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Research Article

Students' Perceptions of Feynman Technique in Mathematics Learning: A Case of a State University in Claveria, Misamis Oriental

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Abstract:

Mathematics learning remains a significant challenge for many students due to its perceived complexity and the limitations of traditional teaching methods. The Feynman Technique, an active learning strategy that emphasizes self-explanation and simplification of concepts, has been proposed as an effective tool for enhancing comprehension and engagement in mathematics. This study explores students' perceptions of the Feynman Technique in learning mathematics at a state university in Claveria, Misamis Oriental. Employing a phenomenological qualitative research design, data were collected through semi-structured interviews and reflective journals from purposively selected mathematics students who had experience using the technique. Thematic analysis revealed that students perceived the Feynman Technique as beneficial in fostering deeper conceptual understanding, increasing engagement, and enhancing confidence in learning mathematics. However, challenges such as difficulty in simplifying complex concepts and self-doubt in explanations were also identified. Despite these challenges, students generally preferred the technique over traditional methods and recommended its use for improving mathematics learning. The findings suggest that integrating the Feynman Technique into mathematics education can support active learning and self-directed knowledge construction. Educators should provide scaffolding and structured guidance to maximize its effectiveness. Future research may explore its long-term impact on academic performance and its applicability across different mathematical topics.

Keywords: Feynman Technique, Mathematics Learning, Active Learning, Self-Explanation, Student Perception.

Introduction

The teaching and learning of mathematics have long been a challenge in education, with students often perceiving the subject as complex and intimidating (Freeman et al., 2014). Traditional teaching methods, while effective to some extent, may not fully address the diverse needs of learners or actively engage them in the learning process. This disengagement can lead to low motivation, poor retention, and anxiety toward mathematics (Hull et al., 2020). As such, innovative instructional strategies are continuously being explored to enhance students' understanding, engagement, and confidence in mathematics. One such method is the Feynman Technique, a structured approach to learning that emphasizes explaining concepts in simple terms, identifying gaps in understanding, and refining explanations (Minh & Giang, 2023).

The Feynman Technique, originally developed by the physicist Richard Feynman, is grounded in the principle that teaching others is one of the most effective ways to learn. Research suggests that self-explanation strategies, such as those used in the Feynman Technique, contribute to improved problem-solving skills, deeper conceptual understanding, and better retention of knowledge (McNamara, 2017). Through encouraging students to articulate their understanding of mathematical concepts in their own words, the technique fosters active participation and deeper comprehension. Freeman et al. (2014) found that active learning approaches significantly improve student performance in STEM subjects by promoting engagement and conceptual mastery. Similarly, Radovic et al. (2018) emphasized that self-explanation enhances students' confidence and reinforces their mathematical identity, which is a critical factor in sustaining interest and persistence in the subject.

Furthermore, the application of the Feynman Technique in various educational contexts has demonstrated its effectiveness in promoting learning gains and conceptual mastery (Adeoye, 2023; Qi et al., 2021). However, its direct impact on motivation remains uncertain, as motivation is influenced by multiple factors, including goal orientation, personal interest, and external rewards (Ryan & Deci, 2000). While previous studies have explored the role of active learning in mathematics education, there is limited research on the implementation of the Feynman Technique in higher education, particularly in the Philippine context.

Despite its theoretical benefits, the practical application of the Feynman Technique in mathematics classrooms remains underexplored, particularly in state universities in the Philippines. Understanding students' perceptions of this technique is crucial in assessing its effectiveness and identifying potential challenges that may arise during its application. As Blaschke and Hase (2016) argue, learning strategies that promote self-directed and active engagement are essential for fostering deeper learning experiences, yet their success depends on how students perceive and interact with them.

This study focuses on the experiences of mathematics students at a state university in Claveria, Misamis Oriental during the 1st semester of SY 2024-2025, offering insights into how the Feynman Technique influences their learning processes, engagement levels, and confidence. Specifically, it aims to: (1) explore students' perceptions of the Feynman Technique in learning mathematics, (2) identify its perceived benefits and challenges, and (3) provide recommendations for its effective implementation. This study contributes to the growing body of knowledge on innovative teaching strategies and their role in enhancing mathematics education.

Methodology

This study employed a phenomenological qualitative research design to explore students' perceptions of the Feynman Technique in learning mathematics. A phenomenological approach was chosen because it focuses on understanding individuals' lived experiences and how they make sense of those experiences (Creswell & Poth, 2018).

The participants of this study were mathematics students enrolled at a state university in Claveria, Misamis Oriental during the 1st semester of SY 2024-2025. Using purposive sampling, students who had direct experience with the Feynman Technique as part of their learning process were selected. This sampling method allowed for the inclusion of students with varying levels of familiarity and comfort with the technique, providing a more comprehensive understanding of its impact on learning.

Data were collected through open-ended semi-structured interviews and reflective journals. The semi-structured interviews provided flexibility, allowing the researchers to explore students' experiences in depth while maintaining a structured focus on key aspects of the Feynman Technique. The open-ended nature of the questions encouraged participants to express their thoughts freely, offering rich qualitative data. Additionally, reflective journals captured students' immediate insights and experiences as they engaged with the technique during study sessions or classroom activities, complementing the interview data with real-time reflections.

Thematic analysis was used to analyze the qualitative data, following a structured process to ensure consistency and accuracy. First, all interview recordings were transcribed verbatim, and reflective journal entries were compiled for analysis. The data were then systematically coded to identify recurring ideas, phrases, and concepts. The codes were subsequently grouped into broader themes that captured the essence of students' perceptions, including enhanced understanding, increased engagement, improved confidence, and perceived challenges. To ensure reliability, the coding and theme development were reviewed by a second researcher, and any discrepancies were resolved through discussion.

The study adhered to strict ethical standards to protect the rights and welfare of participants. Informed consent was obtained from all participants before their inclusion in the study, ensuring they were fully aware of the study's purpose and procedures. Participants were assured that their responses would remain confidential and anonymous, and they retained the right to withdraw from the study at any time without penalty.

Results and Discussion

Students' perceptions play a crucial role in understanding the effectiveness of any learning strategy. Their experiences provide insights into how the Feynman Technique impacted their learning process, engagement, and confidence in mathematics. This study gathered qualitative data from students regarding their views on the technique's strengths and challenges. Their responses were grouped into key themes: enhanced understanding, increased engagement, improved confidence, and perceived challenges.

Theme 1: Enhanced Understanding of Mathematical Concepts

One of the most prominent themes in students' responses is the Feynman Technique's ability to simplify complex topics, making them easier to understand. Breaking down concepts into their simplest forms allowed students to grasp difficult subjects more effectively. Many found that explaining topics in their own words reinforced their learning and allowed them to retain information better.

Several students highlighted this benefit:

"The Feynman Technique made it easier to understand the topics because it involved breaking down complex ideas into simpler terms."

"It makes the problem easier… Mas na easy nako ug sabot ang tanan."

"It kinda works on me, but I combined it with other techniques to make it more efficient for me."

This finding aligns with cognitive learning theories, particularly Mayer's (2002) cognitive theory of multimedia learning, which emphasizes that deep understanding occurs when learners actively process and explain information in their own words. When students simplify complex concepts, they engage in meaningful learning rather than mere rote memorization (McNamara, 2017).

Furthermore, research suggests that self-explanation, a core element of the Feynman Technique, enhances conceptual understanding and problem-solving skills (Chiu, 2022). Freeman et al. (2014) found that active learning methods, including peer teaching and structured self-explanation, significantly improve student performance in STEM subjects by encouraging deeper cognitive processing. Similarly, Radovic et al. (2018) emphasized that self-explanation not only improves comprehension but also strengthens students' confidence in their mathematical abilities.

The Feynman Technique's structured approach—identifying gaps in understanding, refining explanations, and teaching concepts—

mirrors metacognitive strategies that promote deeper learning and long-term retention (Reyes et al., 2021). Students who use metacognitive techniques tend to develop stronger self-regulation skills, which contribute to improved academic outcomes (Blaschke & Hase, 2016).

Moreover, the finding that some students combined the Feynman Technique with other learning strategies suggests that they are developing adaptive learning habits. Qi et al. (2021) found that students who integrated multiple learning techniques, such as visualization, discussion-based learning, and self-explanation, demonstrated greater engagement and academic achievement. This highlights the importance of flexible, student-centered approaches to learning.

Theme 2: Increased Engagement and Active Learning

Another recurring theme in students' feedback was that the Feynman Technique encouraged active participation in their learning process. Instead of simply listening to lectures or memorizing formulas, students had to engage with the material, explain it to their peers, and ask questions—all of which made learning more interactive. Unlike passive memorization, the Feynman Technique encourages students to actively engage with the subject matter. This method requires learners to take an active role in their learning process by explaining topics in a clear and structured manner, thereby improving their retention and overall engagement.

Some students expressed this as follows:

"The technique made me feel like it's my responsibility to study. The amount of knowledge I could accumulate depends on how well I would self-study."

"It also made me more involved with the subject, as it required me to actively engage in and teach my peers."

"The Feynman Technique dramatically shifted my engagement with the subject matter from passive to active."

This observation aligns with research on active learning strategies. Freeman et al. (2014) found that active learning significantly improves student performance in STEM fields by encouraging deeper cognitive engagement with the material. Similarly, Blaschke & Hase (2016) emphasized that students learn more effectively when they take an active role in constructing knowledge rather than being passive recipients of information. The Feynman Technique, by requiring students to teach concepts to others, enhances their sense of responsibility for their learning and promotes a student-centered approach to education.

Additionally, self-directed learning strategies, such as those embedded in the Feynman Technique, are known to improve motivation and engagement. Ryan & Deci (2000) proposed that when students have autonomy in their learning process, they are more intrinsically motivated, which leads to greater persistence and academic success. This aligns with the student responses that highlight an increased sense of ownership over their learning.

Moreover, research by McNamara (2017) and Reyes et al. (2021) suggests that peer teaching, a key component of the Feynman Technique, enhances students' ability to identify knowledge gaps and strengthen their understanding of complex concepts. Through explaining topics to their peers, students reinforce their learning, improve communication skills, and build confidence in their mathematical abilities.

Finally, active engagement strategies such as the Feynman Technique are particularly effective in mathematics education. Radovic et al. (2018) found that students who actively engage in discussions and explanations develop a stronger mathematical identity, which contributes to increased persistence and long-term success in the subject. The cognitive demand of explaining mathematical ideas requires students to think critically, analyze problems more deeply, and integrate concepts more effectively.

Theme 3: Improved Confidence in Learning and Explaining Mathematics

Confidence is an essential factor in students' success in mathematics. Many students reported that using the Feynman Technique boosted their self-confidence, as it allowed them to practice explaining concepts and reinforce their understanding. Many students found that using the Feynman Technique increased their confidence in learning and explaining difficult topics. Articulating concepts in their own words made students more assured of their knowledge and abilities.

Several students noted:

"Using the Feynman Technique did increase my confidence in my ability to learn and explain difficult topics."

"The Feynman Technique significantly boosted my confidence in learning and explaining complex topics."

"Yes, using the Feynman Technique boosted my confidence in my ability to learn and practice my communication skills."

This finding aligns with Radovic et al. (2018), who emphasized that students who develop a strong mathematics identity and confidence are more likely to persist in math-related fields. A positive mathematics identity, which includes self-assurance in one's mathematical abilities, is crucial for long-term academic success and engagement in the subject.

Moreover, Cribbs et al. (2020) found that students' belief in their own mathematical abilities significantly influences their motivation and academic performance. The Feynman Technique, by encouraging students to explain concepts and identify knowledge gaps, fosters a growth mindset, helping students build resilience in mathematics learning.

The impact of peer teaching and self-explanation on confidence is also well-documented. Freeman et al. (2014) demonstrated that active learning methods, including structured peer discussions and teaching strategies, lead to higher academic performance and improved self-efficacy in STEM subjects. Similarly, Blaschke & Hase (2016) highlighted that active engagement in learning builds students' confidence by allowing them to take ownership of their knowledge development.

Additionally, research by McNamara (2017) showed that self-explanation strategies enhance both comprehension and confidence, particularly in complex subjects like mathematics. When students explain a concept, they strengthen their understanding and simultaneously develop the confidence to articulate their reasoning in academic discussions.

Theme 4: Challenges in Using the Feynman Technique

Despite its benefits, some students encountered difficulties when using the Feynman Technique. The most commonly reported challenge was the struggle to simplify complex concepts and explain them clearly. This difficulty suggests that while the technique encourages deep engagement with mathematical content, it also requires significant cognitive effort and metacognitive awareness. Several students expressed these challenges:

"One challenge encountered while using the Feynman Technique was ensuring complete understanding of the topic to explain it in my own words."

"Yes, I encountered a few challenges while using the Feynman Technique. The biggest one was simplifying complex concepts down to their most basic elements. Sometimes, I found myself still using jargon or advanced terminology, even when I thought I'd broken the concept down."

"For me, it's self-doubt because it's questioning one's understanding."

"It made me understand the topic but I found it hard to put into my own words."

"One challenge was recognizing when I didn't fully understand something during the explanation process."

These responses indicate that while the Feynman Technique is useful, it demands effort and critical thinking. The struggle to simplify information suggests that students are engaging deeply with the material, as they must fully understand it before teaching it to others. This challenge, though initially frustrating, ultimately contributes to a more thorough grasp of the subject.

This aligns with findings from Hull et al. (2020), which suggested that students often overestimate their understanding until they attempt to explain a concept. The cognitive effort required to translate knowledge into simpler terms exposes gaps in comprehension, forcing students to refine their understanding further.

Additionally, Ambion et al. (2020) found that while self-explanation techniques are effective, they require practice and guidance to help students develop the skill of simplification. Without structured support, some students may struggle with breaking down complex concepts, leading to frustration and self-doubt.

Research by McNamara (2017) highlights that self-explanation is a metacognitive process that requires students to reflect on their knowledge and identify misunderstandings. However, this process can be difficult for learners who lack confidence in their abilities, as seen in some students' responses regarding self-doubt.

Furthermore, Freeman et al. (2014) emphasized that active learning methods, including self-explanation, require scaffolding and iterative practice to be fully effective. Educators can help students overcome these challenges by providing guided examples, encouraging peer collaboration, and gradually increasing the complexity of concepts explained through the Feynman Technique

Theme 5: Positive Recommendations and Preference Over Traditional Methods

Due to its effectiveness, most students would recommend the Feynman Technique to their peers. Many found it to be a better alternative to traditional learning methods, as it emphasizes critical thinking, comprehension, and active learning rather than rote memorization.

Several students expressed their preference for the technique:

"Yes, especially for those people who have difficulties in understanding some topics."

"I would absolutely recommend the Feynman Technique to my peers. It's a powerful tool for anyone who wants to deepen their understanding of complex topics."

"I prefer the Feynman Technique over traditional learning methods as it encourages active learning and critical thinking."

These responses indicate that students see the Feynman Technique as a valuable learning strategy, particularly for those who struggle with comprehension. Many preferred it over traditional methods, as it encouraged deeper understanding and long-term retention of knowledge. The emphasis on active participation and simplification of concepts made learning more engaging and effective.

This finding aligns with Freeman et al. (2014), who found that active learning strategies significantly improve student performance compared to traditional lecture-based instruction. Active learning, such as the Feynman Technique, shifts the focus from passive knowledge absorption to student-centered exploration and critical thinking, which enhances retention and understanding.

Additionally, Blaschke & Hase (2016) emphasized that learning approaches that promote self-explanation and deep processing contribute to stronger conceptual mastery. Unlike traditional methods that often rely on memorization, the Feynman Technique requires students to actively engage with the material, leading to better long-term retention.

McNamara (2017) further supports this perspective, stating that self-explanation techniques help students develop metacognitive skills, allowing them to monitor their own understanding and adjust their learning strategies accordingly. This ability to self-regulate learning can be particularly beneficial for students who struggle with complex subjects like mathematics.

Moreover, Chiu (2022) highlighted that students who engage in self-explanation tend to perform better in problem-solving tasks and retain knowledge for longer periods. The structured approach of the Feynman Technique—breaking down concepts, identifying gaps, and refining explanations—aligns well with these findings, making it an effective alternative to conventional instructional methods.

Conclusion and Recommendations

The findings of this study suggest that the Feynman Technique is an effective learning strategy for enhancing students' understanding, engagement, and confidence in mathematics. Through self-explanation and active participation, the technique helped students simplify complex concepts, reinforce their learning, and improve their ability to communicate mathematical ideas. While some students faced challenges in breaking down topics and overcoming self-doubt, they recognized the technique's long-term benefits and preferred it over traditional learning methods. These findings align with research on active learning, self-explanation, and peer teaching as effective strategies for improving mathematical comprehension and retention.

To maximize the benefits of the Feynman Technique, educators should provide structured support by modeling concept simplification, encouraging peer collaboration, and using scaffolding techniques such as sentence starters and guiding questions. Addressing students' self-doubt through positive reinforcement and growth mindset strategies can further enhance their confidence. Future research should explore the long-term impact of the technique on academic performance and its applicability to other mathematical topics and learning contexts. Through these improvements, the Feynman Technique can be a powerful tool for transforming mathematics education and fostering deeper, more meaningful learning experiences.

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