



Training Engagement and Utilization of Science Equipment in Enhancing Pedagogical Competence among Science Teachers

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ABSTRACT

This study investigated the role of training engagement and the utilization of science equipment in enhancing the pedagogical competence of teachers in the Province of Cotabato for the school year 2024–2025. Specifically, it aimed to determine the levels of training engagement, science equipment utilization, and pedagogical competence, as well as to examine their significant relationships and influences. Additionally, it identified challenges and coping practices in enhancing pedagogical competence and proposed interventions and policy recommendations based on the findings. Employing a mixed-method research approach, the study used a descriptive-correlational design for the quantitative aspect involving 300 teacher-respondents selected through complete enumeration. The qualitative component engaged 25 selected science teachers. A self-developed and highly reliable instrument was used for data collection. Statistical tools included mean, Spearman rho, and multiple linear regression.

Findings revealed that teachers demonstrated a highly engaged training engagement, particularly in developing pedagogical skills and participating in hands-on laboratory activities. They also showed highly practiced in the utilization of science equipment, especially in ethical and responsible use, safety, experimentation, and maintenance. Moreover, teachers exhibited highly competent level of pedagogical competence, particularly in teaching skills, content knowledge, and the ability to engage and inspire students. Statistically, training engagement and science equipment utilization showed significant relationships with the pedagogical competence of the teacher. Training engagement and utilization of science equipment significantly influenced the measured dimensions of pedagogical competence of the teachers.

Keywords: Pedagogical competence, Utilization, Engagement

Introduction

The rapid evolution of scientific knowledge and technology challenges teachers in enhancing their pedagogical competence. Many struggle to keep up with current science education practices and incorporate innovative strategies like inquiry-based learning and digital tools. Limited access to training, resources, and support worsens this issue, hindering their ability to engage students and promote a deeper understanding of science concepts.

Effective professional development programs equip teachers with the necessary skills to integrate scientific tools and technologies into their teaching practices, enabling more engaging and interactive learning experiences.

Utilizing science equipment appropriately, teachers can promote inquiry-based learning, helping students develop critical thinking and problem-solving skills. Research has shown that training programs that focus on both pedagogy and the use of science tools significantly improve teachers' confidence and effectiveness in the classroom (Smith & Jones, 2017).

A notable research gap exists in the field of teachers' training engagement and effective utilization of science equipment in enhancing pedagogical competence. While many studies emphasize initial training's importance, there is a lack of longitudinal research examining how ongoing professional development and support for teachers in effectively using scientific tools impact their teaching practices over time. Additionally, the integration of innovative technologies within training programs remains underexplored, highlighting the need for further investigation into how these elements contribute to sustained improvements in science education (Blanchard, Southerland, & McDonald, 2017).

The researcher is particularly interested in investigating the impact of teachers' training and effective utilization of science equipment in enhancing pedagogical competence. Recognizing that effective science education relies heavily on educators' ability to integrate hands-on learning experiences, the researcher aims to explore how targeted training programs can equip teachers with both the skills and confidence needed to utilize scientific tools effectively in their classrooms. This research is motivated by the potential to improve instructional practices, foster student engagement, and enhance student understanding of complex scientific concepts through better-trained educators.

Aim

This study aimed to examine the training engagement and utilization of science equipment in enhancing pedagogical competence among science teachers in the Province of Cotabato during the school year 2024-2025.

Specifically, it sought to answer the following research questions.

1. What is the level of training engagement in terms of pedagogical skills, hands-on laboratory, technical competence, and laboratory management?
2. What is the level of the utilization of science equipment in terms of safety practices, maintenance and care, technical proficiency, experimentation and procedures, and ethical and responsible use?
3. What is the level of enhancing pedagogical competence of teachers in terms of teaching skills, content knowledge, ability to engage and inspire students?
4. Is there a significant relationship between training engagement and enhancing pedagogical competence of teachers?
5. Does the training engagement significantly influence in enhancing pedagogical competence of teachers?
6. Is there a significant relationship between the utilization of science equipment and enhancing pedagogical competence of teachers?
7. Does the utilization of science equipment significantly influence in enhancing pedagogical competence of teachers?

Hypothesis

The following hypotheses were tested in this study.

1. There is no significant relationship between training engagement and enhancing pedagogical competence of teachers.
2. Training engagement does not significantly influence in enhancing pedagogical competence of teachers.
3. There is no significant relationship between the utilization of science equipment and enhancing pedagogical competence of teachers.
4. Utilization of science equipment does not significantly influence in enhancing pedagogical competence of teachers.

METHODOLOGY

Research Design

A quantitative design was used in this study. The researcher used structured surveys to assess how these teachers' training engagement and effective utilization of science equipment influenced pedagogical competence of teachers. This approach provided a data-driven understanding of how these trainings and effective utilization of science equipment contributed to enhancing pedagogical competence of teachers.

Respondents of the Study

The respondents of the study were secondary science teachers in the divisions of Cotabato and Kidapawan City. They took part in responding to the survey questionnaire.

There were 300 respondents from the public secondary science teachers in the Province of Cotabato and that included Kidapawan City who participated in the study.

Research Instrument

The researcher utilized the survey questionnaire in data gathering. Statements were taken from the experiences of science teachers in teaching the subject. This process underscored the theoretical understanding of the content of the study to provide clear justifications of the statements which may be essential for the dimensions. A Likert scale was used in determining the level of their responses.

Statistical Analysis

This study used of descriptive statistics employing the mean and weighted mean to answer the problems being investigated.

Spearman rank-order correlation coefficient rho was employed to determine the relationship between the independent and dependent variables of the study (Lee & Preacher, 2017). Finally, Multiple Regression Analysis was utilized to determine the significant influence of the independent and the dependent variables of the study. The hypothesis were tested using 5% level of significance (Field, 2016).

RESULTS and DISCUSSIONS

This part of the study gives the discussions encompassing the actual data gathered pertaining to the training engagement and utilization of science equipment in enhancing pedagogical competence. It presented the data by using the textual and tabular order as it analyzed the data and interpreted the findings of the study.

Level of Teachers' Training Engagement

Table 3 presents the level of training engagement in terms of pedagogical skills, hands-on laboratory, technical competence, and laboratory management obtained a grand mean of 4.04, described as engaged. Data revealed that the highest level of engagement is found in pedagogical skills. It is followed by technical competence, then hands-on laboratory, and laboratory management which all described as engaged.

This implies that while teachers are generally engaged in various aspects, there is a noticeable gap in practical and management-oriented aspects of training, particularly in hands-on laboratory and laboratory management. This indicates a need for schools and educational institutions to strengthen their training programs by providing more opportunities for experiential learning and laboratory-based professional development so that teachers can enhance their capacity to deliver more interactive, technically sound, and well-managed learning environments, ultimately contributing to improved student outcomes and instructional quality.

The findings support to the recent studies on the importance of ongoing teacher training in both pedagogical and technical domains. Almazan et al (2021) mentioned that continuous professional development focused on teaching strategies significantly contributes to teachers' instructional confidence and classroom effectiveness.

Table 3 Level of teachers' training engagement

Teachers' Training Engagement	Weighted Mean	Description
Pedagogical Skills	4.36	Highly Engaged
Hands-on Laboratory	3.89	Engaged
Technical Competence	4.01	Engaged
Laboratory Management	3.88	Engaged
Grand Mean	4.04	Engaged

Level	Range	Description
5	4.21-5.00	Highly Engaged
4	3.41-4.20	Engaged
3	2.61-3.40	Moderately Engaged
2	1.81-2.60	Rarely Engaged
1	1.00-1.80	Very Rarely Engaged

Level of Utilization of Science Equipment

Table 4 displays the level of utilization of science equipment among teachers across five key areas like safety practices, maintenance and care, technical proficiency, experimentation and procedures, and ethical and responsible use with a grand mean of 4.14, described as practiced. Results revealed that the respondents highly practiced on ethical and responsible use, safety practices, and experimentation and procedures. However, they practiced on maintenance and care and technical proficiency.

These results imply that while teachers show commendable practice in ethical use, safety, and conducting scientific procedures, there is room for improvement in areas that involve technical handling and upkeep of science equipment. The relatively lower engagement in maintenance and care and technical proficiency reflects limitations in hands-on training, access to technical support, or familiarity with the equipment's functionality.

Torres and Salazar (2021) explained that ethical handling and safety practices in laboratories are foundational to fostering responsible science learning among students.

Table 4 Level of utilization of science equipment

Utilization of Science Equipment	Weighted Mean	Description
Safety Practices	4.28	Highly Practiced
Maintenance and Care	3.89	Practiced
Technical Proficiency	3.87	Practiced
Experimentation and Procedures	4.28	Highly Practiced
Ethical and Responsible Use	4.40	Highly Practiced
Grand Mean	4.14	Practiced

<i>Level</i>	<i>Range</i>	<i>Description</i>
5	4.21-5.00	Highly Practiced
4	3.41-4.20	Practiced
3	2.61-3.40	Moderately Practiced
2	1.81-2.60	Less Practiced
1	1.00-1.80	Least Practiced

Level of Enhancing Pedagogical Competence

Table 5 reveals the level of enhancing pedagogical competence among teachers across four key indicators like teaching skills, content knowledge, ability to engage, and inspire students which obtained a grand mean of 4.52 with the description of highly practiced. The highest-rated aspects are ability to engage and inspire students, both with a weighted mean of 4.56, described as highly competent. These are closely followed by teaching skills with a weighted mean of 4.49, and content knowledge with 4.45, both also describes as highly competent.

This implies a significant positive impact on the overall quality of education. These competencies are essential for creating dynamic, learner-centered classrooms that not only transmit knowledge but also enhance critical thinking, curiosity, motivation, and lifelong learning habits among students. Further, a teacher who effectively engages and inspires students can make learning more relevant and enjoyable, increasing student participation and retention of concepts. Strong teaching skills ensure that lessons are delivered clearly, efficiently, and adaptively, while solid content knowledge allows teachers to confidently clarify concepts, connect topics across disciplines, and address diverse student needs.

The results conform to the study of Ahmed and Abdurrahman (2021) mentioned that teachers who can meaningfully engage students and create inspiring learning environments significantly improve academic motivation and participation.

Table 5 Level of enhancing pedagogical competence

Enhancing Pedagogical Competence	Weighted Mean	Description
Teaching Skills	4.49	Highly Competent
Content Knowledge	4.45	Highly Competent
Ability to Engage	4.56	Highly Competent
Inspire Students	4.56	Highly Competent
Grand Mean	4.52	Highly Competent

<i>Level</i>	<i>Range</i>	<i>Description</i>
5	4.21-5.00	Highly Competent
4	3.41-4.20	Competent
3	2.61-3.40	Moderately Competent
2	1.81-2.60	Less Competent
1	1.00-1.80	Least Competent

Relationship of the Training Engagement and Enhancing Pedagogical Competence

Pedagogical Skills

Table 6 reflects the relationship between training engagement and enhancing pedagogical competence. The correlation matrix shows that pedagogical skills had a significant relationship with all the parameters used to measure in enhancing pedagogical competence of teachers in terms of teaching skills (corr. coef.=0.687** with a p-value of 0.000); content knowledge (corr. coef.=0.666** with a p-value of 0.000); ability to engage (corr. coef.=0.638** with a p-value of 0.000); and inspire students (corr. coef.=0.609** with a p-value of 0.000).

The result means that training engagement like pedagogical skills are highly significant in enhancing pedagogical competence of teachers. The presented probability values which are less than the set 1% level of significance means that the stated hypothesis on this aspect of the study is rejected. This indicates that the higher the level of pedagogical skills a teacher possesses, the greater their ability to enhance their overall pedagogical competence.

The findings imply that pedagogical skills are critically important in enhancing the overall pedagogical competence of teachers, particularly in areas such as teaching skills, mastery of content knowledge, and the ability to engage and inspire students. This highlights the need for sustained professional development efforts that focus not only on theoretical knowledge but also on practical application. In this manner, teachers can deliver more effective and meaningful learning experiences, thereby contributing to better student outcomes and higher classroom engagement.

Recent studies reinforce the strong link between pedagogical skills and the broader competence of teachers. Lin et al (2021) emphasized that pedagogical skills directly influence a teacher's ability to explain content clearly, manage classroom dynamics, and adapt lessons to meet diverse student needs.

Hands-on Laboratory

On hands-on laboratory, the relationship between training engagement and enhancing pedagogical competence. The correlation matrix shows that hands-on laboratory had a significant relationship with all the parameters used to measure in enhancing pedagogical competence of teachers in terms of teaching skills (corr. coef.=0.425** with a p-value of 0.001); content knowledge (corr. coef.=0.337** with a p-value of 0.011); ability to engage (corr. coef.=0.393** with a p-value of 0.003); and inspire students (corr. coef.=0.388** with a p-value of 0.003).

The result means that training engagement like hands-on laboratory is highly significant in enhancing pedagogical competence of teachers. The presented probability values which are less than the set 1% level of significance means that the stated hypothesis on this aspect of the study is rejected. This indicates that a higher level of hands-on laboratory experience significantly contributes to the enhancement of teachers' pedagogical competence.

The findings imply that hands-on laboratory experiences are essential in enhancing teachers' pedagogical competence. These practical environments strengthen teaching skills, deepen content knowledge, and improve the ability to engage and inspire students. Integrating such activities into teacher training programs helps develop well-rounded and effective teachers.

Recent literature supports the idea that hands-on laboratory experiences significantly contribute to teachers' professional growth and pedagogical competence. Ferdous and Amin (2021) discussed practical teaching environments enable educators to better understand subject content and develop more effective instructional strategies.

Technical Competence

On technical competence, the relationship between training engagement and enhancing pedagogical competence. The correlation matrix shows that technical competence had a significant relationship with all the parameters used to measure in enhancing pedagogical competence of teachers in terms of teaching skills (corr. coef.=0.597** with a p-value of 0.000); content knowledge (corr. coef.=0.379** with a p-value of 0.004); ability to engage (corr. coef.=0.512** with a p-value of 0.000); and inspire students (corr. coef.=0.469** with a p-value of 0.000).

The result means that training engagement like technical competence is highly significant in enhancing pedagogical competence of teachers. The presented probability values which are less than the set 1% level of significance means that the stated hypothesis on this aspect of the study is rejected. This further means that the higher the level of technical competence, the greater the enhancement of teachers' pedagogical competence.

The results imply that technical competence plays a crucial role in enhancing the pedagogical competence of teachers. Specifically, it contributes to strengthening teaching skills, deepening content knowledge, and improving the ability to engage and inspire students. When teachers are technically competent, they can effectively integrate technology and digital tools into their instructional practices, making lessons more interactive, accessible, and relevant.

The results conform to what Arkorful and Abaidoo (2020) stated that the integration of digital tools in teaching enhances both instructional delivery and learner engagement, underscoring the importance of teachers' technical proficiency.

Laboratory Management

On laboratory management, the relationship between training engagement and enhancing pedagogical competence. The correlation matrix shows that laboratory management had a significant relationship with all the parameters used to measure in enhancing pedagogical competence of teachers in terms

of teaching skills (corr. coef.=0.511** with a p-value of 0.000); content knowledge (corr. coef.=0.339* with a p-value of 0.011); ability to engage (corr. coef.=0.468** with a p-value of 0.000); and inspire students (corr. coef.=0.454** with a p-value of 0.000).

The result means that training engagement like laboratory management is highly significant in enhancing pedagogical competence of teachers. The presented probability values which are less than the set 1% level of significance means that the stated hypothesis on this aspect of the study is rejected. This further means that the higher the level of laboratory management, the higher the enhancement of teachers' pedagogical competence.

The findings indicate that effective laboratory management is highly significant in enhancing the pedagogical competence of teachers. Proper management of laboratory activities not only improves teaching skills and deepens content knowledge but also enables teachers to create engaging and inspiring learning environments. When teachers are skilled in organizing, supervising, and facilitating hands-on experiments, they promote active learning and critical thinking among students.

The findings support the idea that strong laboratory management skills contribute to the overall pedagogical competence of teachers. Afolabi and Adedayo (2021) found that teachers who effectively manage laboratory settings enhance student engagement and foster deeper understanding of scientific concepts.

Table 6 Correlation matrix showing the relationship of the **training engagement and enhancing pedagogical competence.**

<i>Spearman Rho</i>		Teaching Skills	Content Knowledge	Ability to Engage	Inspire Students
Training Engagement					
Pedagogical Skills	Cor. Coef.	0.687**	0.666**	0.638**	0.609**
	Probability	0.000	0.000	0.000	0.000
Hands-on Laboratory	Cor. Coef.	0.425**	0.337*	0.393**	0.388**
	Probability	0.001	0.011	0.003	0.003
Technical Competence	Cor. Coef.	0.597**	0.379**	0.512**	0.469**
	Probability	0.000	0.004	0.000	0.000
Laboratory Management	Cor. Coef.	0.511**	0.339*	0.468**	0.454**
	Probability	0.000	0.011	0.000	0.000

**Correlation is significant at the 0.01 level.

*Correlation is significant at the 0.05 level.

Influence of the Training Engagement on the Enhancing Pedagogical Competence

Teaching Skills

Table 7 shows the combined effect of the training engagement significantly influenced in enhancing pedagogical competence in terms of teaching skills (F-value = 12.237, Probability = 0.000). The stated hypothesis of the study was rejected because the probability value is significantly lesser than 0.010 level of significance.

In fact, 49.20% of the variation of enhancing pedagogical competence of teachers in terms of active participation was accounted by pedagogical skills and laboratory management. The remaining 50.80% was accounted by some training engagements not involved in the study.

Considering the training engagement of the teachers, pedagogical skills and laboratory management found to be the significant indicators of the teachers' pedagogical competence in terms of teaching skills.

Result implies that the more the teachers practice their pedagogical skills and manage the laboratory properly, the more competent they are in their teaching skills because they directly enhance a teacher's ability to deliver effective, engaging, and well-organized instruction. Training keeps teachers updated and confident in their methods, pedagogical skills ensure they can present content clearly and adapt to diverse learners, and laboratory management enables them to facilitate safe, hands-on learning experiences. Together, these factors strengthen a teacher's overall capacity to teach effectively in both theory and practice.

Sari et al (2021) mentioned that teachers who engage in continuous professional development and actively practice their pedagogical skills show marked improvement in their instructional effectiveness, including in laboratory settings. The study by Nadi et al (2022) also emphasized that well-managed laboratory environments contribute to teachers' ability to deliver complex concepts clearly, thereby improving teaching skills.

Content Knowledge

On content knowledge, the combined effect of the training engagement significantly influenced in enhancing pedagogical competence in terms of content knowledge (F-value = 9.280, Probability = 0.000). The stated hypothesis of the study was rejected because the probability value is significantly lesser than 0.010 level of significance.

In fact, 42.10% of the variation of enhancing pedagogical competence of teachers in terms of content knowledge was accounted by pedagogical skills. The remaining 57.90% was accounted by some training engagements not involved in the study.

Considering the training engagement of the teachers, pedagogical skills found to be the best predictor of the teachers' pedagogical competence in terms of content knowledge. Result implies that teachers who demonstrate strong content knowledge are able to effectively organize, deliver, and enrich subject matter, leading to deeper student understanding because they enable teachers to effectively communicate, simplify, and connect subject matter to students' understanding. Strong pedagogical skills help teachers not only master the content but also design and deliver lessons that make complex ideas accessible and meaningful. This ensures that their deep content knowledge is translated into clear, engaging, and structured instruction that supports student learning.

Rahman et al (2021) found that teachers with strong pedagogical skills demonstrate a greater ability to connect content with appropriate teaching methods, leading to improved student learning.

Ability to Engage

On ability to engage, the combined effect of the training engagement significantly influenced in enhancing pedagogical competence in terms of ability to engage (F-value = 9.279, Probability = 0.000). The stated hypothesis of the study was rejected because the probability value is significantly lesser than 0.010 level of significance.

In fact, 42.20% of the variation of enhancing pedagogical competence of teachers in terms of ability to engage was accounted by pedagogical skills. The remaining 57.90% was accounted by some training engagements not involved in the study.

Considering the training engagement of the teachers, pedagogical skills found to be the best predictor of the teachers' pedagogical competence in terms of ability to engage. Result implies that teachers who effectively use instructional strategies are more capable of enhancing student interest, participation, and motivation in the classroom because they equip teachers with the strategies to actively involve students in learning. These skills include the use of interactive methods, questioning techniques, differentiated instruction, and real-world connections—all of which capture students' interest and maintain their attention. When teachers apply strong pedagogical approaches, they create dynamic and responsive classrooms where students feel motivated and connected to the learning process.

Kaur and Noman (2021) shared that well-developed pedagogical practices enable teachers to create dynamic and interactive learning environments that keep students actively involved.

Inspire Students

On inspire students, the combined effect of the training engagement significantly influenced in enhancing pedagogical competence in terms of inspire students (F-value = 8.595, Probability = 0.000). The stated hypothesis of the study was rejected because the probability value is significantly lesser than 0.010 level of significance.

In fact, 40.30% of the variation of enhancing pedagogical competence of teachers in terms of ability to engage was accounted by pedagogical skills. The remaining 57.90% was accounted by some training engagements not involved in the study.

Considering the training engagement of the teachers, pedagogical skills found to be the best predictor of the teachers' pedagogical competence in terms of inspire students. The findings imply that pedagogical skills play a significant role in enhancing teachers' competence to inspire students. Teachers who apply effective instructional methods are more likely to motivate learners and foster a love for learning because they allow teachers to present lessons in meaningful, relatable, and creative ways that spark curiosity and enthusiasm. Through effective strategies like storytelling, real-life applications, and interactive activities, teachers can connect with students on both intellectual and emotional levels. This ability to make learning exciting and relevant encourages students to develop a love for learning and see education as something valuable and inspiring.

Zakaria and Daud (2021) discussed that teachers who master diverse teaching strategies can create emotionally engaging lessons that spark student interest.

Table 7 Summary of the influence of the training engagement on the enhancing pedagogical competence

Training Engagement	Teaching Skills	Content Knowledge	Ability to Engage	Inspire Students
	t-value	t-value	t-value	t-value
(Constant)	5.391	6.371	6.908	6.846
Pedagogical skills	3.403**	4.773**	3.467**	3.810**
Hands-on Laboratory	1.551	0.320	0.891	0.782

Technical Competence	0.764	1.518	0.264	0.397
Laboratory Management	1.952*	0.864	1.173	1.224

$R^2 = 0.492$	$R^2 = 0.421$	$R^2 = 0.422$	$R^2 = 0.403$
$Prob. = 0.000$	$Prob. = 0.000$	$Prob. = 0.000$	$Prob. = 0.000$
$F - Value = 12.237$	$F - Value = 9.280$	$F - Value = 9.279$	$F - Value = 8.595$

Relationship of the Utilization of Science Equipment and Enhancing Pedagogical Competence

Safety Practices

Table 8 presents the relationship between the utilization of science equipment and enhancing pedagogical competence. The correlation matrix shows that safety practices had a significant relationship with all the parameters used to measure in enhancing pedagogical competence of teachers in terms of teaching skills (corr. coef.=0.372** with a p-value of 0.005); content knowledge (corr. coef.=0.291* with a p-value of 0.029); ability to engage (corr. coef.=0.345** with a p-value of 0.009); and inspire students (corr. coef.=0.348** with a p-value of 0.008).

The result means that the utilization of science equipment like safety practices are highly significant in enhancing pedagogical competence of teachers. The presented probability values which are less than the set 1% level of significance means that the stated hypothesis on this aspect of the study is rejected. This indicates that the higher the level of safety practices, the higher is their ability to enhance their overall pedagogical competence.

The findings imply that safety practices in the utilization of science equipment significantly enhance teachers' pedagogical competence, particularly in teaching skills, content knowledge, and the ability to engage and inspire students. Ensuring safety allows teachers to deliver hands-on science instruction with confidence and effectiveness.

Asabere and Adzrolo (2020) emphasized that science teachers who follow safety protocols demonstrate higher competence in conducting experiments and facilitating active learning. Similarly, Manurung and Suryani (2021) found that teachers well-versed in laboratory safety can better manage classroom activities, thereby enhancing content delivery and student participation.

Maintenance and Care

On maintenance and care, the relationship between the utilization of science equipment and enhancing pedagogical competence. The correlation matrix shows that maintenance and care had a significant relationship with all the parameters used to measure in enhancing pedagogical competence of teachers in terms of teaching skills (corr. coef.=0.381** with a p-value of 0.004); content knowledge (corr. coef.=0.299* with a p-value of 0.025); ability to engage (corr. coef.=0.403** with a p-value of 0.002); and inspire students (corr. coef.=0.390** with a p-value of 0.003).

The result means that the utilization of science equipment like maintenance and care are highly significant in enhancing pedagogical competence of teachers. The presented probability values which are less than the set 1% level of significance means that the stated hypothesis on this aspect of the study is rejected. This further means that the higher the level of maintenance and care in the utilization of science equipment, the greater the enhancement of teachers' pedagogical competence.

The findings imply that proper maintenance and care in the utilization of science equipment significantly enhance teachers' pedagogical competence, particularly in teaching skills, content knowledge, and the ability to engage and inspire students. Well-maintained tools support effective instruction and meaningful hands-on learning.

Adebayo and Omole (2020) discussed that teachers who consistently maintain laboratory tools are better able to plan and execute practical lessons, thereby strengthening their teaching skills and content mastery.

Technical Proficiency

On technical proficiency, the relationship between the utilization of science equipment and enhancing pedagogical competence. The correlation matrix shows that technical proficiency had a significant relationship with all the parameters used to measure in enhancing pedagogical competence of teachers in terms of teaching skills (corr. coef.=0.437** with a p-value of 0.001); content knowledge (corr. coef.=0.405** with a p-value of 0.002); ability to engage (corr. coef.=0.414** with a p-value of 0.002); and inspire students (corr. coef.=0.341* with a p-value of 0.010).

The result means that the utilization of science equipment like technical proficiency is highly significant in enhancing pedagogical competence of teachers. The presented probability values which are less than the set 1% level of significance means that the stated hypothesis on this aspect of the study is rejected. This further indicates that greater technical proficiency in the use of science equipment leads to a higher level of pedagogical competence among teachers.

The findings imply that technical proficiency in the use of science equipment significantly enhances teachers' pedagogical competence, especially in teaching skills, content knowledge, and the ability to engage and inspire students. Mastery in handling equipment enables teachers to deliver more effective, interactive, and meaningful science instruction.

Rahman and Abdullah (2021), science teachers with strong technical skills are more confident and effective in delivering laboratory-based lessons, which strengthens both their teaching and subject matter expertise.

Experimental and Procedure

On experimental and procedure, the relationship between the utilization of science equipment and enhancing pedagogical competence. The correlation matrix shows that experimental and procedure had a significant relationship with all the parameters used to measure in enhancing pedagogical competence of teachers in terms of teaching skills (corr. coef.=0.472** with a p-value of 0.000); content knowledge (corr. coef.=0.375** with a p-value of 0.004); ability to engage (corr. coef.=0.513** with a p-value of 0.000); and inspire students (corr. coef.=0.472** with a p-value of 0.000).

The result means that the utilization of science equipment like experimental and procedure is highly significant in enhancing pedagogical competence of teachers. The presented probability values which are less than the set 1% level of significance means that the stated hypothesis on this aspect of the study is rejected. This indicates that greater mastery of experimental procedures and the effective use of science equipment contribute to a higher level of pedagogical competence among teachers.

The results imply that teachers' proficiency in conducting experiments and following scientific procedures using laboratory equipment significantly contributes to the enhancement of their pedagogical competence particularly in developing teaching skills, deepening content knowledge, and strengthening their ability to engage and inspire students.

Ahmed and Khan (2021) mentioned that teachers who are well-versed in scientific procedures can better explain concepts and demonstrate experiments, leading to deeper student understanding.

Ethical and responsible Use

On ethical and responsible use, the relationship between the utilization of science equipment and enhancing pedagogical competence. The correlation matrix shows that ethical and responsible use had a significant relationship with all the parameters used to measure in enhancing pedagogical competence of teachers in terms of teaching skills (corr. coef.=0.565** with a p-value of 0.000); content knowledge (corr. coef.=0.494** with a p-value of 0.004); ability to engage (corr. coef.=0.628** with a p-value of 0.000); and inspire students (corr. coef.=0.625** with a p-value of 0.000).

The result means that the utilization of science equipment like ethical and responsible use are highly significant in enhancing pedagogical competence of teachers. The presented probability values which are less than the set 1% level of significance means that the stated hypothesis on this aspect of the study is rejected. This indicates that the more ethical and responsible the use of science equipment, the greater the enhancement of teachers' pedagogical competence.

The results imply that the ethical and responsible use of science equipment plays an important role in enhancing teachers' pedagogical competence, especially in refining their teaching skills, deepening content knowledge, and strengthening their ability to effectively engage and inspire students.

Jackson and Lee (2021) emphasized that teachers who adhere to ethical practices when using laboratory equipment create a safer and more conducive learning environment, which enhances their instructional skills and content delivery.

Table 8 Correlation matrix showing the utilization of science equipment and enhancing pedagogical competence.

<i>Spearman Rho</i>					
		Teaching Skills	Content Knowledge	Ability to Engage	Inspire Students
Utilization of Science Equipment					
Safety Practices	Cor. Coef.	0.372**	0.291*	0.345**	0.348**
	Probability	0.005	0.029	0.009	0.008
Maintenance and care	Cor. Coef.	0.381**	0.299*	0.403**	0.390**
	Probability	0.004	0.025	0.002	0.003
Technical Proficiency	Cor. Coef.	0.437**	0.405**	0.414**	0.341*
	Probability	0.001	0.002	0.002	0.010
Experimental and procedure	Cor. Coef.	0.472**	0.375**	0.513**	0.472**
	Probability	0.000	0.004	0.000	0.000
Ethical and responsible use	Cor. Coef.	0.565**	0.494**	0.628**	0.625**
	Probability	0.000	0.000	0.000	0.000

**Correlation is significant at the 0.01 level.

*.Correlation is significant at the 0.05 level.

Influence of the Utilization of Science Equipment on Enhancing Pedagogical Competence

Utilization of Science Equipment on Teaching Skills

Table 9 shows the combined effect of the utilization of science equipment did not significantly influence in enhancing pedagogical competence in terms of teaching skills (F-value = 3.058, Probability = 0.017). The stated hypothesis of the study was accepted because the probability value is significantly greater than 0.050 level of significance.

Result implies that the utilization of science equipment did not significantly influence the enhancement of teachers' pedagogical competence in terms of teaching skills because the mere use of equipment does not automatically translate to improved instructional practices. Teaching skills require intentional pedagogical planning, effective classroom management, and adaptive instructional methods—elements that go beyond technical use. If teachers are not sufficiently trained in integrating science tools into their lesson delivery or if equipment is used in a routine, non-reflective manner, its impact on pedagogy remains limited.

Kim and Tan (2020) discussed that merely having access to or using equipment is insufficient, teachers must be trained to align its use with clear pedagogical goals. Nguyen and Phan (2021) emphasized that without proper training and reflective practice, the use of science equipment may become procedural rather than pedagogically meaningful. This means that professional development focused on instructional design and strategic equipment use is essential for translating resources into improved teaching skills.

Utilization of Science Equipment on Content Knowledge

On content knowledge, the combined effect of the utilization of science equipment significantly influenced in enhancing pedagogical competence in terms of content knowledge (F-value = 2.297, Probability = 0.050). The stated hypothesis of the study was rejected because the probability value is significantly lesser than 0.050 level of significance.

In fact, 18.70% of the variation of enhancing pedagogical competence of teachers in terms of content knowledge was accounted by ethical and responsible use. The remaining 81.30% was accounted by some training engagements not involved in the study.

Considering the training engagement of the teachers, ethical and responsible use found to be the significant predictor of the teachers' pedagogical competence in terms of content knowledge. Result implies that ethical and responsible use of science equipment plays a vital role in enhancing teachers' pedagogical competence, particularly by strengthening their content knowledge because it reflects a deeper understanding of both the scientific process and the instructional content. When teachers use equipment properly and ethically, they demonstrate a strong grasp of scientific principles, safety protocols, and the correct procedures for conducting experiments.

Hassan and Yilmaz (2021) explained that teachers uphold ethical standards in laboratory procedures, they ensure the reliability of scientific demonstrations, which strengthens content mastery.

Utilization of Science Equipment on Ability to Engage

On ability to engage, the combined effect of the utilization of science equipment significantly influenced in enhancing pedagogical competence in terms of ability to engage (F-value = 3.015, Probability = 0.019). The stated hypothesis of the study was rejected because the probability value is significantly lesser than 0.050 level of significance.

In fact, 23.20% of the variation of enhancing pedagogical competence of teachers in terms of ability to engage was accounted by ethical and responsible use. The remaining 76.80% was accounted by some training engagements not involved in the study.

Considering the training engagement of the teachers, ethical and responsible use found to be the significant predictor of the teachers' pedagogical competence in terms of ability to engage. Result implies that the ethical and responsible use of science equipment significantly contributes to improving teachers' pedagogical competence, particularly by enhancing their ability to actively engage and connect with students during instruction because it directly influences how teachers create meaningful, safe, and trustworthy learning experiences. When teachers handle materials responsibly following safety protocols, respecting proper procedures, and modeling ethical behavior, they build an environment where students feel secure, respected, and motivated to participate. This responsible behavior fosters trust and credibility, making students more likely to engage in the lesson.

Kim and Park (2021) found that when teachers model ethical laboratory practices, students are more likely to stay engaged and feel secure in hands-on learning environments.

Utilization of Science Equipment on Inspire Students

On inspire students, the combined effect of the utilization of science equipment significantly influenced in enhancing pedagogical competence in terms of inspire students (F-value = 2.678, Probability = 0.032). The stated hypothesis of the study was rejected because the probability value is significantly lesser than 0.050 level of significance.

In fact, 21.10% of the variation of enhancing pedagogical competence of teachers in terms of inspire students was accounted by ethical and responsible use. The remaining 78.90% was accounted by some training engagements not involved in the study.

Considering the training engagement of the teachers, ethical and responsible use found to be the significant predictor of the teachers' pedagogical competence in terms of inspire students. Result implies that the ethical and responsible use of science equipment significantly contributes to the development of teachers' pedagogical competence, particularly by strengthening their capacity to inspire, motivate, and positively influence student learning experiences because it reflects a teacher's integrity, professionalism, and commitment to excellence, qualities that naturally motivate and influence learners. When students observe a teacher using materials with care, accuracy, and ethical judgment, they see a strong model of how science should be practiced not just as a subject, but as a responsible and meaningful discipline.

Zhou and Brown (2021) found that when teachers demonstrate integrity and responsibility in science instruction, students are more likely to develop respect for scientific practices and feel motivated to explore scientific concepts.

Table 9 Summary of the influence of the **utilization of science equipment on the enhancing pedagogical competence**

Utilization of Science Equipment	Teaching Skills	Content Knowledge	Ability to Engage	Inspire Students
	t-value	t-value	t-value	t-value
(Constant)	7.014	7.688	8.734	8.580
Safety Practices	0.573	0.343	1.498	1.182
Maintenance and Care	0.486	0.374	0.149	0.674
Technical Proficiency	1.619	1.301	1.050	0.346
Experimental & Procedure	0.068	0.863	0.083	0.364
Ethical & Responsible Use	1.619	2.057*	2.090*	2.320*
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	$R^2 = 0.234$	$R^2 = 0.187$	$R^2 = 0.232$	$R^2 = 0.211$
	Prob.= 0.017	Prob. = 0.050	Prob.= 0.019	Prob.= 0.032
	F – Value = 3.058	F-Value=2.297	F-Value =3.015	F-Value =2.678

SUMMARY, CONCLUSIONS and RECOMMENDATIONS

Summary of Findings

The study explored the training engagement and utilization of science equipment in enhancing pedagogical competence in the Province of Cotabato during the school year 2024-2025. It specifically determined the level of training engagement; level of the utilization of science equipment; and the level of enhancing pedagogical competence of teachers.

Further, it determined the significant relationship between training engagement and enhancing pedagogical competence of teachers; the significant influence of training engagement on the enhancing pedagogical competence.

Moreover, the significant relationship between utilization of science equipment and enhancing pedagogical competence of teachers; and the significant influence of the utilization of science equipment and enhancing pedagogical competence. However, this study identified the challenges and coping practices in enhancing pedagogical competence of teachers. Moreover, this study offered intervention and policy formulation that can be crafted based on the results.

This research employed a quantitative approach to enhance the depth of gathered information and ensure data validity. A descriptive-correlational research design was utilized for quantitative analysis, involving 300 science teacher respondents selected through complete enumeration. A self-made instrument was employed for data collection. The reliability test using Cronbach's Alpha yielded scores of .968, .979, and .966 based on a sample of 20, indicating highly reliable of the instrument. The data collection procedure involved formal communication addressed to the Schools Division Superintendents. Statistical tools used included the mean for descriptive analysis, while Spearman rho and multiple linear regression were applied to test the hypotheses.

The study disclosed that teachers demonstrated a highly engaged on the level of training engagement, particularly in developing their pedagogical skills. Moreover, they actively all engaged in hands-on laboratory activities, enhanced their technical competence, and effectively managed laboratory environments.

It revealed also that teachers highly practiced on the utilization of science equipment, particularly in terms of ethical and responsible use, safety practices, and experimentation and procedures. Meanwhile, maintenance and care, as well as technical proficiency, were also consistently practiced by the teachers.

However, teachers demonstrated highly competent level of pedagogical competence, particularly in teaching skills, content knowledge, and their ability to engage and inspire students.

On the relationship, the study revealed that training engagement key areas highly significant to all dimensions measured in enhancing pedagogical competence of teachers.

On the influence, pedagogical skills highly influenced on the teaching skills, content knowledge, ability to engage, and inspire students. While teaching skills were influenced by pedagogical skills and laboratory management.

The utilization of science equipment key areas highly significant to all dimensions measured in enhancing pedagogical competence of teachers.

Moreover, ethical and responsible use of science equipment significantly influenced on teaching skills, content knowledge, ability to engage, and inspire students.

Conclusions

Based on the findings of the study, the following conclusions were drawn:

Teachers were highly engaged in training activities, particularly in developing their pedagogical skills. They engaged in hands-on laboratory activities, improving their technical competence and effectively managing laboratory environments.

Additionally, teachers highly practiced the ethical and responsible use of science equipment, with a strong focus on safety, and experimentation and procedures. While maintenance, care, and technical proficiency were also practiced, these elements were less emphasized.

Teachers demonstrated a high level of pedagogical competence, excelling in teaching skills, content knowledge, and their ability to engage and inspire students.

Teachers' training engagements and enhancing pedagogical competence were significantly related.

Pedagogical skills of teachers contributed to the teaching skills, content knowledge, ability to engage, and inspire students. While teaching skills were influenced by pedagogical skills and laboratory management.

The utilization of science equipment and enhancing pedagogical competence were significantly associated.

Ethical and responsible use of science equipment contributed on the teaching skills, content knowledge, ability to engage, and inspire students.

Recommendations

1. District Supervisors may continue to support and expand training programs for teachers, focusing on enhancing their pedagogical skills and technical competence. Increased emphasis should be placed on hands-on laboratory activities and fostering effective laboratory management to ensure teachers remain up to date with evolving educational practices.

2. School Administrators. It is essential for school administrators to provide ongoing professional development that addresses both pedagogical and technical aspects to strengthen teachers' ability to engage and inspire students.

3. Teachers should be encouraged to maintain their commitment to ethical and responsible use of science equipment while further developing their expertise in maintenance and care to ensure long-term sustainability.

4. Students. should prioritize safety and responsible behavior in laboratory settings, as it not only contributes to their own learning experience but also ensures a conducive and safe learning environment for them.

5. Future Researchers are encouraged to explore the long-term impacts of these teaching practices on student outcomes and investigate how they can be further optimized to foster higher levels of engagement and learning.

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Authors' Biography

RONA P. TRASPE, a devoted Christian, was born on August 28, 1985, in the serene community of Dungo-an, Mlang, Cotabato. She embodies the dynamic traits often associated with it—versatility, determination, and a strong sense of purpose. Throughout her life and career, she has consistently demonstrated a deep commitment to personal growth, academic excellence, and public service, guided by the values of perseverance, confidence, and an unwavering desire to make a difference.

Mrs. Traspe is a dedicated professional educator and a committed public servant under the Department of Education. She currently holds the position of Teacher II at Mlang National High School, located in the Mlang Central District and that holds the tagline "In Mlang National High School, EXCELLENCE is ou Business". Her role as a classroom teacher and Chairman of Grade 8 Curriculum goes beyond instruction; he serves as a mentor, role model, and leader within his school and community.

Her academic achievements reflect her passion for lifelong learning and her drive to improve the quality of education in her locality. She holds a Master of Arts in Education, major in Educational Administration, from Central Mindanao Colleges, equipping her with strong leadership and managerial competencies essential for educational leadership roles. She also holds a Bachelor of Secondary Education from Southern Baptist College, which laid the foundation for her teaching career.

With her rich educational background, extensive teaching experience, and genuine dedication to student development and community upliftment, her journey is a testament to what passion, hard work, and faith can accomplish in the pursuit of excellence in public service and education.

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