DOI 10.26773/smj.240720

SportMont

ORIGINAL SCIENTIFIC PAPER

Effect of Different Instructions on Learning Proprioceptive Neuromuscular Facilitation Skills among Physiotherapy Students

Mohd Helmi Kamal[1,2] & Hosni Hasan[1]

[1]Universiti Teknologi MARA, Faculty of Sports Science and Recreation, Shah Alam, Malaysia, [2]Ministry of Health Malaysia, Management Training Division, Putrajaya, Malaysia

Abstract

This study aims to assess the effect of different instructions on learning proprioceptive neuromuscular facilitation (PNF) skills among physiotherapy students. Twenty-five (n=25) first-year undergraduate physiotherapy students were randomly assigned into two groups. The first group (n=12) was a live demonstration group watching the instructor performing the technique, while the second group (n=13) was a video demonstration group watching a pre-recorded video by the same instructor. Both groups were shown identical eight (8) patterns of PNF skills. After watching the skill, the students in both groups were asked to perform in an isolation room using all the techniques shown to measure their psychomotor skills using the standard Objective Structured Clinical Examination form. The test revealed an insignificant difference in the total performance score between live and video demonstrations of PNF skills among physiotherapy students. Live demonstration group (Mean=59.50±25.69) and video demonstration group (Mean=75.00±13.71), U=48.5, z=-1.605, p>0.05, r=0.321. The finding of this study indicates that live and video demonstration groups are on par in performing the PNF skills. Although video demonstration may reduce time teaching and at the same time ensure the students learn motor skills accordingly. The current study suggests that video demonstration should be employed as an adjunct to pre-, during, and post-live demonstration to augment knowledge retention. This finding can also be a reference for policymakers or higher institutions to decide to change the existing policy for new norms after the breakout of COVID-19 as there is no difference in students' performance between these two groups.

Keywords: *Covid-19, proprioceptive neuromuscular facilitation, live instructions, video instructions*

Introduction

Proprioceptive Neuromuscular Facilitation (PNF) is part of the treatment given by the physiotherapist to the patient to promote or hasten the response of the neuromuscular mechanism through stimulation of the proprioceptors, and it is aimed at effect motor learning from a lasting response of the neuromuscular mechanism (Chaturvedi et al., 2017; Smedes, Heidmann, Schäfer, Fischer, & Stępień, 2016). Sagittal, frontal, and transverse planes and movement diagonally in line with muscle fiber arrangement were the patterns involved. There were three types of contraction combined in PNF which are concentric, isometric, and eccentric contraction and at the same time, auditory, visual, and cutaneous also been stimulated to improve neuromuscular facilitation (Nunes & Martins e Silva, 2016).

PNF is known for improving the flexibility and strength of the muscles, reducing pain and stiffness, and improving trunk stability. According to Lim, Nam and Jung (2014) PNF stretching is being used widely in athletic training, and it serves to avoid injuries. Borges, Medeiros, Minotto and Lima (2018) claim athletes who sustain hamstring tightness can implement PNF stretching to enhance hamstring flexibility due to it is effectiveness in improving the flexibility of the muscles. Besides improving flexibility and strength of the muscles Birinci,

Correspondence:

Hosni Hasan
Universiti Teknologi MARA, Faculty of Sports Science and Recreation, 40450 Shah Alam, Malaysia
E-mail: hosnihasan@uitm.edu.my

Razak Ozdincler, Altun and Kural (2019) claim an individual with a golfer's elbow (elbow tendinitis) can benefit from PNF stretching by alleviating pain, enhancing range of motion, and reducing stiffness. However, studies by Papadimitriou, Loupos, Tsalis, and Manou (2017) on PNF among swimmers didn't produce a positive or negative effect in their results (i.e. 10 10-10-second kick trial & hip curl and extension).

PNF requires a complex task and requires many demonstrations due to mapping ample input space to a large output space, for example, from camera input to the desired joint movement (Manschitz, Gienger, Kober, & Peters, 2018). Farsi, Bahmanbegloo, Abdoli, and Ghorbani (2016) stated that coaches, instructors, and physical educators used live demonstrations widely when teaching new motor skills. According to White, Rodger, and Tang (2016), skill is a stable and reliable link between the perception of humans and the environmental constraint to perform the task, which is compatible across persistent performances of the action and can be adapted to changes in task constraints flexibly. While this task is trained repeatedly, it can enhance spatial and temporal, which control the accuracy of movements (Bonassi et al., 2020).

Face-to-face is a well-recognized form of learning; however, it is necessary to prepare for distance learning in higher institutions due to unexpected events in the future such as COVID-19 (Arifiati et al., 2020). The COVID-19 pandemic has put forth a great challenge for higher institutions with the remarkable responsibility of reconsidering delivering excellent quality education when implementing social distancing policies by the government to prevent further spreading the virus. As a result, all higher institutions carried out distance learning to overcome the constraints in delivering the lessons and continuing the academic schedule (Amir et al., 2020; Zutshi, 2020). Various approaches to e-learning are being used to make sure the continuousness of the higher education learning process does not stop, including Zoom, Google Meet, Google Classroom, Telegram, and many more platforms (Kapasia et al., 2020).

Even though live demonstration are well known for delivering the best outcome in motor learning skills for the past several decades, Seals, Gustowski, Kominski, and Li (2016) claim a live demonstration can be replaced by a video demonstration to give more time on assessment and feedback in the practical session. There were several advantages of video demonstration compared to live demonstration. Brockfeld, Müller, and de Laffolie (2018) mention that one of the advantages was video demonstration could be repeated at any time and place while the student does not have to attend lecture class. Besides that, the university improves the learning process through e-learning. In addition, the learning effects of live and video demonstrations are equal, and this has been confirmed in other fields (Azeem, Ali, Shaukat & Arfan ul Haq, 2018; Thulakumar, Jayasinghe, Rasnayaka, Jayasinghe, & Abeysundara, 2018).

Nowadays demand for delivering the best approach to education in higher institutions puts great pressure on to lecturers teach motor learning skills in physiotherapy programs. With the constraint of live demonstration teaching hours and increasing demand in clinical settings and real-world situations, the students need to prepare themselves to overcome this limitation, especially in the pandemic situation of COVID-19 (Stone, Cooke, & Mitchell, 2020). Video demonstrations are pre-recorded demonstrations of the motor skills that need to be learned and are part of the solution that is thought can fill the gap in delivering and transferring the knowledge among the students. Therefore, further research and evaluation of transferability of the motor learning skills through watching video demonstrations need to be done compared to live demonstrations which are already known to deliver the knowledge (Stone et al., 2020).

Nevertheless, to our knowledge, the effectiveness of video demonstration compared with a live demonstration in acquiring hands-on skills among physiotherapy students is still limited in the previous literature. PNF exercises are among the complex exercises that need to be learned by the student to conduct the exercise to the client. Information technologies are alternative to fill the gap or lack in lab activity on campus. Therefore, the purpose of this study was to compare live instruction with video-based instruction methods for learning proprioceptive neuromuscular facilitation skills among physiotherapy students.

Material and methods

Participants

The study population was Physiotherapy students in a local university. The sampling technique that was used in this study was purposive sampling. Only semester one student were selected due to only this group had not learned or knew anything about PNF while the other Physiotherapy students in higher semesters had learned PNF. The students participated voluntarily in this study and was assigned into two groups: live demonstration group (n=12, mean age 19.67±0.89 years old) and video demonstration group (n=13, mean age 19.69±1.11 years old). This study was approved by the Research Ethics Committee, Research Management Centre, Universiti Teknologi MARA (REC/09/2021(MR/762)).

Procedures

During the live demonstration, the researcher performed the eight patterns of PNF skills, and the participants could only watch while disallowed to interrupt or ask any questions in that session. It took only 20 minutes to perform all eight PNF patterns (Diagonal 1 Flexion Upper Limb, Diagonal 1 Extension Upper Limb, Diagonal 2 Flexion Upper Limb, Diagonal 2 Extension Upper Limb, Diagonal 1 Flexion Lower Limb, Diagonal 1 Extension Lower Limb, Diagonal 2 Flexion Lower Limb, and Diagonal 2 Extension Lower Limb). For the video demonstration, the researcher did a pre-recorded video on eight patterns of PNF skills (same movement as in the live demonstration group), and participants only watched the video through the LCD provided by the researcher while disallowed to interrupt or ask any question in that session. It took only 20 minutes to watch all the PNF patterns. The equipment used to record the demonstration in this study was a handphone camera model OPPO F11 (Oppo, Hong Kong), while during the video demonstration laptop brand Lenovo (Chengdu, China) was used to play the video. The measurement of PNF skills was taken in one trial during the post-test. A researcher with more than 10 years of experience teaching the Physiotherapy Program conducted the assessments using the Objective Structured Clinical Examination Form. The participants were graded one at a time using the same human model. All eight patterns of PNF skills were assessed for each participant at one time by the researcher. The participant read the instructions given and followed by performing the PNF skills for each eight pattern involving four patterns for the upper limb and four patterns for the lower limb. The participants started by intro-

ducing themselves and then they explained the procedure to the model. After that, the participant is required to move the model's limb passively three times followed by asking the model to perform the movement pattern three times while the participant resists the movement as shown in the demonstration.

Data Analysis

IBM SPSS Statistics for Windows Version 21.0 (IBM Corp., Armonk, NY, USA) was used for statistical analysis. The data was check using Shapiro-Wilk Test to identify normal distribution. Mann-Whitney U test was carried out to determine the significant level of the Objective Structured Clinical Examination (PNF Movement) results due to the data are generally not normal distributed when using Shapiro-Wilk Test ($p<0.05$). The significant level of this study was set at $p<0.05$ and the effect size (r) of <0.3 (small effect), 0.3 to 0.5 (medium) and >0.5 (large).

Results

The performance score of PNF Diagonal 1 Flexion Upper Limb pattern among physiotherapy students (Table 1) by live demonstration (Mean=11.17±1.80) and video demonstration group (Mean=11.69±1.03,), U=61.5, z=-0.924, p=0.355, r=0.185 (there was no significant difference between the two groups). The performance score of PNF Diagonal 1 Extension Upper Limb pattern among physiotherapy students by live demonstration (Mean=9.75±4.86) and video demonstration group (Mean=10.92±1.04), U=73.5, z=-0.249, p=0.803, r=0.050 (there was no significant difference between the two groups). The performance score of PNF Diagonal 2 Flexion Upper Limb pattern among physiotherapy students by live demonstration (Mean=6.08±5.55) and video demonstration group (Mean=8.23±4.02), U=61.0, z=-0.0944, p=0.345, r=0.019 (there was no significant difference between the two groups).

Table 1. The results obtained by live and video demonstrations group for each PNF patterns

PNF Movements	Live		Video		U	z	p	r
	Mean	SD	Mean	SD				
Diagonal 1 Flexion Upper Limb	11.17	1.80	11.69	1.03	61.5	-0.924	0.355	0.185
Diagonal 1 Extension Upper Limb	9.75	4.86	10.92	1.04	73.5	-0.249	0.803	0.050
Diagonal 2 Flexion Upper Limb	6.08	5.55	8.23	4.02	61.0	-0.0944	0.345	0.0190
Diagonal 2 Extension Upper Limb	6.17	5.52	8.00	4.81	65.5	-0.704	0.048	0.141
Diagonal 1 Flexion Lower Limb	7.25	4.58	10.15	3.29	35.5	-2.344	0.019	0.459
Diagonal 1 Extension Lower Limb	6.92	5.20	9.62	3.20	59.5	-1.027	0.305	0.205
Diagonal 2 Flexion Lower Limb	5.50	4.70	8.62	3.36	48.0	-1.654	0.098	0.331
Diagonal 2 Extension Lower Limb	6.67	5.42	7.77	3.85	71.5	-0.358	0.720	0.072

Abbreviations: U - Mann-Whitney U Test; p - significant level; z - z score; r - effect size.

The performance score of PNF Diagonal 2 Extension Upper Limb pattern among physiotherapy students by live demonstration (Mean=6.17±5.52) and video demonstration group (Mean=8.00±4.81), U=65.5, z=-0.704, p=0.482, r=0.141 (there was no significant difference between the two groups). The performance score of PNF Diagonal 1 Flexion Lower Limb pattern among physiotherapy students by live demonstration (Mean=7.25±4.58) and video demonstration group (Mean=10.15±3.29), U=35.5, z=-2.344, p=0.019, r=0.469 (there was a significant difference between the two groups). The performance score of PNF Diagonal 1 Extension Lower Limb pattern among physiotherapy students by live demonstration (Mean=6.92±5.20) and video demonstration group (Mean=9.62±3.20), U=59.5, z=-1.027, p=0.305, r=0.205 (there was no significant difference between the two groups). The performance score of PNF Diagonal 2 Flexion Lower Limb pattern among physiotherapy students by live demonstration (Mean=5.50±4.70) and video demonstration group (Mean=8.62±3.36), U=48, z=-1.654, p=0.098, r=0.331 (there was no significant difference between the two groups). The performance score of PNF Diagonal 2 Extension Lower Limb pattern among physiotherapy students by live demonstration (Mean=6.67±5.42) and video demonstration group (Mean=7.77±3.85), U=71.5, z=-0.358, p=0.720, r=0.072 (there was no significant difference between the two groups).

The test revealed insignificant difference (Table 2) in the total performance score between live and video demonstration on PNF skills among physiotherapy students by live demonstration group (Mean=59.50±25.69) and video demonstration group (Mean=75.00±13.71), U=48.5, z=-1.605, p=0.109, r=0.321 (there was no significant difference between the two groups).

Table 2. Mean (SD) for score performance for the total mark of all the patterns

PNF Movements	Live		Video		U	z	p	r
	Mean	SD	Mean	SD				
Total Performance Score	59.50	25.69	75.00	13.71	48.5	-1.605	0.109	0.321

Abbreviations: U - Mann-Whitney U Test; p - significant level; z - z score; r - effect size.

Discussion

The purpose of this study was to determine the effect of different instructions on learning proprioceptive neuromuscular facilitation (PNF) skills among physiotherapy students. In this study, the participants were given 20 minutes each to learn the PNF technique either via live or video demonstrations. It was hypothesized that there is no significant difference in total performance score between live and video demonstra-

tion of PNF skills among physiotherapy students, and it was proved that the result was the same. This finding is consistent with some recent studies (Alqahtani et al., 2015; Azeem et al., 2018; Gorucu-Coskuner, Atik & Taner, 2020). The causes of no significant differences between live and video demonstration group in this study maybe due to experience by the participants and the time constraints when participants receiving live instructions. The content of delivering instructions for live and video demonstrations in this study are similar, thus the participants can follow the instructions and remembers the flow the movements easily in order to perform the PNF movements. In addition, all participants in this study were in the first year, and they don't any experience yet in performing the movement task. However, in the previous study by Ramlogan, Raman and Sweet (2013) and Gorucu-Coskuber, Atik and Taner (2020), the participants in their study were in the third and fifth year, and have some basic experience in performing the skill tasks, that produced significant differences between live and video instructions groups.

During live instructions, participants have to shift their eyes many times to follow the cues by the instructor in order to look for important points when learning the PNF movement patterns. Preston et al. (2012) claimed the weaknesses of live demonstration as current students of physiotherapy program were taught through the live demonstration. After a live demonstration, the lecturer will allow students to practice and get feedback in a limited time during class. The students who wholly depend solely on memory or simple notes taken during the class will be inaccurate in practicing the skills acquired via live demonstration. Alqahtani et al. (2015) also agreed with Preston et al. (2012) by revealing that live demonstration had disadvantages: lack of manpower to demonstrate, low ratio of lecturer to students, and time constraint to demonstrate. In addition, despite there were no significant differences between the live and video demonstration groups, participants in the video group may see better on the technique as they can bring the device closer to their eyes, or can focus on the image as compared to the video demonstration where in reality it will be with every-one crowding around (Alqahtani et al, 2015).

As this study found no significant differences between live and video demonstrations, the usage of these methods are advisable for skill learning task in physiotherapy, sports and clinical settings. Gorucu-Coskuber, Atik and Taner (2020) states that the participants in the study preferred both method of instructions in order to achieve highest effect in the learning the skills task. In addition, the use of both methods also should be considered as the learning style of the students are not the same (Alqahtani et al, 2015). Future studies also should look at whether combining live and video demonstrations can produce highest learning effect and compared to live or video demonstrations only.

Conclusion

The finding of this study indicates that live and video demonstration groups are on par in performing the PNF skills. This finding can also be a reference for policymakers or higher institutions to make necessary changes to the existing policy in the education sector after the breakout of COVID-19 as there is no difference in students' performance between these two groups. The video demonstration is equally as practical as a live demonstration. To improve students' learning experiences and match multiple intelligences, both methods should be considered in teaching undergraduate physiotherapy students. Future studies should investigate the effect of different feedback methods on learning PNF skills among physiotherapy students in the universities.

Acknowledgments
There are no acknowledgments.

Conflict of interest
The authors declare that there are no conflict of interest.

Received: 16 April 2024 | **Accepted:** 29 May 2024 | **Published:** 01 June 2024

References

Alqahtani, N. D., Al-Jewair, T., Al-Moammar, K., Albarakati, S. F., & Alkofide, E. A. (2015). Live demonstration versus procedural video: A comparison of two methods for teaching an orthodontic laboratory procedure Approaches to teaching and learning. *BMC Medical Education, 15*(1), 1–4. https://doi.org/10.1186/s12909-015-0479-y

Amir, L. R., Tanti, I., Maharani, D. A., Wimardhani, Y. S., Julia, V., Sulijaya, B., & Puspitawati, R. (2020). Student perspective of classroom and distance learning during COVID-19 pandemic in the undergraduate dental study program Universitas Indonesia. *BMC Medical Education, 20*(1), 1–8. https://doi.org/10.1186/s12909-020-02312-0

Arifiati, N., Nurkhayati, E., Nurdiawati, E., Pamungkas, G., Adha, S., Purwanto, A., Julyanto, O., & Azizi, E. (2020). University Students Online Learning System During Covid-19 Pandemic: Advantages, Constraints and Solutions. *Systematic Reviews in Pharmacy, 11*(7), 570–576.

Azeem, M., Ali, S., Shaukat, A., & Arfan ul Haq. (2018). Traditional Lecture. *The Professional Medical Journal, 25*(06), 937–940. https://doi.org/10.29309/tpmj/18.4706

Birinci, T., Razak Ozdincler, A., Altun, S., & Kural, C. (2019). A structured exercise programme combined with proprioceptive neuromuscular facilitation stretching or static stretching in posttraumatic stiffness of the elbow: a randomized controlled trial. *Clinical Rehabilitation, 33*(2), 241–252. https://doi.org/10.1177/0269215518802886

Bonassi, G., Lagravinese, G., Bisio, A., Ruggeri, P., Pelosin, E., Bove, M., & Avanzino, L. (2020). Consolidation and retention of motor skill after motor imagery training. *Neuropsychologia, 143*(4), 107472. https://doi.org/10.1016/j.neuropsychologia.2020.107472

Borges, M. O., Medeiros, D. M., Minotto, B. B., & Lima, C. S. (2018). Comparison between static stretching and proprioceptive neuromuscular facilitation on hamstring flexibility: systematic review and meta-analysis. *European Journal of Physiotherapy, 20*(1), 12–19. https://doi.org/10.1080/21679169.2017.1347708

Brockfeld, T., Müller, B., & de Laffolie, J. (2018). Video versus live lecture courses: a comparative evaluation of lecture types and results. *Medical Education Online, 23*(1). https://doi.org/10.1080/10872981.2018.1555434

Chaturvedi, P., Tiwari, V., Singh, A. K., Kulshrestha, D., Maurya, P. K., & Thacker, A. K. (2017). Effects of Early Proprioceptive Neuromuscular Facilitation Exercises on Functional Outcome and Quality of Life in Patients with Stroke. *MGM Journal of Medical Sciences, 4*(3), 130–133. https://doi.org/10.5005/jp-journals-10036-1155

Farsi, A., Bahmanbegloo, Z. H., Abdoli, B., & Ghorbani, S. (2016). The effect of observational practice by a point-light model on learning a novel motor skill. *Perceptual and Motor Skills, 123*(2), 477–488. https://doi.org/10.1177/0031512516662896

Gorucu-Coskuner, H., Atik, E., & Taner, T. (2020). Comparison of live-video and video demonstration methods in clinical orthodontics education. *Journal of Dental Education*, *84*(1), 44-50.

Kapasia, N., Paul, P., Roy, A., Saha, J., Zaveri, A., Mallick, R., Barman, B., Das, P., & Chouhan, P. (2020). Impact of lockdown on learning status of undergraduate and postgraduate students during COVID-19 pandemic in West Bengal, India. *Children and Youth Services Review, 116*(6), 105194. https://doi.org/10.1016/j.childyouth.2020.105194

Lim, K. Il, Nam, H. C., & Jung, K. S. (2014). Effects on hamstring muscle extensibility, muscle activity, and balance of different stretching techniques. *Journal of Physical Therapy Science, 26*(2), 209–213. https://doi.org/10.1589/jpts.26.209

Manschitz, S., Gienger, M., Kober, J., & Peters, J. (2018). Mixture of Attractors: A Novel Movement Primitive Representation for Learning Motor Skills from Demonstrations. *IEEE Robotics and Automation Letters*, 3(2), 926–933. https://doi.org/10.1109/LRA.2018.2792531

Nunes, M., & Martins e Silva, D. (2016). Motor Irradiation According to the Concept of Proprioceptive Neuromuscular Facilitation: Measurement Tools and Future Prospects. *International Journal of Physical Medicine &*

Rehabilitation, 04(02), 4–5. https://doi.org/10.4172/2329-9096.1000330

Papadimitriou, K., Loupos, D., Tsalis, G., & Manou, B. (2017). Effects of proprioceptive neuromuscular facilitation (PNF) on swimmers leg mobility and performance. *Journal of Physical Education and Sport, 17*(2), 663–668. https://doi.org/10.7752/jpes.2017.02099

Preston, E., Ada, L., Dean, C. M., Stanton, R., Waddington, G., & Canning, C. (2012). The Physiotherapy eSkills Training Online resource improves performance of practical skills: A controlled trial. *BMC Medical Education, 12*(1). https://doi.org/10.1186/1472-6920-12-119

Ramlogan, S., Raman, V., & Sweet, J. (2014). A comparison of two forms of teaching instruction: video vs. live lecture for education in clinical periodontology. *European Journal of Dental Education*, *18*(1), 31-38.

Seals, R., Gustowski, S. M., Kominski, C., & Li, F. (2016). Does replacing live demonstration with instructional videos improve student satisfaction and osteopathic manipulative treatment examination performance? In *Journal of the American Osteopathic Association, 116*(11), 726–734). https://doi.org/10.7556/jaoa.2016.143

Smedes, F., Heidmann, M., Schäfer, C., Fischer, N., & Stępień, A. (2016). The proprioceptive neuromuscular facilitation-concept; the state of the evidence, a narrative review. *Physical Therapy Reviews, 21*(1), 17–31. https://doi.org/10.1080/10833196.2016.1216764

Stone, R., Cooke, M., & Mitchell, M. (2020). Undergraduate nursing students' use of video technology in developing confidence in clinical skills for practice: A systematic integrative literature review. *Nurse Education Today, 84*, 104230. https://doi.org/10.1016/j.nedt.2019.104230

Thilakumara, I. P., Jayasinghe, R. M., Rasnayaka, S. K., Jayasinghe, V. P., & Abeysundara, S. (2018). Effectiveness of Procedural Video Versus Live Demonstrations in Teaching Laboratory Techniques to Dental Students. *Journal of Dental Education, 82*(8), 898–904. https://doi.org/10.21815/jde.018.086

White, C., Rodger, M. W., & Tang, T. (2016). Current understanding of learning psychomotor skills and the impact on teaching laparoscopic surgical skills. *The Obstetrician & Gynaecologist, 18*(1), 53–63. https://doi.org/10.1111/tog.12255