Assessing Grade 10 Learners' Physics Vocabulary Anxiety in Design Thinking Process

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DOI: https://doi.org/10.51584/IJRIAS.2025.100500026

Received: 25 April 2025; Accepted: 06 May 2025; Published: 03 June 2025

ABSTRACT

The Design Thinking Process (DTP) is an iterative and flexible teaching approach consisting of five phases—empathize, define, ideate, prototype, and test—that encourages student collaboration to solve complex problems. This research study investigates the effects of Design Thinking Process on the physics vocabulary anxiety of the Grade-10 ABM learners of Quezon Bukidnon Comprehensive National High School during the second quarter of the 2023-2024 academic year. The study aims to examine 1. The level of learners' physics vocabulary anxiety when exposed to DTP and those in non-DTP; and 2. Identify any significant difference in the learners' physics vocabulary anxiety when exposed to DTP and those in non-DTP. This study used a quasi-experimental research design. The participants were seventy-five (75) grade10 ABM learners who were enrolled in physics. This study adopted a twelve (12) item survey questionnaire which is the Physics Vocabulary Classroom Anxiety Scale (PVCAS) with a Cronbach alpha of .80. The level of learners' physics vocabulary anxiety is determined using descriptive statistics, while Analysis of Covariance (ANCOVA) was used to determine the significant difference between groups. The study found that following the intervention, the DTP group exhibited a reduction in physics vocabulary anxiety, shifting from high anxiety during the pretest to moderate anxiety post-intervention. In contrast, the non-DTP group maintained consistently high anxiety levels both before and after the intervention. Additionally, the results revealed a significant difference in the levels of physics vocabulary anxiety between learners exposed to DTP and those exposed to non-DTP. These findings suggest that, despite physics being perceived as a challenging subject, the collaborative nature of the DTP approach effectively alleviated learners' anxiety.

Keywords: design thinking process, define, empathize, ideate, physics vocabulary anxiety, prototype, teaching approach, and test

INTRODUCTION

Science education in the Philippines has undergone significant changes in recent years, as the country continues to recognize its vital role in shaping learners' critical thinking, creativity, and problem-solving abilities. The implementation of the K to 12 Basic Education Curriculum marked a shift toward more student-centered and inquiry-based approaches, bringing science instruction closer to international standards. Among the various scientific disciplines, Physics stands out, not only for its real-world applications but also for its contributions to technological progress and national development. In response, Filipino educators and institutions have taken meaningful steps to make Physics more accessible and engaging for both junior and senior high school students.

Despite these efforts, many students, especially those in junior high, still find Physics to be one of the most difficult subjects. It's often seen as abstract and math-heavy, which can make it hard for students to understand and stay motivated (Mkpanang, 2016). Research also shows that students tend to feel frustrated or discouraged by the subject (Solis & Orale, 2017), and this fear can lead to anxiety that negatively impacts learning

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume X Issue V May 2025

outcomes (Putranta & Jumadi, 2019). This ongoing struggle points to a gap between what the curriculum aims to achieve and how students are actually performing.

One overlooked factor is the anxiety students feel when faced with Physics vocabulary. These terms can seem foreign and mentally overwhelming, making it harder for learners to engage in class or fully grasp concepts. Studies show that students often misinterpret terms like “work,” “force,” or “weight,” leading to confusion and incorrect assumptions (Mallow & Kastrup, 2023). For example, some might believe that greater constant velocity means greater force, or that momentum and force are the same (Taibu et al., 2015). This kind of vocabulary anxiety can be especially challenging for Grade 10 students, who are at a key point in their academic journey. Helping them overcome this anxiety is crucial for building both confidence and competence in the subject.

While some level of anxiety is normal and can even serve as motivation to study or complete tasks (Hooda & Saini, 2017), it becomes a problem when it starts to feel overwhelming (Besoyo & Tancinco, 2016). That’s why it’s important to understand how anxiety affects learning in Physics, and to find ways to reduce its negative impact.

One promising approach is the use of Design Thinking in the classroom. This creative, problem-solving process focuses on empathy, exploration, and collaboration (Panke, 2019). By encouraging students to brainstorm, experiment, and work together, Design Thinking can make learning more engaging and less intimidating. Applying this method to Physics education may help students better understand complex vocabulary, feel less anxious, and connect more meaningfully with the subject. Exploring how Grade 10 students experience vocabulary anxiety through the lens of Design Thinking could offer valuable insights into improving Physics instruction in the Philippines.

Objectives of the Study

The study investigates the effects of Design Thinking Process on the physics vocabulary anxiety of the Grade-10 ABM learners at Quezon Bukidnon Comprehensive National High School during the second quarter of the 2023-2024 academic year. Specifically, it aims to:

1. Determine the learners’ level of physics vocabulary anxiety when exposed to DTP and those in non-DTP; and
2. Identify any significant difference in the learners’ level of physics vocabulary anxiety when exposed to DTP and those in non-DTP.

METHODOLOGY

Research Design

This study utilized a quasi-research experimental design to examine the learners’ level of physics vocabulary anxiety in Design Thinking Process. The aim is to analyze the effectiveness of Design Thinking Process in alleviating anxiety of the learners in learning Physics. The research will focus on Grade 10 ABM learners at Quezon Bukidnon Comprehensive National High School.

Participants and Sampling Method

The participants of the study were from two (2) heterogeneous sections of Grade 10 ABM at Quezon Bukidnon Comprehensive National High School (QBCNHS) in Mibando, Quezon, Bukidnon. The participants were selected using a random sampling method and the sections were randomly assigned to either the DTP group or the non-DTP group. One of the identified groups was exposed to Design Thinking Process (DTP) and the other was exposed to non-Design Thinking Process (non-DTP). The two sections included forty-three (43) students, who was exposed to the Design Thinking Process (DTP), and thirty-two (32) students, was exposed to the Non-Design Thinking Process (Non-DTP).

Data Collection Methods

Before the data collection, the researcher obtained approval from the Institutional Ethical Review Committee (IERC) at Central Mindanao University to ensure the study adhered to ethical research standards. Subsequently, formal permission was sought from the relevant administrative offices to conduct the study within their institutions. A pilot test of the survey instrument, which is the Physics Vocabulary Classroom Anxiety Scale (PVCAS) adapted from Taibu and Ferrari-Bridgers (2020), comprised twelve (12) items, was conducted with Grade 11 learners at Quezon Bukidnon Comprehensive National High School to ensure the instrument's reliability and appropriateness for the target population. The survey demonstrated high internal consistency with a Cronbach’s alpha value of .80, confirming its reliability.

The instrument utilized a 5-point Likert scale for measuring anxiety levels, with participants rating statements on physics vocabulary anxiety ranging from 'Strongly Disagree' (1), ‘Disagree’ (2), ‘Uncertain’ (3), ‘Agree’ (4), and 'Strongly Agree' (5). Next, the researcher implemented the Design Thinking Process (DTP). The same survey was administered to the participants both before and after their exposure to the Design Thinking Process (DTP), allowing for the measurement of changes in anxiety levels resulting from the intervention.

Research Questions

Aligned with the objectives, the study seeks to answer the following:

1. What is the learners’ level of physics vocabulary anxiety when exposed to DTP and those in non-DTP; and
2. Is there any significant difference in the learners’ level of physics vocabulary anxiety when exposed to DTP and those in non-DTP.

Data Analysis

Data from the survey was analyzed using an SPSS (Statistical Package for the Social Sciences). The quantitative data was analyzed using descriptive statistics examining the learners’ level of physics vocabulary anxiety in Physics and Analysis of Covariance (ANCOVA) was used to examine any significant differences in the learners’ level of physics vocabulary anxiety before and after exposure to Design Thinking Process (DTP) and those exposed to non-Design Thinking Process (non-DTP).

Ethical Considerations

The study adheres to ethical research protocols. Informed consent was obtained from both participants and their parents, ensuring that the learners comprehended the study's objectives and voluntarily agreed to participate. The consent documents emphasized confidentiality and anonymity, with participants required to sign them. All data will be kept confidential, and the identities of participants will not be disclosed in the presentation of the results.

RESULTS AND DISCUSSION

This section presents the level of learner’s Physics vocabulary anxiety when they are exposed to Design Thinking Process (DTP) and non-Design Thinking Process (non-DTP). The level of anxiety was shown in Table 1 and Table 2 through a statistical analysis of students mean scores with corresponding qualitative interpretation.

Level of Learners’ Physics Vocabulary Anxiety When Exposed to Design Thinking Process (DTP) and Those Exposed to non-Design Thinking Process (non-DTP)

Physics vocabulary anxiety refers to the feelings of apprehension or stress that learners experienced when encountering the complex and abstract terminology used in Physics, such as force, waves, electromagnetic fields, and others.

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume X Issue V May 2025

Table 1. Learners' Level of Physics Vocabulary Anxiety in Pretest.

Indicators	Pretest			
	DTP		Non-DTP	
	Mean	QI	Mean	QI
1. I get nervous and confused when I am speaking the technical language of Physics in class.*	3.95	HA	3.66	HA
2. I am afraid that the other students will laugh at me when I speak the technical language of Physics.*	3.95	HA	4.25	HA
3. I get nervous when I don't understand every Physics term the Physics instructor says.*	3.91	HA	3.59	HA
4. I always feel that the other students speak the technical language of Physics better than I do. *	3.86	HA	3.41	MA
5. I feel more tense and nervous in my Physics class than in my other classes due to the vocabulary of Physics.*	3.86	HA	3.22	MA
6. I start to panic when I have to define terms without preparation in Physics class.*	3.79	HA	3.56	HA
7. I am afraid that my Physics instructor is ready to correct every Physics vocabulary mistake I make.*	3.74	HA	3.63	HA
8. Even if I am well prepared for Physics class, I feel anxious about the Physics terminology.*	3.72	HA	3.47	MA
9. In Physics class, I can get so nervous if I forget the technical terms I know.*	3.70	HA	3.31	MA
10. I feel very self-conscious about speaking the technical language of Physics in front of other students*	3.67	HA	3.50	HA
11. I feel overwhelmed by the number of definitions/ terminologies you have to learn to understand Physics.*	3.58	HA	3.41	MA
12. It frightens me when I don't understand the Physics terms.*	3.19	MA	3.28	MA
OVERALL MEAN	3.74	HA	3.52	HA

*negative indicators (scoring is reversed)

Legend: Legend: (for reverse scoring)

Scale	Range	Qualitative Interpretation	Qualitative Statement	Scale	Range	Qualitative Interpretation	Qualitative Statement
5	4.50-5.00	Very Low Anxiety (VLA)	Confident	5	4.50-5.00	Very High Anxiety (VHA)	Overwhelming
4	3.50-4.49	Low Anxiety (LA)	Comfortable	4	3.50-4.49	High Anxiety (HA)	Strenuous
3	2.50-3.49	Moderate Anxiety (MA)	Manageable	3	2.50-3.49	Moderate Anxiety (MA)	Manageable
2	1.50-2.49	High Anxiety (HA)	Strenuous	2	1.50-2.49	Low Anxiety (LA)	Comfortable
1	1.00-1.49	Very High Anxiety (VHA)	Overwhelming	1	1.00-1.49	Very Low Anxiety (VLA)	Confident

As shown in table 1, the DTP group obtained an overall mean score of 3.74, indicating High Anxiety while the non-DTP group obtained an overall mean score of 3.52, which was interpreted as High Anxiety. This means that, before exposure to either the DTP or non-DTP environments, both groups exhibited high levels of anxiety, reflecting a strenuous difficulty that they encountered when learning Physics vocabularies. The findings overall mean revealed that anxiety levels were uniformly elevated across both groups prior to any interventions.

The DTP group's highest mean of 3.95, which states, "*I get nervous and confused when I am speaking the technical language of Physics in class*" and *"I am afraid that the other students will laugh at me when I speak* *the technical language of Physics"* were both interpreted as High Anxiety. In contrast, the lowest mean was 3.19, which corresponds to the statement *"It frightens me when I don't understand the Physics terms."* was interpreted as Moderate Anxiety. All twelve (12) indicators were found to represent High Anxiety, except for one, with a mean of 3.19, which was categorized as Moderate Anxiety. Meanwhile, the *"I am afraid that the other students will laugh at me when I speak the technical language of Physics"* indicator showed the highest mean of 4.25 of the non-DTP group which was interpreted as High Anxiety while the lowest indicator mean of 3.22, which states *"I feel more tense and nervous in my Physics class than in my other classes due to the vocabulary of Physics."* was interpreted as Moderate Anxiety.

Based on the findings, both groups' highest mean corresponded to the same indicator *"I am afraid that the other students will laugh at me when I speak the technical language of Physics*". In the academic realm, particularly in the context of Physics, students often experience high levels of anxiety that may negatively impact their performance and learning experiences. One of the primary sources of this anxiety stems from the fear of being judged by peers, particularly the apprehension that fellow students will laugh at or ridicule them when they attempt to communicate using the technical language of Physics. This phenomenon is commonly referred to as social anxiety, which occurs when individuals feel that their performance may be scrutinized by others. The fear of judgment in the classroom, particularly regarding technical language, may hinder students' ability to fully engage with the subject, impacting their learning process.

Hence, the comparable levels of physics vocabulary anxiety observed in both groups prior to the intervention establish a reliable baseline. This allows for a more accurate evaluation of the intervention's potential impact on learners' anxiety levels.

Table 2. Learners' Level of Physics Vocabulary Anxiety in Posttest.

Indicators	Posttest			
	DTP		Non-DTP	
	Mean	QI	Mean	QI
1. I feel very self-conscious about speaking the technical language of Physics in front of other students*	3.51	HA	3.84	HA
2. I always feel that the other students speak the technical language of Physics better than I do. *	3.47	MA	3.91	HA
3. I feel more tense and nervous in my Physics class than in my other classes due to the vocabulary of Physics.*	3.40	HA	4.00	HA
4. I get nervous and confused when I am speaking the technical language of Physics in class.*	3.37	MA	3.66	HA
5. I start to panic when I have to define terms without preparation in Physics class.*	3.35	MA	3.84	HA
6. I feel overwhelmed by the number of definitions/terminologies you have to learn to understand Physics.*	3.33	MA	3.66	HA
7. Even if I am well prepared for Physics class, I feel anxious about the Physics terminology.*	3.30	MA	3.81	HA
8. I get nervous when I don't understand every Physics term the Physics instructor says.*	3.30	MA	4.00	HA
9. In Physics class, I can get so nervous if I forget the technical terms I know.*	3.26	MA	3.97	HA
10. It frightens me when I don't understand the Physics terms.*	3.19	MA	3.59	HA
11. I am afraid that the other students will laugh at me when I speak the technical language of Physics.*	3.16	MA	4.31	HA
12. I am afraid that my Physics instructor is ready to correct every Physics vocabulary mistake I make.*	3.09	MA	3.69	HA
OVERALL	3.31	MA	3.86	HA

*negative indicators (scoring is reversed)

Legend: Legend: (for reverse scoring)

Scale	Range	Qualitative Interpretation	Qualitative Statement	Scale	Range	Qualitative Interpretation	Qualitative Statement
5	4.50-5.00	Very Low Anxiety (VLA)	Confident	5	4.50-5.00	Very High Anxiety (VHA)	Overwhelming
4	3.50-4.49	Low Anxiety (LA)	Comfortable	4	3.50-4.49	High Anxiety (HA)	Strenuous
3	2.50-3.49	Moderate Anxiety (MA)	Manageable	3	2.50-3.49	Moderate Anxiety (MA)	Manageable
2	1.50-2.49	High Anxiety (HA)	Strenuous	2	1.50-2.49	Low Anxiety (LA)	Comfortable
1	1.00-1.49	Very High Anxiety (VHA)	Overwhelming	1	1.00-1.49	Very Low Anxiety (VLA)	Confident

As shown in Table 2, after exposure, DTP learners have moderate anxiety regarding Physics vocabulary anxiety after being exposed to DTP. This conforms to Huyen (2023) study that Design Thinking Process not only enhances students' problem-solving skills but also contributes to reducing anxiety related to Physics terminologies through engaging and practical learning experiences. By integrating educational technologies, design creativity, and therapy into the design practice, students can engage in anti-stress processes that promote self-actualization, decrease anxiety, and help manage depressive conditions (Skliarenko et al., 2022). In addition, moderate anxiety can increase students' motivation to engage with the learning material. It often triggers a sense of alertness and a desire to overcome the challenges posed by anxiety-inducing tasks. According to Prasetya et al. (2022), moderate anxiety can improve motivation in Physics learning, as it encourages students to push through their discomfort and focus more on mastering the material.

On the other hand, the non-DTP group experienced a high level of anxiety. The heightened anxiety of the students may be attributed to the traditional teaching methods used by the teacher, who did not incorporate modern, interactive, or student-centered approaches. This is supported by the study of Molin et al. (2022), which examined the effect of traditional instruction on students' academic performance and found that traditional methods increase students' anxiety level. Traditional teaching methods often rely heavily on rote memorization and passive learning, which may not engage students adequately or address their individual needs. This can lead to increased stress and anxiety when dealing with complex subjects like Physics (Samifanni & Gumanit, 2020).

High anxiety can overwhelm cognitive resources, leading to difficulties in information processing, memory retention, and problem-solving. According to Mowen and Zhang (2020), high levels of anxiety can impair working memory, which is crucial for understanding and applying complex Physics concepts. It could reduce students' motivation to engage with the material. This lack of motivation can contribute to academic disengagement and ultimately hinder long-term learning (Zeidner (2014). These effects create a negative feedback loop, where anxiety undermines students' learning experiences, leading to further frustration and disengagement. As what Constantino et al. (2020) stated in the literature, anxiety can vary in intensity, from low levels that may motivate individuals to perform a task to higher levels that can disrupt daily functioning and learning processes. Such a high level of anxiety could negatively affect students' learning and performance.

After being exposed to the Design Thinking Process (DTP), learners exhibited a reduction in anxiety levels, shifting from high to moderate as indicated in the posttest results. In contrast, the non-DTP group maintained a consistent level of anxiety before and after their respective intervention. Hence, the use of DTP appears to contribute to the reduction of learners' physics vocabulary anxiety.

This section below presents the significant difference of learner's physics vocabulary anxiety when they are exposed to Design Thinking Process (DTP) and non-Design Thinking Process (non-DTP). The significant difference of the level of anxiety was shown in Table 3 by Analysis of Covariance (ANCOVA).

Significant Difference of Learners' Level of Physics Vocabulary Anxiety When Exposed to Design Thinking Process (DTP) and Those Exposed to non-Design Thinking Process (non-DTP)

Table 3. The Significant Difference of Learners' Level of Physics Vocabulary Anxiety

Groups	N	Mean		Std. Deviation	
DTP	43	3.31		.45	
Non-DTP	32	3.87		.21	
Total	75	3.55		.46	
Source	Type III sum of squares	df	Mean Square	F-value	Sig.
Corrected model	6.152[a]	2	3.076	23.458	.000
Pretest (Covariate)	.445	1	.445	3.392	.070
Group	6.079	1	6.079	46.358	.000**
Error	9.441	72	.131		
TOTAL	959.574	75			

Significant at p<0.05**

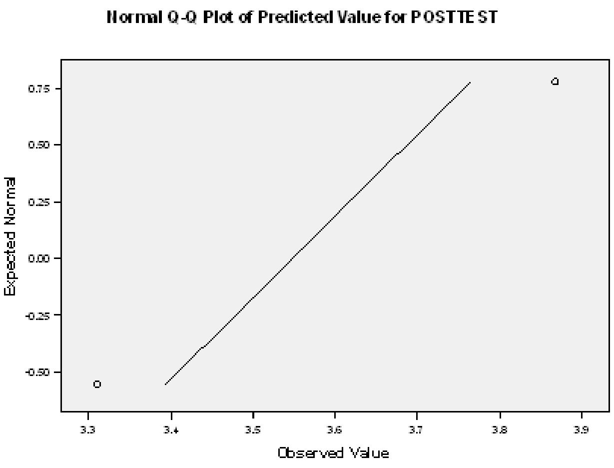
As shown in Table 3, learners in the DTP group had a mean score of 3.31 (n=43, SD=.45) which is higher compared to the non-DTP group having a mean score of 3.87 (n=32, SD=.21). The F-value between the two groups is 46.36 with a probability of 0.00 (P<0.05) indicating a highly significant difference. This implies that when learners were exposed to DTP, a significant difference was found and suggest that the intervention effectively promotes positive effects on learners' anxiety in physics.

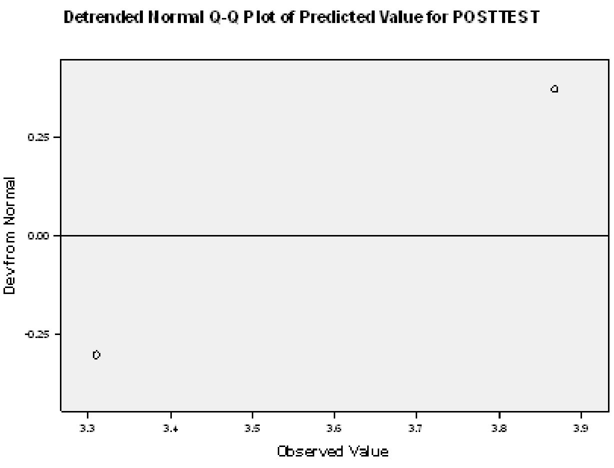
In addition, to ensure the validity of the ANCOVA analysis, the assumption of homogeneity of regression slopes was tested. This assumption states that the relationship between the covariate (pretest scores) and the dependent variable should be consistent across all groups. To test this assumption, an interaction term between the Group and Pretest variables was included in the analysis.

The interaction between Group and Pretest was found to be not statistically significant (p = 0.534), suggesting that the regression slopes for the pretest scores are homogeneous across the different groups. This result indicates that the effect of pretest scores on the dependent variable does not vary significantly between groups, allowing the assumption of homogeneity of regression slopes to be met.

Given this finding, it can be concluded that the relationship between pretest scores and the dependent variable is consistent across all groups, and therefore, the ANCOVA analysis is appropriate for evaluating group differences after controlling for the pretest scores.

Moreover, to test the assumption of normality of residuals, both visual and statistical methods were employed. The Normal Q-Q Plot showed that the residuals approximated a diagonal line, and the Detrended Q-Q Plot displayed a random scatter around a horizontal line, suggesting approximate normality. However, the Shapiro-Wilk test of normality was statistically significant, W(75) = .629, p < .001, indicating a deviation from normality. Given the large sample size and the relatively normal appearance of the plots, the violation may be considered minor and unlikely to substantially affect the validity of the ANCOVA results.





Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Predicted Value for POSTTEST	.378	75	.000	.629	75	.000

a. Lilliefors Significance Correction

Generally, the result showed a significant difference in the level of anxiety of the two (2) groups. This may imply that the Design Thinking Process (DTP) effectively reduces anxiety level in learners. Aini et al. (2022) state that the collaborative approach inherent in the DTP was anticipated to reduce anxiety levels among learners. By working together in teams, learners can share the cognitive load, offer mutual support, and foster a sense of belongingness. This collaborative environment mitigates individual stress and pressure and encourages open communication and the sharing of ideas especially when topics in Physics are considered challenging. As a result, students are likely to feel more confident and participative and less anxious about tackling complex problems.

Further research conducted by Fäldt and Stöhr (2017) aligns with the findings. They assert that collaborative learning activities within Physics courses play a crucial role in reducing learners' anxiety. By fostering a positive learning environment, these activities alleviate stress and enhance learners' performance, attitudes towards the subject, and interpersonal relationships among peers. This holistic improvement underscores the multifaceted benefits of collaborative learning. Hence, the Design Thinking Process (DTP) can create a safer and more supportive environments that encourage students to engage with challenging content without fear of embarrassment or failure.

CONCLUSION

This study assessed Grade 10 learners' Physics vocabulary anxiety within the context of the Design Thinking Process (DTP) and non-Design Thinking Process (non-DTP) instructional environments. Findings revealed that both groups initially exhibited high levels of vocabulary-related anxiety, with a common peak concern centered on the fear of peer judgment when using technical Physics language—an indication of prevalent social anxiety in the academic setting.

After intervention, learners exposed to the Design Thinking Process demonstrated a significant reduction in anxiety levels, transitioning from high to moderate anxiety. This outcome supports existing literature suggesting that DTP promotes learner engagement, reduces stress, and fosters a more inclusive environment through creative, hands-on, and empathetic learning practices. The immersive and student-centered nature of DTP appears to provide not only cognitive support but also emotional reassurance, allowing students to approach Physics vocabulary with greater confidence and reduced fear.

Conversely, the non-DTP group maintained a high level of anxiety after the same period, highlighting the limitations of traditional teaching approaches in addressing students' affective needs. The continued reliance on passive instructional strategies likely failed to mitigate the intimidation often associated with scientific terminologies. Such high anxiety can impair cognitive function, hinder motivation, and reduce overall academic performance, thereby creating a negative feedback loop that exacerbates students' struggles in Physics.

Furthermore, the results of this study revealed a statistically significant difference in the level of Physics vocabulary anxiety between learners exposed to the Design Thinking Process (DTP) and those to non-Design Thinking Process (non-DTP) methods.

This notable difference implies that the DTP not only serves as a content delivery method but also as an anxiety-reducing intervention. Its collaborative, empathetic, and student-centered nature fosters a supportive classroom climate where learners feel safer to express themselves and engage with difficult content.

In conclusion, this study demonstrates that integrating the Design Thinking Process into Physics education is not only beneficial for enhancing conceptual understanding but also crucial for addressing affective barriers to learning, such as vocabulary anxiety. It advocates for the broader adoption of innovative, learner-centered pedagogies that promote collaboration, reduce stress, and ultimately enhance student success in complex subject areas like Physics.

RECOMMENDATIONS

Based on the findings of this study, the following recommendations are proposed to enhance Physics instruction and address vocabulary anxiety among Grade 10 learners:

- Provide teacher training on Design Thinking Process (DTP): Educators should be equipped with a solid understanding of DTP principles and their classroom application. This can be achieved through workshops, training sessions, and continuous professional development programs. Building teacher confidence in using DTP will help them design lessons that are more responsive to both the emotional and cognitive needs of learners in Physics.
- Develop context-based and visual instructional materials: Instructional tools and activities that highlight the meaning of Physics vocabulary through visuals, real-life contexts, and hands-on engagement should be developed. Examples include vocabulary maps, simulations, interactive models, and collaborative design tasks. These materials, aligned with the DTP approach, will allow students to use complex terms in practical and meaningful ways.
- Foster a supportive and inclusive learning environment: Since many students—regardless of instructional approach—reported anxiety stemming from fear of peer judgment, it is crucial to establish a classroom culture where students feel safe expressing ideas. Teachers should encourage respect, empathy, and equal participation. Group norms that promote openness and inclusivity can reduce social pressure and enhance collaborative learning.
- Encourage further research on related anxiety factors: Future studies could explore other types of anxiety in Physics learning, such as math anxiety or test anxiety, and how these might interact with innovative teaching methods like DTP. Longitudinal research would also be valuable in examining the lasting effects of DTP on student performance, confidence, and sustained interest in Physics.
- Expand DTP to other science subjects: Given the positive impact of DTP in alleviating vocabulary anxiety in Physics, it is recommended that the same approach be piloted in other science areas like Chemistry or Biology. These subjects also involve abstract and technical language, and DTP may offer similar benefits in making content more relatable and engaging.

APPENDIX

Implementation of Design Thinking Process (DTP) with its Five Phases.

Empathize phase, the initial stage of the Design Thinking Process (DTP), involves the teacher employing various strategies, such as presenting video clips, displaying images, or posing thought-provoking questions, to encourage active participation and observation among learners. The materials provided were carefully selected to align with the topic and feature problem scenarios, ensuring relevance and engagement. This phase aimed to deepen learners' involvement with the task and foster their ability to understand and empathize with the perspectives and emotions of those involved in the scenarios.

Define phase, the second stage of the Design Thinking Process (DTP), involves learners synthesizing insights gained during the previous phase. In this stage, learners collect and analyze the gathered data, identifying recurring patterns, themes, and key challenges that emerged consistently during presentations.

Ideate phase, the third stage of the Design Thinking Process (DTP), involves learners crafting a problem statement that precisely defines the specific issue or challenge they aim to address. This statement serves as a foundational framework, guiding their subsequent research and problem-solving efforts.

Prototype phase, the fourth stage of the Design Thinking Process (DTP), involves learners actively engaging in the development of a prototype. This prototype can take diverse forms, such as simple paper models, interactive digital designs, or tangible representations, depending on the ideas selected in the preceding phase. Working in groups, learners are tasked with creating a prototype that embodies their proposed solution to the identified problem.

Test phase, the fifth stage of the Design Thinking Process (DTP), where teachers and learners assessed the prototype to determine its effectiveness in addressing the identified problem. This phase allows learners or groups to identify design flaws or limitations, serving as the foundation for necessary improvements. By adopting a feedback-driven approach, this stage encourages groups to revisit and refine their prototype, integrating insights gained during the evaluation.

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