ORIGINAL ARTICLE

Improving Physiotherapy Students' Understanding of Pain: The Impact of Pain Neuroscience Education

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ABSTRACT

Introduction: Pain is one of the most common reasons individuals seek medical care, as chronic pain can significantly affect daily activities, quality of life, social relationships, and work performance. In addition to physical discomfort, chronic pain is often associated with psychological distress such as stress and anxiety. Given its prevalence and impact, pain neuroscience education (PNE) has emerged as an important physiotherapy intervention for chronic pain management. This study aimed to examine the effect of a PNE lecture on physiotherapy students' knowledge of pain and to compare outcomes between the PNE and control groups. **Methods:** A quasi-experimental pre-test/post-test study was conducted involving 67 undergraduate physiotherapy students (mean age 22.06 ± 0.86 years). Participants were assigned to either a PNE intervention group (n = 31) or a control group (n = 36) using purposive sampling. The intervention group received a single 70-minute lecture on pain neuroscience, while the control group attended a 70-minute lecture on basic neuroanatomy. Pain knowledge was assessed before and immediately after the lectures using the 12-item Revised Pain Neurophysiology Questionnaire (RPNQ). **Results:** RPNQ scores in the PNE group increased significantly following the lecture ($p < 0.001$), with post-intervention scores (6.32 ± 2.02) exceeding pre-intervention scores (3.81 ± 1.60). A 2 × 2 mixed ANOVA revealed a significant effect of time ($p < 0.001$) and a significant group-by-time interaction ($p = 0.011$, partial eta squared = 0.096), indicating greater knowledge gains in the PNE group. No significant main effect of group was observed ($p = 0.400$). **Conclusion:** A single 70-minute PNE lecture significantly improved physiotherapy students' understanding of pain neurophysiology. Integrating PNE into physiotherapy education may enhance future clinicians' ability to manage pain effectively and empathetically.

Keywords: chronic pain, physiotherapy, students, teaching, treatment

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INTRODUCTION

Pain is among the most common reasons people seek medical care, especially when it becomes chronic and impacts daily life. Chronic pain can interfere with everyday activities, diminish quality of life, strain social relationships, and reduce workplace performance. The International Association for the Study of Pain (IASP) defines chronic primary pain as pain in one or more anatomical locations lasting more than three months and associated with significant emotional distress or functional limitations. Chronic pain often entails not only ongoing physical discomfort but also psychological stress and anxiety. Many patients report challenges with pain management, and approximately half feel their pain is not adequately controlled (Driscoll et al., 2018; Saracoglu et al., 2021).

Physiotherapy education programs have traditionally emphasized a biomechanical approach to managing disorders rather than incorporating pain science. In conventional physiotherapy practice, patient education tends to focus on anatomical or pathomechanical explanations for pain. In contrast, pain neuroscience education (PNE) emphasizes neurophysiological and neurobiological principles of pain generation and modulation (Meeus et al., 2010; Ryan et al., 2010). It is therefore crucial that physiotherapy students gain a strong understanding of PNE, as they will play an important role in future

pain management.

Prior research suggests that PNE can improve healthcare providers' knowledge, beliefs, and attitudes about pain. For example, Moseley (2003) demonstrated that educating patients about pain neurophysiology can shift their perceptions about pain. Saracoglu et al. (2021) found that incorporating PNE into an undergraduate physiotherapy curriculum enhanced students' understanding of pain and positively influenced their attitudes toward persistent low back pain. Including PNE content in physiotherapy and rehabilitation programs may thus be beneficial, as it helps students understand the nature of pain, underlying mechanisms, psychological factors, and effective pain management strategies. Ultimately, better pain education can improve patients' quality of life.

Despite the documented benefits of PNE, there are few studies in Malaysia examining PNE among physiotherapy students, which may hinder informed curriculum development and reduce physiotherapy students' readiness to implement PNE effectively in local clinical practice. To address this gap, the present study aimed to evaluate the effects of a short PNE session on undergraduate physiotherapy students' knowledge of pain.

METHODS

Study design and participants
This study used a quasi-experimental pretest/posttest design. A total of 67 undergraduate physiotherapy students (mean age = 22.06 ± 0.86 years) participated and were recruited from a single center. Participants were divided into two non-randomized groups: a control group (n = 36) and an intervention group (n = 31). The number of participants was based on the actual group in their academic class. A power analysis (effect size f = 0.25) indicated that approximately 98 participants would be needed to achieve 80% power at α = 0.05, accounting for a 20% dropout rate. Participants were recruited from the university students using purposive sampling. The achieved sample size was smaller than the estimated requirement due to practical constraints, including a limited pool of eligible undergraduate physiotherapy students during the data collection period and scheduling conflicts with academic commitments.

Eligibility criteria
The inclusion criteria for participation included: 1) Full-time undergraduate students (Year 2 and Year 3), 2) Age between 19 and 26. Individuals will be excluded if they have previously received PNE.

Ethical considerations
All participants were fully informed about the study procedures, and consent was obtained before participation. Ethical approval was obtained from the UiTM Research Committee. All information collected from participants was treated as private and confidential, solely for research purposes. The study strictly adhered to ethical guidelines and standards established by the review board to safeguard the well-being and rights of all participants.

Revised Pain Neurophysiology Questionnaire (RPNQ)
The 12-item RPNQ was used to assess knowledge of pain neurophysiology. Responses were categorized as yes, no, or undecided. Correct answers were awarded one point each. Scores ranged from 0 to 12, with higher scores indicating better knowledge. The RPNQ was a valid and reliable measure of pain knowledge (Catley et al., 2013).

Intervention

Control
The control group was taught a 70-minute PowerPoint-based presentation on basic neuroanatomy by a senior lecturer, an expert in Human Physiology. An overview of the nervous system, including the peripheral and central nervous systems (PNS and CNS), was presented to the control group. The lecture was delivered face-to-face in the classroom.

PNE group
A 70-minute PowerPoint-based didactic group lecture was delivered to the PNE group. A PNE theoretical lecture based on the justifications presented in Explain Pain (Butler and Moseley, 2003) was delivered to the intervention group by a physiotherapist. To illustrate pain science and theory, stories and analogies were used. The lecture was delivered face-to-face in the classroom.

Data collection procedure
All data collection took place in December 2024. The invitation was delivered by the WhatsApp channel for physiotherapy groups. 67 participants agreed to participate in this study. Before any instruction, participants completed a consent form and provided basic demographic information (age and year of study). Participants were then allocated to either the PNE lecture or the neuroanatomy (control) lecture as described above. The Revised Pain Neurophysiology Questionnaire (RPNQ) was administered by the researchers immediately before the lecture (PRE) and again immediately after (POST) for both groups. The theoretical lecture was delivered in a group. The study flowchart, adapted from the CONSORT diagram for randomized trials, is presented in Figure 1.
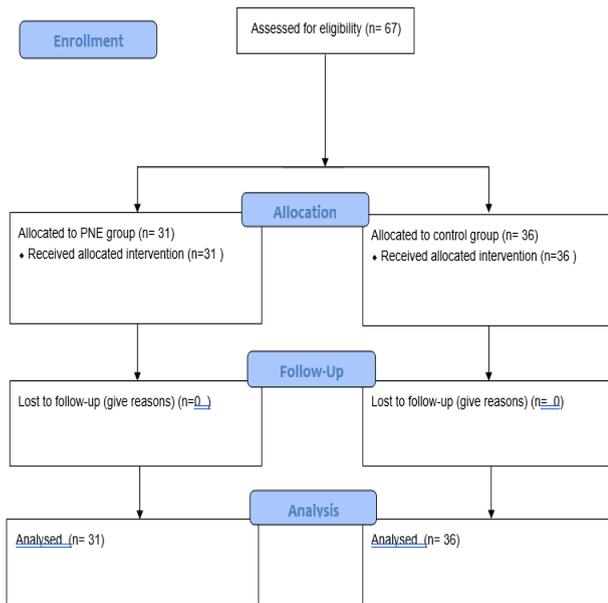
Figure 1: CONSORT flow diagram on the development of the quasi-experimental study

Data Analysis

Data were analyzed using SPSS Version 28. Descriptive statistics (means, standard deviations, and percentages) were calculated for participant characteristics and outcome measures. The Shapiro–Wilk test was used to confirm that the RPNQ scores were normally distributed. Independent t-tests were performed to compare baseline characteristics between the control and PNE groups. A paired t-test was used to evaluate the effect of the PNE lecture on RPNQ scores within the intervention group. Finally, a 2 × 2 mixed-design analysis of variance (ANOVA) was conducted to assess the effects of group (PNE vs. control) and time (PRE vs. POST) on RPNQ scores. The main hypothesis of interest for the ANOVA was the group × time interaction. Effect sizes for the ANOVA were interpreted using Cohen's criteria for partial eta squared, where 0.01 is a small effect, 0.06 is medium, and 0.14 is large (Cohen, 1988).

RESULTS

Descriptive Statistics

Demographic baseline data of participants

The participants' baseline demographic characteristics are presented in Table 1. There were no significant differences between the control and PNE groups in any baseline variable except for age (the PNE group was slightly older on average)

Table 1: Demographic baseline data of participants

	CONTROL (n=36)	INTERVENTION (n=31)	p- value
	Mean ± SD	Mean ± SD	
Age	22.06 ± 0.86	22.45 ± 0.72	0.050
Study year	2.42 ± 0.5	2.52 ±0.51	0.423
RPNQ	4.39 ± 1.32	3.81±1.6	0.107

SD=standard deviation; *significant at p < .05

The effect of PNE on physiotherapy students' knowledge of pain.

A paired t-test was conducted to assess the effect of PNE on knowledge. The paired t-test showed that the mean difference in total pre- and post-RPNQ scores was statistically significant ($t(30) = -5.81$, $p < 0.001$). The mean RPNQ post- intervention (mean = 6.323, SD = 2.0230) was significantly higher than the pre-intervention (mean = 3.81, SD = 1.60). As shown in Table 2, several individual items also demonstrated significant improvements:Q2: $t(30) = -2.66$, $p = <.001$, Q6: $t(30) = -0.35$, $p = .01$, Q9: $t(30) = -02.53$, $p= 0.02$, Q12: $t (30) = -4.45$, $p < .001$. These findings suggest that the PNE lecture was effective in enhancing participants' knowledge of pain neuroscience. Items Q1, Q3,Q4, Q5,Q7 Q8, Q10, and Q11 did not show significant changes (all $p > .05$).

Table 2 : Change of RPNQ score before and after the PNE lecture among 31 respondents

	Pre	Post	Mean difference (G5% CI)	t-stats (df)	p-value
	Mean ± SD	Mean ± SD			
Total	3.77 ± 1.63	6.26 ± 1.43	-2.66 (-3.34, -1.88)	-5.70 (30)	0.001*
Q1	.129± 01.71	6.26 ± 01.44	-.06 (-.33, .02)	-4.94(30)	0.63
Q2	.20 ± .046	0.36 ± 0.49	-.42(-.60, -.23)	-4.66(30)	0.001*
Q3	0.00 ± 0.00	.49 ± 0.50	-.10(-.32, -.12)	-.9(30)	0.37
Q4	.39 ± 0.48	.48 ± 0.38	-.16(-.40, .07)	-1.41(30)	0.17
Q5	.68 ± 0.46	.84 ± 0.38	-.13(-.29, .28)	-1.68(30)	0.10
Q6	.78 ± 0.48	.90 ± 0.20	-.35(-.60, -.11)	-2.99(30)	0.01*
Q7	.36 ± 0.49	.71 ± 0.46	-.13(-.31, .05)	-1.44(30)	0.16

Q8	.13 ± 0.34	.25 ± 0.45	-.16(-.38, .05)	-1.54(30)	0.13
Q9	.13 ± 0.34	.29 ± 0.46	-.23(-.41, -.04)	-2.53(30)	0.02*
Q10	.32 ± 0.18	.19 ± 0.40	-.03(-.25, .18)	-.97(30)	0.77
Q11	.45 ± 0.51	.54 ± 0.51	-.10(-.35, .16)	-0.78(30)	0.45
Q12	.52 ± 0.51	.97 ± 0.18	-.45(-.64, -.27)	-4.97(30)	0.001*

A 2 × 2 mixed analysis of variance (ANOVA) was conducted to determine the effect of two groups (PNE lecture vs basic neuroanatomy) on participants at pre-intervention and post-intervention. Table 3 shows that there was a significant main effect for time at PRE and POST, Wilks' Lambda = 0.55, F = 52.476, p< .0.001, partial eta squared = 0.435. The main effect comparing the two intervention types was not significant, F = 0.79,

$p = 0.400$, partial eta squared = .011, suggesting no difference in effectiveness between the two approaches. There was a significant interaction between program type and time, Wilks' Lambda = 0.9, F = 7.01, p = 0.011, partial eta squared = 0.096. There were greater percentage changes in the intervention group (64.3%) compared to the control group (33.41%).

Table 3: Comparison the effect of PNE on knowledge towards pain

PERFORMANCE		CONTROL			INTERVENTION			MIX-ANOVA OUTCOME (P-VALUE)		
		BASELINE	POST		BASELINE	POST				
		Mean ± SD	Mean ± SD	CHANGE (%)	Mean ± SD	Mean ± SD	CHANGE(%)	TIME	GROUP	GROUP X TIME
RPNQ	POST	4.22 ±1.38	5.36 ± 1.57	33.41	3.81 ± 1.6	6.26 ±1.43	64.3	0.001*	0.400	0.011*

Frequency, f(%); mean ± standard deviation (SD); *significant at p < .05
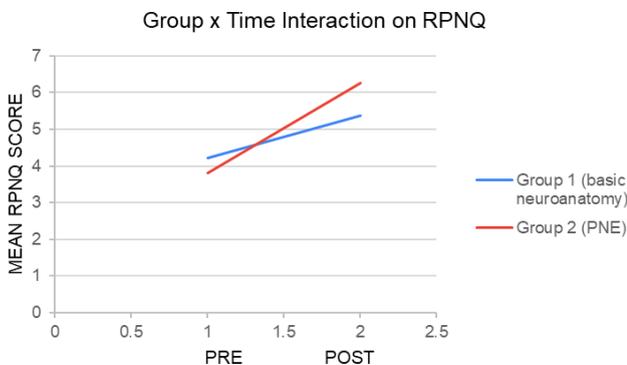

Figure 2: Interaction effect between time and group

DISCUSSION

The primary goal of this study was to investigate the impact of a short PNE lecture on physiotherapy students' knowledge of pain and to compare it with that of a traditional neuroanatomy lecture. Overall, the findings demonstrate that a single 70-minute PNE lecture can significantly enhance students' understanding of pain neurophysiology, as evidenced by the PNE group's increased total RPNQ scores. This result aligns with previous research indicating that educational interventions focusing on pain mechanisms can positively influence individuals' beliefs and attitudes toward pain (Andrea et al., 2025; Louw et al., 2011; Moseley,2003).

In the PNE group, significant improvements were observed for specific RPNQ items, particularly those addressing the biological and cognitive aspects of pain. This suggests that participants understood the lecture's

key concepts. These results support the notion that even brief educational sessions can produce meaningful cognitive shifts, which may contribute to improved pain management outcomes (Moseley & Butler, 2015). However, several other RPNQ items (Q1, Q3, Q4, Q5, Q7, Q8, Q10, and Q11) did not show significant changes. This could indicate content areas where the lecture was not sufficiently detailed or where students already had relatively high baseline knowledge.

One plausible explanation for the lack of change in certain items is the complexity of the concepts involved. Some pain-related beliefs, especially those rooted in a traditional biomedical model, can be resistant to change (Louw et al., 2011; Moseley, 2003). For instance, items that challenge the notion that pain is directly proportional to tissue damage or introduce ideas such as central sensitization may conflict with participants' pre-existing beliefs. A single lecture might not provide enough time and reinforcement for students to fully internalize these more challenging concepts.

The format and duration of the intervention may also have influenced the outcomes. While the 70-minute lecture was informative, it might not have offered the depth or reinforcement necessary for more substantial cognitive restructuring. Nijs et al. (2011) emphasized that effective PNE often requires multimodal delivery, including visual aids, metaphors, and interactive discussions, often over multiple sessions. Thus, the one-time, didactic nature of our session may have limited its impact on deeply entrenched misconceptions.

Additionally, there is the possibility of ceiling or floor effects for certain RPNQ items. Items with high correct response rates at baseline would have limited room for improvement (for example, item Q5 had a relatively high pre-lecture correct rate). Conversely, items with very low initial understanding might require more intensive educational strategies to show measurable change. It is notable that items Q8, Q10, and Q11 had low scores; even after the lecture, many participants answered these incorrectly on the post-test. This pattern echoes findings from other studies using the RPNQ, which have reported that certain pain concepts consistently show minimal improvement after brief interventions (Louw et al., 2011).

Despite these nuances, the intervention group showed a significantly greater overall improvement in pain knowledge compared to the control group, as evidenced by the significant group-by-time interaction. This supports the hypothesis that PNE is a valuable addition to physiotherapy education for improving pain-related knowledge. Our results are in line with those of Andrea et al. (2025), who conducted a meta-analysis of 19 studies and concluded that PNE interventions significantly reduce pain intensity and cognitive distortions related to pain (such as fear-avoidant beliefs and catastrophizing). That work highlights that even brief PNE sessions can lead to meaningful improvements in outcomes for individuals with chronic musculoskeletal pain.

The improvements in RPNQ scores in our PNE group reflect a shift in how the students conceptualize pain from a purely biomedical perspective toward a more comprehensive biopsychosocial framework. PNE emphasizes that pain is not always a straightforward indicator of tissue damage, but rather a complex output of the nervous system influenced by multiple factors. Adopting this understanding is crucial for reducing maladaptive beliefs like fear-avoidance and catastrophizing, which are known to perpetuate chronic pain (Moseley, 2003; Louw et al., 2011). Our findings resonate with prior clinical studies and reviews: Louw et al. (2011) noted that PNE, when combined with physiotherapy, can improve patient outcomes, and Moseley and Butler (2015) observed that helping patients reconceptualize pain through education empowers them and encourages positive behavioral changes.

Interestingly, although the PNE intervention clearly improved knowledge over time (as shown by the strong time effect in the ANOVA), the overall group effect was not significant. This suggests that, at baseline, the two groups had comparable knowledge levels, and that both improved to some extent after their respective lectures (with the control group perhaps gaining some general knowledge from the neuroanatomy review). The interaction effect, however, indicates that the PNE lecture led to a greater magnitude of improvement. In terms of effect size, the observed interaction falls in the moderate range (Cohen, 1988), suggesting the knowledge gains are not only statistically significant but also educationally meaningful.

In summary, the present study, consistent with recent literature such as Andrea et al. (2025), provides evidence that even a single-session PNE intervention can be an effective tool for improving pain knowledge and potentially shifting maladaptive pain beliefs among physiotherapy students. These insights could have important implications for physiotherapy curricula and clinical practice.

Educational and Clinical Implication
The findings of this study suggest that even brief educational interventions can produce substantial improvements in students' pain literacy. Clinicians and educators should consider incorporating PNE into routine training for physiotherapy students and healthcare providers. By improving understanding of pain neurophysiology, PNE can foster patients' self-efficacy and encourage more active participation in rehabilitation, as patients better understand that pain can be managed and is not always indicative of severe harm.

When physiotherapy students acquire a deeper understanding of the neurophysiological and biopsychosocial aspects of pain, they become better equipped to assess patient conditions with greater empathy and accuracy. This knowledge enables future therapists to choose more effective, evidence-based treatment strategies, ultimately improving patient outcomes and advancing the standard of care. Additionally, the benefits of PNE extend beyond individual clinical encounters; they can also benefit community health initiatives. As noted by Andrea et al. (2025), PNE is a low-cost, scalable intervention that can be adapted for diverse populations and delivery formats. Given its accessibility and impact, integrating dedicated PNE content into undergraduate physiotherapy curricula could strengthen students' foundational understanding of pain early in their training. Early exposure to PNE principles may help students adopt a more holistic approach to persistent pain, improve their communication with patients about pain, and emphasize empathy in their clinical practice.

Limitations and Future Directions
This study contributes to the growing evidence supporting the value of PNE in physiotherapy education. However, several limitations should be considered when interpreting the results, and they point toward directions for future research. First, the sample size was relatively small, which may limit statistical power and the generalizability of the findings. A larger sample would provide a more robust test of the intervention's effects and help confirm these results across a broader student population. Second, the study relied on a single-session lecture format. While we observed short-term improvements in knowledge, a

one-time lecture may be insufficient to address deeply ingrained pain-related beliefs or misconceptions. Previous studies have highlighted the benefits of multi-session, interactive PNE programs for achieving more sustained changes (Nijs et al., 2011; Louw et al., 2016). In addition, the study only assessed immediate

Effects using the RPNQ, administered before and directly after the lecture. Without longitudinal follow-up, the lasting impact of the intervention remains unknown, and it is unclear whether short PNE lectures produce durable changes in pain-related knowledge or beliefs over time. Finally, the exclusion of final-year (Year 4) physiotherapy students, who typically possess more advanced theoretical and clinical experience, may have influenced the findings, potentially underestimating the broader impact of PNE across academic levels.

CONCLUSION

In conclusion, this study provides evidence that a single 70-minute PNE lecture can significantly improve physiotherapy students' understanding of pain neurophysiology, as reflected in higher RPNQ scores. The students who received PNE showed markedly greater knowledge gains than those who received a traditional neuroanatomy lecture, underscoring the educational impact and clinical relevance of PNE. These findings are consistent with previous research and highlight the importance of incorporating PNE as a foundational component of pain management training. While the lecture successfully conveyed key concepts, especially the biological and cognitive aspects of pain, some topics remained resistant to change in a one-off session, likely due to either conceptual complexity or pre-existing beliefs. This suggests that certain complex pain concepts may require more extensive or repeated educational efforts. Overall, the results demonstrate the potential of even short-form PNE to shift students' perspectives from a strictly biomedical view of pain to a more integrative biopsychosocial understanding. Embedding PNE content into physiotherapy curricula could better equip future clinicians to manage pain holistically, improving patient outcomes and fostering greater empathy in care. Moreover, PNE is a valuable tool for community health initiatives, especially in settings where access to multidisciplinary pain management is limited. Future research should build on these findings by using larger sample sizes, incorporating interactive and longitudinal educational approaches, and including students at various levels of training to fully explore the long-term impact of PNE in physiotherapy education.

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