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AnaPhyStory as An Innovative Pedagogical Approach for Enhancing Conceptual Understanding and Reflective Comprehension Among BPED Students

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ABSTRACT

This quasi-experimental study assesses the effectiveness of AnaPhyStory, a narrative-based approach, in improving conceptual understanding and reflective comprehension of anatomy and physiology among Bachelor of Physical Education (BPED) students at Ramon Magsaysay Memorial Colleges, General Santos City, during the 2025-2026 academic year. Utilizing a non-equivalent control group pretest-posttest design, the experimental group (n=25) received AnaPhyStory instruction, which incorporated structured narratives on the skeletal, muscular, and nervous systems, whereas the control group (n=25) participated in traditional lectures; the instruments employed consisted of validated 60-item assessments and reflective comprehension evaluations. Pretest scores revealed inadequate conceptual comprehension in both groups (Control: M=19.08, SD=3.79; Experimental: M=19.04, SD=3.22), progressing to intermediate levels (Control posttest: M=32.24, SD=6.84) and high levels (Experimental: M=36.04, SD=4.14) following the intervention. Paired t-tests indicated significant pre-post improvements (Control: t=-7.67, p<.001; Experimental: t=-17.06, p<.001), while an independent t-test demonstrated higher posttest performance in the experimental group (t=-2.48, p=.018). The experimental group exhibited proficient reflective comprehension (M=14.28, SD=1.27). The findings confirm AnaPhyStory's superiority over conventional techniques in promoting deeper learning, aligning with the significance of story pedagogy in STEM education. Recommendations advocate for its incorporation into teacher training programs to enhance scientific literacy in accordance with SDG 4.

Keywords: *Anatomy and Physiology, AnaPhyStory, Narrative Story-Based Approach, Conceptual Understanding, Reflective Comprehension*

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INTRODUCTION

The human body can be perceived as a dynamic narrative of interrelated systems perpetually collaborating to maintain life and mobility. Each heartbeat, muscle contraction, and breath signifies a delicate interaction between organs, tissues, and physiological mechanisms. The primary objective of anatomy and physiology is to elucidate the interactions among body structures and their functions in sustaining life. For numerous learners, the study of anatomy and physiology often resembles the memorization of an extensive array of unfamiliar scientific terminology rather than the exploration of a narrative. Research in science education indicates that students frequently encounter difficulties with topics involving intricate systems and processes, as these necessitate the simultaneous integration of multiple concepts and the construction of mental representations of phenomena that are not directly observable (Jiménez-Valverde, 2025). Consequently, numerous learners rely on rote memorization instead of cultivating a profound conceptual comprehension of human bodily functions.

A major hurdle in the teaching of anatomy and physiology stems from the subject's inherent abstraction and breadth. Students often perceive these disciplines as difficult, a perception stemming from the extensive vocabulary, the requirement to mentally reconstruct three-dimensional forms from two-dimensional illustrations, and the cognitive effort needed to connect anatomical structures with their physiological roles (Royse et al., 2024). Research findings in the field of anatomy and physiology education consistently demonstrate that students face cognitive challenges, diminished motivation, and shallow comprehension when instruction relies heavily on conventional lectures and rote memorization techniques (Satoh et al., 2023). These challenges hinder learners' capacity to develop profound, transferable mental models of human body systems, a fundamental skill for allied health and education programs.

In science education research, narrative or storytelling-based instructional strategies have garnered attention as pedagogical methods that structure complex information into sequences of significant events, allowing learners to cognitively organize and connect new concepts to pre-existing knowledge frameworks. Barchas-Lichtenstein et al. (2023) assert that storytelling can augment learner engagement and cognitive processing in STEM education, as narratives offer coherent and meaningful contexts that render scientific concepts more accessible. Jiménez-Valverde (2025) elucidates that storytelling serves as a cognitive scaffold, aiding learners in interpreting intricate scientific principles and enhancing information retention by contextualizing concepts within structured narratives. Narrative-based learning environments have been utilized in health-related fields to enhance engagement, reflection, and a profound comprehension of scientific material and practical applications (Dutta & Keith, 2023), particularly by integrating real-life scenarios that allow learners to connect theoretical knowledge with practical experiences.

In the Philippine educational framework, science instruction within the K to 12 Science Curriculum actively fosters inquiry-based, learner-centered methodologies that facilitate the development of conceptual understanding through contextualized and interactive strategies. Notwithstanding these curriculum objectives, numerous classrooms persist in utilizing conventional teaching methods that prioritize memorization over profound comprehension of scientific concepts, which undermines the effectiveness of the K to 12 Science Curriculum in fostering deeper learning and critical thinking skills among students. Furthermore, there exists a significant deficiency of experimental or quasi-experimental studies that

systematically evaluate narrative-based instruction as an intervention to enhance learners' conceptual comprehension of anatomy and physiology. Although current research indicates the potential of storytelling in science education, it predominantly remains theoretical or descriptive, resulting in a significant deficiency in empirical evidence regarding the impact of narrative strategies on quantifiable learning outcomes (Dahlstrom, 2014; Barchas-Lichtenstein et al., 2023), particularly in anatomy and physiology instruction for non-biology majors, such as BPEd students. This gap necessitates a controlled comparison of narrative-based instruction with traditional teaching methods to ascertain causality in learning outcomes.

Therefore, this investigation endeavors to address the existing void by employing a quasi-experimental framework to evaluate the effectiveness of storytelling as a pedagogical approach for imparting anatomical and physiological knowledge to first-year Bachelor of Physical Education (BPEd) students at Ramon Magsaysay Memorial Colleges. The primary objective of this research is to determine if narrative-driven instruction facilitates a more substantial enhancement in BPEd students' conceptual understanding of bodily structures and physiological processes compared to conventional lecture-based methodologies.

Through the generation of empirical data derived from a controlled intervention and comparative analysis, this study contributes to the existing body of literature concerning pedagogy in anatomy and physiology education, while also enriching the understanding of science instruction within the specific context of Philippine higher education.

The researchers aim to ascertain the effects of AnaPhyStory as an innovative pedagogical approach in enhancing the conceptual understanding and reflective comprehension of freshmen BPED students in the subject Anatomy and Physiology enrolled at Ramon Magsaysay Memorial Colleges in the First Semester of Academic Year 2025-2026.

Specifically, this study sought answers on the following questions:

1. What are the levels of students' conceptual understanding in their pre-test and post-test scores using:
   1.1 AnaPhyStory Innovative Pedagogical Approach; and
   1.2 conventional approach?
2. What level of reflective comprehension is demonstrated by freshman BPED students in Anatomy and Physiology through the integration of the *AnaPhyStory* pedagogical approach?
3. Is there a significant difference between the Pre-Test and Posttest scores of students in the Control Group?
4. Is there a significant difference between the Pre-test and Posttest scores of students in the Experimental Group?
5. Is there a significant difference between the conceptual understanding of students in the control and experimental group?

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METHODOLOGY

Research Design

This study utilized a quasi-experimental non-equivalent control group pretest-posttest design to examine the effectiveness of the AnaPhyStory innovative pedagogical approach on the conceptual understanding of freshman BPED students in Anatomy and Physiology. Research respondents from Section A were assigned to the experimental group, which received instruction using the AnaPhyStory pedagogical approach, while another intact class served as the non-equivalent control group taught through conventional instructional methods. To establish a participant sample of 25 from the larger class of 35, a blind eye procedure was implemented whereby respondents were randomly selected without researcher knowledge of specific student identities—ensuring the researchers remained unaware of the names of the 25 students included in data collection and analysis until completion. Both groups completed pretests and posttests to measure changes in conceptual understanding, with the pretest establishing baseline comparability despite natural group differences. Additionally, reflective comprehension was assessed exclusively among experimental group students to evaluate the depth of reflective understanding fostered by the AnaPhyStory learning materials. These results determined significant differences between pretest-posttest scores within each group and described the reflective comprehension levels achieved through the intervention.

Respondents of the Study

The study's respondents were 50 freshmen BPED students enrolled in Anatomy and Physiology at Ramon Magsaysay Memorial Colleges, General Santos City for the 2025-2026 academic year, comprising 12 males and 38 females. The respondents were grouped based on their pre-test scores in Mechanics.

Table 1: *Respondents of the study*

Group	A	B	Total
Male	7	5	12
Female	18	20	38
Total	25	25	50

Locale of the Study

The study was conducted at Ramon Magsaysay Memorial Colleges in General Santos City because it offers an active teacher education program with first-year BPED students enrolled in Anatomy and Physiology, who were appropriate participants for this research.

Sampling Technique

The study employed a random sampling design, utilizing the Freshmen BPED students of Ramon Magsaysay Memorial Colleges, General Santos City. The researcher took only the students who were active during the experiment so as to get accurate results and minimize the occurrence of biases in the result.

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Data Gathering Instrument

This study utilized two primary research instruments: an AnaPhyStory Learning Material and a self-made pretest-posttest questionnaire designed to assess students' conceptual understanding of the subject. The pretest and posttest, consisting of 60 questions, focused on identifying and analyzing key concepts particularly in the system involved in the production of movement like Skeletal, Muscular and Nervous Systems and were validated by subject-matter experts using a Table of Specifications. The AnaPhyStory Learning Material, developed by the researchers, was anchored on various resources and structured into sections such as introduction, the main story, comprehension check, and self-reflection. The researcher-made test was validated and Kudder – Richardson Formula 20 was employed to ensure the reliability of the test.

The level of students' conceptual understanding was determined using the scale below.

Score	Equivalent (%)	Descriptive Rating
49 – 60	90 – 100	Very High Conceptual Understanding
37 – 48	85 – 89	High Conceptual Understanding
25 – 36	80 – 84	Moderate Conceptual Understanding
13 – 24	75 – 79	Low Conceptual Understanding
0 – 12	74 and below	Very Low Conceptual Understanding

Furthermore, the level of students' reflective comprehension was determined using the scale below.

Score	Equivalent (%)	Descriptive Rating
17 – 20	85% – 100%	Exceptional
13 – 16	65% – 84%	Proficient
9 – 12	45% – 64%	Developing
5 – 8	25% – 44%	Emerging
0 – 4	0% – 24%	Beginning

Data Gathering Procedure

Following institutional protocols for instrument validation and reliability, the researcher formally secured approval from the school president, through the Dean of the College of Teacher Education, to conduct the study on *AnaPhyStory* as an innovative pedagogical approach aimed at enhancing the conceptual understanding and reflective comprehension of BPED students. After obtaining the necessary

permissions, the study commenced with the administration of a pretest to establish baseline data and ensure comparability between the control and experimental groups.

Participants were then randomly assigned to either the control group or the experimental group. The control group received instruction using the conventional teaching method, while the experimental group was exposed to the AnaPhyStory approach, which integrates story-based instructional materials in teaching Anatomy and Physiology. This structured implementation enabled a systematic examination of the effect of the innovative pedagogical approach on students' conceptual understanding.

At the end of the intervention period, both groups were administered a posttest to measure learning gains. Data collection focused on the posttest scores of both groups as well as the reflective comprehension demonstrated by students in the experimental group, particularly through the comprehension check and self-reflection components embedded in the learning material. The collected data were subsequently analyzed using appropriate statistical techniques to determine the effectiveness of AnaPhyStory as an innovative instructional approach in improving students' conceptual understanding in Anatomy and Physiology.

Statistical Tool

This study utilized the mean and standard deviation to determine the level of conceptual understanding of the students based on their pretest and posttest scores as well as to describe the level of reflective comprehension of the students in the experimental group based on the comprehension check and self-reflection components embedded in the learning material. To examine differences, a dependent sample t-test was employed to compare the pretest and posttest scores within each group, determining whether students' conceptual understanding significantly improved after the intervention. Additionally, an independent sample t-test was used to compare the posttest scores

between the control and experimental groups, assessing the effectiveness of the AnaPhyStory pedagogical approach.

Ethical Consideration

This study strictly adhered to ethical guidelines to protect the rights and well-being of all participants. Prior to data collection, informed consent was obtained, ensuring that participants fully understood the study's objectives, procedures, potential risks, and benefits. Participation was entirely voluntary, with individuals informed of their right to withdraw at any time without penalty. Confidentiality and anonymity were rigorously maintained, with all data securely stored and accessible only to the research team. The study was designed to minimize any potential harm or discomfort, collecting only essential information to avoid unnecessary intrusion.

RESULTS AND DISCUSSION

Table 1 establishes methodological rigor through baseline equivalence, with both groups exhibiting low conceptual understanding during the pre-test (Control M = 19.08, SD = 3.785; Experimental M = 19.04,

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SD = 3.221). This similarity in baseline scores ensures group comparability and reduces the possibility of selection bias in the study. The low conceptual understanding demonstrated by both groups aligns with previous research indicating that Anatomy and Physiology is often perceived as a challenging subject among undergraduate learners due to the complexity of integrating anatomical structures with physiological processes (Michael, 2020; Harris et al., 2021). Students frequently encounter difficulties in constructing meaningful conceptual frameworks because they must simultaneously process large volumes of terminology and visualize internal biological mechanisms that cannot be directly observed (Knight & Wood, 2020).

Post-test divergences underscore treatment efficacy: Control's moderate gain to M=32.24 (SD=6.839) reflects typical curriculum benefits but higher heterogeneity, potentially from diverse learner responses. Previous studies suggest that structured lecture-based instruction remains effective in delivering foundational knowledge in science education when supported by organized explanations and guided practice (Adams & Dewsbury, 2022). However, the relatively higher variability observed in the control group suggests that traditional instructional methods may lead to uneven learning outcomes, as students differ in their prior knowledge, motivation, and learning preferences.

In contrast, the treatment group advance to high levels (M=36.04, SD=4.138) demonstrates enhanced uniformity and depth, likely driven by reflective interventions promoting conceptual understanding using the intervention. This improvement suggests that the storytelling-based instructional approach facilitated deeper comprehension of anatomical and physiological concepts. Narrative-based learning has been identified as an effective pedagogical strategy because it organizes information into coherent story structures that help learners connect scientific ideas with prior knowledge and real-world contexts (Green & Brock, 2021). Research in science education also indicates that contextualized and student-centered teaching strategies enhance conceptual learning by promoting active engagement and cognitive processing of complex scientific content (Freeman et al., 2020; Deslauriers et al., 2021). Consequently, the higher conceptual understanding observed in the experimental group (gain ratios ≈1.7 for Control, 1.9 for Experimental) may be attributed to the storytelling intervention, which highlight the intervention's promise for elevating conceptual understanding in Anatomy and Physiology among BPED students.

Table 1. *Level of Conceptual Understanding*

Group	Pre-Test		Description	Post-Test		Description
	Mean	SD		Mean	SD	
Control	19.08	3.785	Low Conceptual Understanding	32.24	6.839	Moderate Conceptual Understanding
Experimental	19.04	3.221	Low Conceptual Understanding	36.04	4.138	High Conceptual Understanding

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Table 2 indicates that the experimental group (N=25) achieved proficient level of reflective comprehension, with a high mean score of 14.28 (SD=1.2725). This elevated mean indicates strong performance in reflective comprehension skills, reflecting effective mastery of the construct among participants. Reflective learning plays an important role in knowledge construction because it allows learners to connect new information with prior experiences and develop deeper conceptual understanding (Kolb, 2021; Moon, 2020).

Meanwhile, the low standard deviation of 1.2725 further reveals high consistency across the group, as scores clustered tightly around the mean, suggesting reliable and uniform outcomes from the intervention. Such minimal variability implies the approach minimized individual differences, yielding predictable proficiency regardless of baseline learner diversity. Research on storytelling in education indicates that narrative frameworks can help minimize learning disparities by providing clear conceptual structures that guide students' understanding of complex content (Jiménez-Valverde, 2025).

Table 2. *Level of Reflective Comprehension of the Experimental Group*

	N	Mean	SD	Description
Reflective Comprehension	25	14.2800	1.27250	Proficient

Table 3 presents a paired samples t-test for the Control group (df=24), revealing a statistically significant pre-post improvement with a mean difference of -13.16 SD=8.577, SEM=1.715), t(24) =-7.672, and p<.001. This negative mean difference indicates post-test scores substantially exceeded pre-test scores by an average of 13.16 points, confirming that the conventional approach effectively enhanced conceptual understanding from low to moderate levels.The 95% confidence interval for the difference [-16.70, -9.62] excludes zero, reinforcing the reliability of this gain and its practical meaningfulness in an educational context, as the true population difference is unlikely to include no change. A large t-value magnitude (|t|=7.672) alongside p<.001 rejects the null hypothesis decisively, establishing standard methods as a valid benchmark intervention.

However, the elevated standard deviation of 8.577 signals greater variability in individual gains, implying heterogeneous responses—some participants improved markedly while others progressed more modestly—typical in non-personalized group instruction. This dispersion contrasts with tighter spreads in experimental conditions, highlighting opportunities for refinement while affirming the curriculum's overall efficacy as a solid comparative baseline.

Traditional lecture-based teaching methods have long been used in science education to convey complex information systematically, and previous research has demonstrated that well-structured lectures can support foundational knowledge acquisition when combined with effective assessment and feedback mechanisms (Adams & Dewsbury, 2022). However, the relatively high standard deviation observed in the control group suggests greater variability in students' learning gains. This variability may be attributed to differences in students' prior knowledge and cognitive readiness, which are known to influence learning outcomes in science courses (Kirschner et al., 2020). Consequently, although traditional instruction can

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produce significant improvements in conceptual understanding, its effectiveness may vary depending on individual learner characteristics.

Table 3. *Significant difference between the Pre-Test and Posttest scores of Control Group*

Control Group	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
PRETEST POSTTEST	-13.160	8.577	1.715	-16.700	-9.620	-7.672	24	.000

Table 4 presents a paired samples t-test for the Experimental group (df=24), showing a highly significant pre-post improvement with a mean difference of -17.00 (SD=4.983, SEM=0.997), t(24)=-17.057, and p<.001. This substantial negative mean difference reflects that post-test scores exceeded pre-test scores by an average of 17 points, driving conceptual understanding from low to high levels through the intervention.

This finding supports previous research emphasizing the effectiveness of narrative-based teaching strategies in facilitating conceptual learning. Stories allow learners to construct mental models of complex phenomena by organizing information into meaningful sequences, thereby enhancing comprehension and retention (Green & Brock, 2021). Additionally, student-centered instructional approaches have been shown to promote deeper engagement and improved academic performance in science education by encouraging learners to actively process and apply knowledge (Freeman et al., 2020; Deslauriers et al., 2021).

The 95% confidence interval [-19.06, -14.94] excludes zero entirely, confirming the gain's precision and practical significance—the true difference in the population falls reliably within this narrow, negative range. The exceptionally large t-value magnitude (|t|=17.057) and minuscule p-value provide overwhelming evidence against the null hypothesis, underscoring the intervention's potent impact.

Notably, the lower standard deviation of 4.983 (versus Control's 8.577) indicates reduced variability in gains, with scores clustering tightly around the mean and a smaller SEM enhancing statistical power. This uniformity suggests that the experimental approach produced consistent, equitable improvements across participants, minimized outliers, and established a superior benchmark for science education interventions, supporting the effectiveness of storytelling as a pedagogical strategy in Anatomy and Physiology learning (Prince, 2004; Kolb, 2021).

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Table 4. *Significant difference between the Pre-Test and Posttest scores of Experimental Group*

Experimental Group	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
PRETEST POSTTEST	-17.000	4.983	.997	-19.057	-14.943	-17.057	24	.000

Table 5 reveals a significant difference in post-test conceptual understanding between the control and experimental groups, as evidenced by the independent samples t-test results. The analysis shows a mean difference of -3.80 points favoring the experimental group (standard error = 1.532), meaning experimental students, on average, outperformed control students by this margin following the intervention. Under the equal variances assumption, the t-statistic stands at $t(48) = -2.481$ with $p = .017$; however, Levene's test for equality of variances ($F = 6.695$, $p = .013$) confirms unequal variances, so the adjusted results apply: $t(35.447) = -2.481$, $p = .018$.

Both p-values remain below the conventional alpha level of .05, offering compelling evidence to reject the null hypothesis of equal group means and establishing the experimental intervention's statistically superior impact on conceptual understanding in among BPED students. The consistently negative t-value across assumptions indicates the experimental group's higher mean, while the 95% confidence interval under unequal variances [-6.91, -0.69] fully excludes zero, attesting to the finding's precision, reliability, and practical significance—the true population difference confidently lies within this range.

This moderate yet dependable separation, characterized by a narrow CI and low SE, highlights the intervention's tangible 3.8-point advantage in conceptual understanding. The observed result aligns with prior investigations indicating that instructional methodologies prioritizing learner engagement and interactivity can substantially improve conceptual learning outcomes relative to traditional lecture formats (Freeman et al., 2014; Deslauriers et al., 2019). These pedagogical approaches foster deeper cognitive involvement, active knowledge construction, and meaningful learning experiences, all of which are critical for the comprehension of intricate scientific concepts (Prince, 2004).

As a result, the findings imply that the instructional intervention employed in this research facilitated enhanced conceptual understanding among BPED students, thereby supporting its potential applicability within teacher preparation programs that prioritize inclusive, learner-centered pedagogical practices.

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Table 5. *Significant Difference Between the Conceptual Understanding Between Control and Experimental Group*

	Levene's Test for Equality of Variances		t-test for Equality of Means						
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
								Lower	Upper
CONTROL VS EXPERIMENTAL	6.695	.013	-2.481	48	.017	-3.800	1.532	-6.880	-.720
			-2.481	35.447	.018	-3.800	1.532	-6.908	-.692

CONCLUSION

The AnaPhyStory innovative pedagogical approach significantly elevated the experimental group's conceptual understanding from low pre-test to high post-test levels with notably consistent gains, while the conventional approach advanced the control group from similarly low pre-test performance to moderate post-test proficiency, albeit with greater individual variability. Freshman BPED students demonstrated proficient reflective comprehension through AnaPhyStory integration, evidencing robust mastery of higher-order cognitive skills essential for anatomy and physiology. Statistically significant pre-post improvements occurred within both groups, with the experimental condition yielding substantially larger and more uniform enhancements. Critically, post-test comparisons confirmed the experimental group's superiority over the control, establishing AnaPhyStory's transformative efficacy for fostering deeper conceptual understanding and reflective competence among non-science major students. These findings advocate its adoption within inclusive teacher training curricula to optimize science literacy outcomes.

RECOMMENDATIONS

Educational institutions preparing BPED students, particularly for Anatomy and Physiology courses, may integrate the AnaPhyStory innovative pedagogical approach into their curricula to consistently achieve high conceptual understanding and proficient reflective comprehension, replacing or supplementing conventional methods that yield more variable outcomes especially to students whose interest in Science is not evident. Teacher educators may also prioritize its implementation in diverse and inclusive classrooms, capitalizing on its demonstrated ability to produce uniform gains across participants and thereby address disparities among struggling learners in alignment with DepEd standards for equitable science education. Future research may pursue longitudinal studies tracking the long-term retention of conceptual mastery and reflective skills among pre-service teachers, incorporating mixed-methods designs to elucidate the underlying mechanisms of AnaPhyStory's superiority. Additionally, faculty development programs—such as targeted workshops—may emphasize training on AnaPhyStory techniques to ensure faithful adoption and scalability, ultimately advancing science literacy outcomes essential for SDG 4 quality education goals within Philippine teacher training contexts.

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