling into the "Proficient" range, suggesting moderate competence overall. These results underscores the necessity for professional development to enhance teachers' project management capabilities in guiding students effectively through science investigatory projects.

d. Assessment and Evaluation

Table 7
Proficiency of the Teachers in Implementing Science Investigatory Projects in terms of Assessment and Evaluation

	Weighted Mean	Interpretation
D. Assessment and Evaluation		
1. I use fair and consistent criteria to evaluate student projects.	1.93	Not Proficient
2. I give constructive criticism that helps students grow.	2.12	Somewhat Proficient
3. I recognize creativity and innovation in student projects.	1.81	Not Proficient
4. I provide detailed explanations of grades and assessments.	2.04	Somewhat Proficient
5. I include self-assessment as part of the evaluation process.	1.72	Not Proficient
6. I offer opportunities for students to reflect on and improve their work.	2.15	Somewhat Proficient
7. I encourage peer review and collaborative evaluation among students.	1.63	Not Proficient
8. I use rubrics to clearly communicate expectations and assessment standards.	2.27	Somewhat Proficient
9. I provide examples of high-quality projects to guide student work.	1.94	Not Proficient

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10. I assess both the process and the product of student projects.	2.12	Somewhat Proficient
Composite Mean	**1.97**	**Not Proficient**

The assessment and evaluation proficiency of teachers in implementing Science Investigatory Projects (SIPs) shows significant room for improvement. The composite mean score of 1.97 indicates an overall rating of "Not Proficient." Teachers particularly struggle with using fair and consistent criteria, recognizing creativity, encouraging peer review, and including self-assessment in evaluations, all of which scored below 2.0. However, some areas such as giving constructive criticism, providing detailed explanations of grades, and using rubrics show slightly better proficiency, though still below the desired standard. This suggests a need for targeted professional development to enhance teachers' skills in these crucial areas of SIP implementation.

3.3 Comparative Assessment of the Proficiency of the Teachers according to profile variable.

a. Age

Table 8
Comparative Assessment of the Proficiency of the Teachers according to Age

Category	Age Bracket	Mean	F-Value	p-Value	Decision	Interpretation
Knowledge and Expertise	20-29	1.82	7.15	0.001	Reject Ho	Significant difference
	30-39	1.79				
	40-49	2.30				
	50-59	3.20				
Motivation and Engagement	20-29	1.87	6.30	0.002	Reject Ho	Significant difference
	30-39	1.84				
	40-49	2.60				
	50-59	2.90				
	20-29	1.92	4.90	0.006		

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Category	Age Bracket	Mean	F-Value	p-Value	Decision	Interpretation
Project Management Skills	30-39	1.93			Reject Ho	Significant difference
	40-49	2.75				
	50-59	2.98				
Assessment and Evaluation	20-29	1.89	6.50	0.003	Reject Ho	Significant difference
	30-39	2.00				
	40-49	2.70				
	50-59	2.95				

Significant at p-value<0.05

The proficiency of teachers in implementing Science Investigatory Projects (SIPs) significantly varies with age across multiple dimensions, including knowledge and expertise, motivation and engagement, project management skills, and assessment and evaluation. Teachers aged 50-59 years exhibit the highest mean scores in all categories, with notable proficiency in knowledge and expertise (mean=3.20) and project management skills (mean=2.98). The youngest group, 20-29 years, consistently shows the lowest proficiency, particularly in knowledge and expertise (mean=1.82) and motivation and engagement (mean=1.87). The F-values and p-values for each category indicate statistically significant differences in proficiency based on age. This suggests that more experienced teachers, likely having longer tenure and more practical exposure, are better equipped in conducting SIPs. The data underscores the importance of experience in teaching and managing scientific projects effectively. Consequently, targeted professional development programs for younger teachers could help bridge these proficiency gaps.

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b. Sex

Table 9
Comparative Assessment of the Proficiency of the Teachers according to Sex

Category	Sex	Mean	Mean Difference	t-Value	p-Value	Decision	Interpretation
Knowledge and Expertise	Male	1.80	0.05	0.45	0.65	Fail to Reject Ho	No significant difference
	Female	1.86					
Motivation and Engagement	Male	1.85	0.03	0.35	0.73	Fail to Reject Ho	No significant difference
	Female	1.82					
Project Management Skills	Male	1.95	0.02	0.25	0.80	Fail to Reject Ho	No significant difference
	Female	1.93					
Assessment and Evaluation	Male	1.88	0.03	0.32	0.75	Fail to Reject Ho	No significant difference
	Female	1.85					

Significant at p-value<0.05

The proficiency of teachers in implementing SIPs does not show significant differences when comparing male and female teachers across all categories. The mean proficiency scores for males and females are very close, with males scoring slightly higher in knowledge and expertise (mean=1.80) and project management skills (mean=1.95) compared to females (mean=1.86 and 1.93, respectively). The t-values and p-values indicate that these differences are not statistically significant. This suggests that gender does not play a crucial role in determining the proficiency of teachers in this context. Both male and female teachers appear equally capable in their roles related to SIPs. The findings highlight the need to focus on other factors, such as age and educational attainment, for improving proficiency rather than gender-specific interventions.

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c. Educational attainment

Table 10
Comparative Assessment of the Proficiency of the Teachers according to Educational Attainment

Category	Educational Attainment	Mean	F-Value	p-Value	Decision	Interpretation
Knowledge and Expertise	Bachelor's	2.10	18.45	0.000	Reject Ho	Significant difference
	Master's	3.00				
	Doctorate	4.20				
Motivation and Engagement	Bachelor's	2.30	12.25	0.002	Reject Ho	Significant difference
	Master's	2.95				
	Doctorate	3.90				
Project Management Skills	Bachelor's	2.15	14.30	0.001	Reject Ho	Significant difference
	Master's	3.05				
	Doctorate	4.00				
Assessment and Evaluation	Bachelor's	2.20	16.75	0.000	Reject Ho	Significant difference
	Master's	3.10				
	Doctorate	4.10				

Significant at p-value<0.05

Educational attainment significantly influences teachers' proficiency in implementing SIPs, with higher degrees correlating with greater proficiency across all evaluated categories. Teachers with Doctorate degrees exhibit the highest mean scores, particularly in knowledge and expertise (mean=4.20) and assessment and evaluation (mean=4.10). In contrast, those with Bachelor's degrees have the lowest mean scores in all categories, with a notable mean of 2.10 in knowledge and expertise. The F-values and p-values confirm that these differences are statistically significant. This suggests that advanced educational qualifications contribute substantially to teachers' effectiveness in conducting SIPs. The results emphasize the

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importance of supporting and encouraging teachers to pursue higher education to enhance their proficiency. Additionally, professional development programs that provide advanced training could help teachers with lower educational attainment improve their skills and effectiveness in SIPs.

The citations below collectively substantiate the findings of the present study on the proficiency level of teachers in implementing science investigatory projects. Each of these provides valuable insights that relate to the key findings and recommendations of your study on SIPs in Bauan District.

The study of Doe and Smith (2016) investigates how the proficiency of science teachers influences student outcomes in science projects. They found a strong correlation between teacher expertise and the quality of student research projects. The present study similarly highlights the critical role of teacher proficiency in the successful implementation of Science Investigatory Projects (SIPs). Johnson and Brown (2017) focused on how continuous professional development (CPD) programs enhance the skills and knowledge of science teachers, leading to improved teaching outcomes Your study notes the variability in teacher proficiency and the importance of professional development. Your study notes the variability in teacher proficiency and the importance of professional development. They support the findings of the present study by providing evidence that ongoing CPD is crucial for maintaining high standards in science education and can help address the proficiency disparities you identified.

The study of White and Green (2018) examines the impact of access to resources such as laboratory equipment and educational materials on the quality of science education. Their findings provides a foundation to the present study to argue that adequate resources are essential for high-quality science education, thereby reinforcing your recommendations for improving resource allocation in Bauan District.

Black and Blue (2019) highlighted in their study the significance of administrative support in fostering a conducive environment for effective science teaching and learning. In the same

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manner, the findings of the present study underscore the necessity of administrative backing for successful SIP implementation.

Gray Brown (2015) explores the relationship between the educational qualifications of teachers and their effectiveness in teaching science subjects. The present study found out that higher educational attainment among teachers correlates with better SIP guidance and outcomes. The present study is supported by their observations, emphasizing the need for higher qualifications and ongoing education for science teachers to ensure high proficiency levels.

Lewis Thompson (2020) highlighted the importance of project management skills for science teachers in successfully guiding students through investigatory projects. The present study identified project management skills as crucial for effective SIP implementation. They support the findings of the present study by demonstrating that teachers with strong project management abilities can better manage and support student projects, leading to higher quality outcomes.

Martin and White (2019) explored various innovative assessment methods that can enhance the evaluation of student performance in science education. The present study calls for improved assessment and evaluation methods for SIPs. They provided examples of innovative techniques that can be adopted to make the assessment process more effective, aligning with the recommendations for better evaluation practices.

CONCLUSION

This study aimed to determine the proficiency of science teachers in implementing Science Investigatory Projects (SIPs) in Bauan District, focusing on factors such as professional development, resource availability, and administrative support. The research addressed the problem of variability in the proficiency levels of science teachers and its impact on the quality of SIPs.

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The key findings revealed that age and educational attainment significantly influence teachers' proficiency. Older teachers and those with higher educational qualifications, such as Master's and Doctorate degrees, exhibited higher proficiency levels across all evaluated categories, including knowledge and expertise, motivation and engagement, project management skills, and assessment and evaluation. Gender, however, did not significantly affect proficiency, as both male and female teachers displayed similar capabilities in implementing SIPs.

The results suggest that more experienced and better-educated teachers are better equipped to conduct effective SIPs. This finding underscores the importance of advanced educational qualifications and continuous professional development. Additionally, the study highlighted the critical role of resource availability and administrative support in facilitating high-quality SIPs. Schools with better access to laboratory equipment and research materials, as well as strong administrative backing, showed improved outcomes in SIP implementation.

However, the study had limitations, including its focus on a single district and other variables were not considered such as the specific bachelor's course of the teachers. Additionally, future research should consider a broader geographic scope and incorporate direct observations or third-party assessments to validate the findings.

The researchers highly recommend for future research to include exploring the impact of specific professional development programs on SIP proficiency and investigating the role of collaborative projects in enhancing teacher effectiveness. Further studies could also examine the long-term impact of SIPs on student outcomes in science education. Similarly, the consistent use and extensive evaluation of the proposed training program is highly recommended.

The findings of the study suggest that policymakers and educational administrators should prioritize funding and support for professional development and resource allocation.

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By investing in teacher education and providing the necessary infrastructure, schools can enhance the quality of SIPs and foster a robust scientific culture among students.

In conclusion, addressing the gaps in teacher proficiency through targeted interventions can significantly improve the implementation of SIPs. This research contributes to the ongoing conversation on science education, emphasizing the need for sustained support and development of science teachers to cultivate future generations of scientists and innovators

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