

Needs Assessment: Utilizing 7E Model in Teaching Protein Synthesis through Storybook

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DOI: <https://dx.doi.org/10.47772/IJRISS.2025.910000210>

Received: 25 October 2025; Accepted: 30 October 2025; Published: 01 November 2025

ABSTRACT

Teaching protein synthesis poses persistent challenges to both teachers and learners in senior high school biology due to its abstract, sequential, and molecular nature. This study aimed to conduct a needs assessment to identify the instructional challenges encountered by Grade 12 STEM teachers and to determine the pedagogical supports required to enhance student understanding. Using a qualitative-descriptive design, data were collected from five in-service science teachers through a validated needs assessment questionnaire adapted from Hadji Shaeef (2023). Thematic analysis based on Braun and Clarke's (2006) framework revealed five major themes: (1) the importance of protein synthesis, (2) teaching strategies currently used, (3) student learning difficulties, (4) storybooks as an emerging pedagogical tool, and (5) additional resources and support needed. Findings indicate that while teachers recognize protein synthesis as a core concept in molecular biology, students struggle to distinguish between transcription and translation and to visualize molecular interactions. Teachers commonly use lectures, PowerPoint presentations, and animations, but acknowledge the need for contextualized and engaging materials. They expressed strong support for developing storybooks integrated with the 7E model to simplify abstract processes and enhance engagement. Results from this assessment provide the empirical foundation for designing and developing innovative instructional materials that align with teachers' and students' needs.

Keywords: needs assessment, protein synthesis, 7E instructional model, storybook, STEM education

INTRODUCTION

Protein synthesis is central to the study of molecular biology and genetics, forming the basis of the central dogma—the flow of genetic information from DNA to RNA to protein. Within the senior high school STEM curriculum in the Philippines, understanding this process is crucial for preparing students for advanced studies in life sciences and health-related fields. Despite its importance, protein synthesis remains a difficult topic for learners due to its microscopic and abstract nature. Students frequently struggle to conceptualize transcription, translation, and RNA interactions, leading to widespread misconceptions (Tsui & Treagust, 2013).

For teachers, the abstractness of molecular processes presents pedagogical challenges. Traditional approaches—such as lectures and textbook diagrams—often fail to sustain engagement or promote deep conceptual understanding. As Mayer (2021) emphasized, meaningful learning requires integrating both visual and verbal representations. Therefore, identifying teachers' specific challenges and instructional needs is critical to improving biology teaching practices.

This study constitutes the Define phase of the 4D Model (Thiagarajan et al., 1974), which involves conducting

a needs assessment to determine existing instructional gaps prior to designing innovative materials. The findings from this phase inform the later stages—Design, Develop, and Disseminate—particularly the creation of a 7E Model-based storybook that contextualizes and simplifies protein synthesis for senior high school learners.

Objective Of The Study

This study seeks to achieve:

1. Conduct a needs assessment to identify challenges faced by Grade 12 STEM teachers in teaching protein synthesis.

Methods

A qualitative-descriptive research design was employed to gather in-depth insights into the experiences and perceptions of science teachers. The respondents were five in-service senior high school STEM teachers with at least three years of teaching experience in biology. The study focused on identifying the existing challenges and instructional needs related to teaching protein synthesis in the Philippine STEM curriculum.

Data Gathering Procedure

Data were gathered using a Needs Assessment Questionnaire adapted from Hadji Shaeef (2023). The instrument consisted of open-ended questions designed to elicit teachers' experiences, teaching practices, observed student difficulties, and suggestions for improving instructional materials. Prior to administration, permission from the school administration was secured, and participants were informed about the purpose of the study. Their responses were coded anonymously as NA:ST1 to NA:ST5. Interviews and survey responses were collected within two weeks and subsequently transcribed for analysis. Ethical standard was met to provide security for all the data and documents gathered by the researcher in the study.

Data Analysis

The collected data were analyzed thematically following the six-phase framework of Braun and Clarke (2006): (1) data familiarization, (2) generating initial codes, (3) searching for themes, (4) reviewing themes, (5) defining and naming themes, and (6) producing the final report. Codes were grouped into thematic categories that reflected teachers shared experiences. The credibility of the analysis was strengthened through peer checking and triangulation.

RESULTS AND DISCUSSION

Needs Assessment for Science Teachers

Table 1 The Summary of the Responses of In-service Science Teachers on the Need Assessment Survey

Theme	Coded for	Quote
The Importance of Protein Synthesis	Protein synthesis as fundamental to life; foundation for understanding genetics; preparation for advanced studies	"Protein synthesis is a basic principle of molecular biology and genetics. It is fundamental to understanding how genetic information contained in DNA is translated into useful proteins" (NA:ST1)
	Connection to traits and cellular function	"We make students understand how DNA controls life by creating proteins that is important for cell function. It helps students understand how genes determine traits, or life in cellular level" (NA:ST3)

	Central dogma as key learning	“It is essential because protein synthesis explains how cells make proteins using genetic information. It’s a key part of the central dogma of molecular biology” (NA:ST5)
Teaching Strategies Currently Used	Lecture-discussions and visual aids	“I mostly employ a mixture of lecture discussions, visual aids such as diagrams and animations, and interactive activities” (NA:ST1)
	Videos and hands-on activities	“Usually animated videos to capture the processes and gives visuals. Also hands on activities” (NA:ST3)
	Real-world connections	“Aside from that I relate the topic in real world situation in order for the learners to understand it in easy way” (NA:ST5)
Student Learning Difficulties	Confusion in transcription vs. translation	“The transcription and translation processes... students often struggle to differentiate between transcription and translation” (NA:ST5)
	Struggles with ribosome and tRNA roles	“Students often struggle with understanding the role of ribosomes, tRNA, and codon-anticodon interactions during translation” (NA:ST4)
	Complexity of RNA functions and genetic code	“The different roles of mRNA, tRNA, and rRNA can be overwhelming... The redundancy of the genetic code adds complexity” (NA:ST2)
Storybooks as an Emerging Pedagogical Tool	Storybooks simplify complex concepts	“Yes, I think utilizing a storybook can make the subject more compelling and accessible for students” (NA:ST1)
	Engaging and relatable through characters	“Yes, because we are providing them characters and we explain them how essentials those characters and their functions” (NA:ST5)
	Improves retention and understanding	“Yes, utilizing a storybook can significantly enhance students’ conceptual understanding... storytelling makes abstract concepts more relatable” (NA:ST2)
Additional Resources and Support Needed	Need for interactive tools and simulations	“More interactive and engaging digital tools, such as simulations and virtual labs, would help students visualize transcription and translation in action” (NA:ST1)
	Digital and 3D models	“Interactive Multimedia, 3D models, Digital Books” (NA:ST3)
	Hands-on and real-world applications	“High-quality animations or using 3D molecular models can further enhance engagement... storytelling and analogies can improve conceptual understanding” (NA:ST2)

The summary result of the need assessment was answered by Five (5) Science teachers. Teachers consistently highlighted the importance of protein synthesis as a foundational concept in molecular biology and genetics. They emphasized its role in linking DNA's genetic information to the formation of proteins that determine cellular function and observable traits. Respondents described protein synthesis as essential for developing scientific literacy and preparing students for advanced studies in the biological sciences. This view reflects the position of Alberts et al. (2019), who identify protein synthesis as a “core idea” in biology that connects molecular mechanisms to physiological outcomes. Despite its importance, teachers acknowledged that its abstract and sequential nature makes it one of the most conceptually demanding topics to teach in senior high school biology, a difficulty also emphasized by Tsui and Treagust (2013) in their study on multiple representations in biological education.

In addressing these instructional challenges, teachers reported employing a combination of traditional and multimedia strategies such as lecture-discussions, PowerPoint presentations, diagrams, animations, and real-world connections. These approaches are consistent with Mayer's (2021) principle of multimedia learning, which emphasizes that integrating verbal and visual information enhances comprehension and retention. However, teachers admitted that even with these strategies, misconceptions persist, particularly in differentiating transcription from translation and understanding the roles of ribosomes, mRNA, and tRNA. To overcome these difficulties, respondents expressed enthusiasm for integrating storybooks as innovative teaching tools. They believed that storytelling could transform abstract molecular processes into relatable narratives, making learning more meaningful and engaging. This finding is supported by Isik and Kar (2022), who found that storytelling improves conceptual understanding and student attitudes toward science learning.

Beyond the use of storybooks, teachers also underscored the need for supplementary materials such as interactive simulations, 3D models, and continuous professional training to strengthen instructional delivery. These perspectives align with Gess-Newsome et al. (2019), who argue that sustained teacher professional development and access to innovative tools are crucial to improving science teaching and student achievement. The needs assessment revealed that protein synthesis, though central to molecular biology, remains a persistent source of difficulty in the classroom. Teachers employ diverse strategies, yet misconceptions and engagement issues prevail. There is a strong consensus that contextualized, narrative-based, and multimodal instructional materials—particularly storybooks following the 7E Model (Bybee, 2015)—could substantially enhance understanding.

These findings represent the Define phase of the 4D Model (Thiagarajan et al., 1974) and provide the empirical foundation for designing and developing the 7E storybook as an innovative teaching tool for protein synthesis.

CONCLUSION AND RECOMMENDATIONS

This study concluded that in-service science teachers face consistent challenges in teaching protein synthesis due to its abstract nature and students' conceptual difficulties. Teachers rely on traditional methods but express a need for innovative, story-driven, and interactive materials. The findings strongly support the integration of the 7E instructional model into a storybook format, which can contextualize molecular processes and improve student engagement.

In light of the result revealed in the need assessment survey, the following recommendations should be taken into consideration.

1. Develop narrative-based instructional materials that incorporate the 7E model for teaching protein synthesis.
2. Provide professional development for teachers on integrating storytelling and digital simulations into science instruction.
3. Conduct further research on the effectiveness of multimodal and contextualized learning materials in addressing student misconceptions in molecular biology.

These insights establish the foundation for the next phases of the 4D model—Design and Develop—and affirm that storybooks hold significant potential in transforming abstract scientific concepts into meaningful learning experiences.

REFERENCES

1. Alberts, B., Johnson, A., Lewis, J., Morgan, D., Raff, M., Roberts, K., & Walter, P. (2019). *Molecular Biology of the Cell* (7th ed.). Garland Science.
2. Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3(2), 77–101.
3. Bybee, R. (2015). *The BSCS 5E Instructional Model: Creating Teachable Moments*. NSTA Press.
4. Gess-Newsome, J., Taylor, J. A., Carlson, J., Gardner, A. L., Wilson, C. D., & Stuhlsatz, M. A. M. (2019). Teacher professional development and student achievement in science: A logic model approach. *International Journal of Science Education*, 41(7), 862–883.
5. Hadji Shaeef, H. (2023). Needs Assessment Instrument for Science Instruction. *Localized Stem Lesson in Teaching Biodiversity for Grade 8 Learner*
6. Isik, D., & Kar, T. (2022). Storytelling in science education: Effects on students' conceptual understanding and attitudes. *Research in Science & Technological Education*, 40(4), 529–546.
7. Mayer, R. E. (2021). *Multimedia Learning* (3rd ed.). Cambridge University Press.
8. Thiagarajan, S., Semmel, D. S., & Semmel, M. I. (1974). *Instructional Development for Training Teachers of Exceptional Children: A Sourcebook*. Indiana University.
9. Tsui, C. Y., & Treagust, D. F. (2013). Introduction to multiple representations: Their importance in biology and biological education. In D. Treagust & C. Tsui (Eds.), *Multiple Representations in Biological Education* (pp. 3–18). Springer.