Lessons about Motor Learning: How Is Motor Learning Taught in Physical Therapy Programmes Across Canada?

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ABSTRACT

Purpose: This article describes the content of and delivery methods for motor learning (ML) education and the attitudes and beliefs of instructors with regard to how ML is taught in Canadian physical therapy (PT) programmes. **Method:** A qualitative descriptive design was employed, using an online questionnaire and semi-structured telephone interviews. A descriptive content analysis was used to develop codes and themes. An online search of PT programme Web sites was conducted to supplement missing data and collect information from schools that did not participate in the online questionnaire or interview. **Results:** Eight individuals representing seven schools completed the questionnaire; six of the eight also completed the interview. Responses conveyed the fact that ML content was fairly consistent across schools and was predominantly situated in the neurological curriculum. Schools differed in the delivery methods used for clinical application of ML content. Respondents believed that ML underlies PT practice and should be integrated throughout the programme. **Conclusion:** Current instruction may deliver adequate ML content but may not provide optimal opportunities to apply ML principles in a clinical context. Continuing education emerged as one suggestion for remediating clinicians' knowledge–practice gap and facilitating student learning on placement. Only half the eligible PT schools participated, and all were English-language programmes; thus, the findings may not be generalizable to all Canadian programmes. Future work should explore how ML can be integrated into the PT curriculum to promote the application of ML principles across different fields. Students' perspectives on their understanding of ML and ML principles and self-efficacy for entry to practice should also be explored.

Key Words: curriculum; education; motor learning; survey; qualitative research.

RÉSUMÉ

Objectif : décrire le contenu et le mode de prestation de l'apprentissage moteur (AM) ainsi que les attitudes et les croyances des professeurs à l'égard du mode d'enseignement de l'AM dans les programmes de physiothérapie du Canada. **Méthodologie :** méthodologie descriptive qualitative à l'aide d'un questionnaire en ligne et d'entrevues téléphoniques semi-structurées. Les auteurs ont utilisé une analyse de contenu descriptive pour élaborer les codes et les thèmes. Ils ont effectué une recherche dans les sites Web des programmes de physiothérapie pour compléter les données manquantes et colliger de l'information sur les écoles qui n'avaient pas participé au questionnaire en ligne ni à l'entrevue. **Résultats :** huit personnes, représentant sept écoles, ont rempli le questionnaire, et six des huit ont également participé à l'entrevue. D'après les réponses, la matière sur l'AM était plutôt uniforme entre les écoles et était surtout donnée dans le volet sur la neurologie. Les modes de prestation utilisés pour l'application clinique de la matière sur l'AM variaient selon les écoles. Les répondants étaient d'avis que l'AM est à la base de la pratique de la physiothérapie et devrait être intégré dans l'ensemble du programme. **Conclusion :** la matière sur l'AM est appropriée dans les cours actuels, mais ne fournit peut-être pas des occasions optimales d'en appliquer les principes en situation clinique. La formation continue a été proposée pour corriger les lacunes des cliniciens et faciliter l'apprentissage des étudiants en stage. Seule la moitié des écoles de physiothérapie admissibles a participé, et toutes ces écoles étaient anglophones. Il n'est peut-être donc pas possible de généraliser les résultats à tous les programmes canadiens. Les futures recherches devraient porter sur l'intégration de l'AM au programme de physiothérapie afin de promouvoir l'application des principes s'y rapportant entre les divers volets. Il faudrait également examiner les points de vue des étudiants quant à leur compréhension de l'AM et de son application et à l'auto-efficacité au moment de commencer à exercer.

Motor learning (ML), or the acquisition of motor skills, is “a set of processes associated with practice or experience leading to relatively permanent changes in

capability for skilled movement.”^{1(p.327)} ML underlies physical therapy (PT) because recovery occurs through the use of exercises that incorporate many repetitions to

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improve a patient's capability for movement.² A considerable body of research has identified key principles to optimize the practise and retention of motor skills; in this article, we refer to them as *ML principles* (MLPs).^{3,4} MLPs typically focus on the features and parameters of the practice session (e.g., content and mode of skill instruction, amount of practice, and type and frequency of feedback) that are associated with improved motor skill performance, tested at some delay after the practice session.⁵ Applying MLPs during rehabilitation sessions can help patients acquire motor skills, recover from injury, and overcome the recovery plateau.^{6–8}

To apply MLPs correctly, physical therapists must understand the neurophysiological basis of ML and how to integrate MLPs into clinical practice. However, physical therapists have identified a gap between their knowledge of ML and their clinical practice.^{9,10} Moreover, inconsistencies have been observed in how MLPs are applied in PT practice.^{10,11} A significant proportion of therapists either do not use MLPs informed by the available research or do not use MLPs at all.¹⁰ Specific areas of difficulty include frequency of feedback, focus of attention, and strategies for skill instruction (e.g., verbal, visual, and manual guidance).^{10,11} Clinicians have also identified barriers to implementing MLPs, including patient factors (e.g., fatigue, cognitive impairment) and organizational factors (e.g., time and staff constraints).¹⁰

In addition to barriers identified by clinicians, limitations in applying MLPs in clinical practice could be related to education because entry-to-practice PT education directly influences practice.^{12,13} Canadian PT curriculum content guidelines recommend including ML.¹⁴ Therefore, a first step in understanding why clinical practice does not reflect the ML literature is to evaluate the current state of ML education in entry-to-practice PT programmes. A deeper understanding of ML education can highlight strengths, areas for improvement, and strategies for addressing the knowledge–practice gap. The main objectives of this study were to (1) describe ML content and delivery methods in Canadian entry-to-practice programmes and (2) describe instructors' beliefs about how ML is taught in Canadian entry-to-practice PT programmes.

METHODS

Study design

We conducted a descriptive qualitative study on Canadian PT programmes using an online questionnaire; semi-structured telephone interviews; and a systematic online search of all Canadian PT programme Web sites. This study was approved by the Research Ethics Board at the University of Toronto. All participants provided informed consent.

Participants

Instructors from each accredited Canadian entry-to-practice PT programme ($n = 14$) were eligible to partici-

pate if they met the following criteria: (1) they were the primary instructor responsible for or knowledgeable about the programme's content and delivery of ML and (2) they were able to speak English or French. Potential participants were recruited through an email sent to the chair of the institution's PT programme that requested the chair to forward the study information to the instructor who best fit the inclusion criteria. Participants who met the criteria were invited to complete the online questionnaire and participate in a semi-structured telephone interview. Participants provided informed consent both electronically (on the online questionnaire) and verbally (in the telephone interview).

Online questionnaire

The online questionnaire was designed to fulfil the study's first objective: to describe ML content and delivery methods in Canadian entry-to-practice programmes. We chose this mode of collection because it was efficient and cost effective. Because potential participants would be university employees, it was highly likely that all respondents would have access to the Internet. First, one member of our team developed a list of close-ended questions designed to collect information about the ML curriculum (e.g., number of ML content hours) and the instructors (e.g., educational background). We then reviewed and discussed this list to ensure that the questions were clear and not repetitive and that the questionnaire was as short as possible so as to gain the necessary information without overburdening the participants.

We then created a revised version of the questionnaire that began with the following definition of ML¹:

a set of processes associated with practice or experience leading to relatively permanent changes in the capability for skilled movement. True learning of a motor skill is demonstrated when performance and practice of the motor skill during acquisition results in persistence of performance during a later retention phase.

A person with expertise in questionnaire-based research reviewed this revised version for logic, question construction, and overall clarity. After this review, we made minor changes to clarify wording and reorder the questions to be more logical. We entered the final version into the Web-based questionnaire system, FluidSurveys (SurveyMonkey, Palo Alto, CA), for distribution to respondents. Eight respondents from seven institutions completed the final version of the questionnaire (see Appendix 1 online). At one institution, two respondents were considered the primary instructors of ML, one of whom also completed the telephone interview.

Semi-structured telephone interview

We conducted a semi-structured telephone interview to fulfil the study's second objective: to describe the instructors' beliefs about how ML is taught in Canadian entry-to-practice programmes. We chose this mode of

collection because it allowed participants to answer open-ended questions in more detail and allowed individuals from across the country to participate. We developed a list of open-ended questions and probes, allowing the respondents to direct the conversation and inviting them to share their beliefs about their respective programmes. The interview guide began with the investigator restating the definition of ML used in the questionnaire and confirming that the respondent agreed with it. Two team members reviewed this initial version of the guide and then revised it to remove repetitive questions.

Two team members (VW, WD) conducted the semi-structured telephone interviews. They first rehearsed the interview with each other and made notes to further revise repetitive questions. We then reviewed these notes as a group and made further revisions to the interview guide. A person with expertise in qualitative research reviewed this version of the guide. We made revisions on the basis of the expert's feedback, and this final version was used with the respondents (see Appendix 2 online). The interviews took approximately 45–60 minutes to complete and were audio-recorded with a digital audio recorder and transcribed verbatim for data analysis.

Other data sources

The online questionnaire requested course syllabi from each participating institution. If the institution provided its syllabus, we included it in our analysis to further assess the content, delivery methods, and area of study in which ML was included. In addition, we searched all PT programme departmental Web sites to collect information from the schools that did not participate and to supplement or complete missing data for the schools that did. Four team members (AB, AAR, JC, WD) used a standardized extraction tool to collect information from each Web site, including the programme year in which ML was taught, the course in which ML was taught, the number of course hours dedicated to the topic, and the course description.

Data analysis

We summarized the quantitative data collected from the online questionnaire using Microsoft Excel 2010 (Microsoft Corporation, Redmond, WA). The transcripts, Web search results, and syllabi were analyzed using descriptive content analysis.¹³ This method allowed us to familiarize ourselves with the data and develop a framework of recurring and emerging codes and themes.¹⁵ Five team members (AB, AAR, JC, WD, VW) reviewed the first two transcripts to develop an initial coding scheme using NVivo, version 10 (QSR International, Melbourne, VIC, Australia). Two team members (AAR and WD) then coded the subsequent transcripts, Web searches, and syllabi independently using the coding scheme and added, combined, or deleted codes as necessary.

Any decision to change or adapt codes was made in collaboration with a third investigator (VW) for an additional opinion. Once all transcripts were coded, five

investigators (AB, AAR, JC, WD, VW) reviewed and refined the codes together to further condense or elaborate on the chosen codes. This systematic process¹⁶ of reviewing transcripts several times and analyzing the codes on the basis of occurrence and context allowed key issues to emerge from the data. These key issues represented patterned responses in the data set and captured important information about the data in relation to the research question and study objectives.

RESULTS

Participants and data sources

Although the option was provided to complete the questionnaire and telephone interview in English or French, all questionnaires and interviews were completed in English. Of the 14 schools invited to participate, 7 completed the online questionnaire; 1 institution had two respondents ($n = 8$). Respondent characteristics are summarized in Table 1. Six of the eight instructors completed the telephone interview, and three provided course syllabi. The Web site search conducted in March 2016 for all 14 Canadian PT programmes yielded results for 10. The search largely returned course descriptions and sometimes course syllabi, textbook lists, and hours dedicated to ML instruction. No information was gathered on three of the schools through any of these methods (i.e., online questionnaire, telephone interview, or Web search).

Key issues that emerged from the analysis are summarized under ML content delivered, location of ML education in PT programmes, delivery methods used to teach ML, and educational factors related to the knowledge–practice gap.

ML content in Canadian entry-to-practice PT programmes

ML as defined by Schmidt¹⁷ is currently part of the curriculum at all 10 schools from which data were collected. We also found similarities in the MLPs taught, including structure of practice sessions (random vs. blocked practice), appropriate practice conditions (whole vs. part component practice), and type of feedback (knowledge of results, knowledge of performance, frequency of feedback). Schools also used similar textbooks and journal articles to develop content. For example, in the interview, several respondents cited using the Shumway-Cook and Woollacott⁵ textbook as well as literature from Boyd and colleagues¹⁸ and Winstein.³ Another similarity was that the majority of schools discussed ML in the context of its application to neurological conditions, but few discussed musculoskeletal (MSK) or cardiorespiratory (CR) conditions.

In the interview, some respondents discussed their belief that ML content varied across schools: “I think there’s probably quite a bit of variability in terms of how it’s taught and how much it’s taught” (Respondent 2).

Respondents suggested that variability existed across schools in how many, and which, MLPs were being taught: “There is a grey area with ... what people think

Table 1 Respondents' Level of Education and Experience ($n = 8$)

Characteristic	No. (%) of respondents
Highest level of education completed	
Bachelor's	0 (0.0)
MSc	2 (25.0)
PhD	5 (62.5)
MD	1 (12.5)
Highest level of physical therapy education	
Bachelor's	6 (75.0)
Master's	2 (25.0)
Clinical experience, y	
<5	1 (12.5)
5–10	3 (37.5)
11–15	0 (0.0)
16–20	2 (25.0)
>20	2 (25.0)
Main area of clinical practice	
Cardiorespiratory	0 (0.0)
Musculoskeletal	0 (0.0)
Neurological	8 (100.0)
Current role at institution	
Part-time instructor	1 (12.5)
Lecturer	1 (12.5)
Assistant professor	6 (75.0)
Teaching at institution, y	
<1	2 (25.0)
1–5	4 (50.0)
6–10	1 (12.5)
>10	1 (12.5)
Primary area of instruction	
Cardiorespiratory	0 (0.0)
Musculoskeletal	0 (0.0)
Neurological	7 (87.5)
Other	1 (12.5)
Involved in motor learning research?	
Yes	2 (25.0)
No	6 (75.0)

motor learning principles are.... Teachers as well as certain practitioners will say THAT'S motor learning versus that's practice" (Respondent 4).

With respect to variability across schools, the online questionnaire and Web search results revealed that the number of hours devoted to ML content varied from school to school. Schools used various delivery methods to maximize the use of this time (Table 2).

The respondents proposed changes to ML content, including introducing newer ML concepts discussed in the literature (e.g., self-evaluation) and increasing the number of conditions or populations (e.g., Parkinson's disease) that were covered. Several respondents said they would not necessarily increase the amount of content but would allow more time to cover the current concepts in greater depth.

Location of ML education in PT programmes

The majority of respondents interviewed stated that ML content was delivered in the neurological curriculum.

The perceived advantages of this included studying a greater body of MLP literature applicable to neurological populations and ML's connection to neuroplasticity: "Particularly [in] neuro I feel there is published literature we can draw upon and allow the students to read that and then ... give them a background to it, and obviously there's lots of motor learning texts" (Respondent 5).

However, the majority of respondents also stated that they were unaware of the extent to which ML was taught in other areas of their PT programme. Respondents generally assumed that ML content might be taught in MSK courses and were unsure about CR courses.

I can't speak that well of the MSK.... I know that they don't have any formal motor learning lecture, [and] maybe they leave that to us. But I don't know how it's incorporated in the other ... areas of PT with regard to MSK or maybe cardiorespiratory. (Respondent 5)

Some respondents identified the difficulty of regulating ML instruction across courses as a limitation.

There is always the limitation of consistency, right? So there's the general concepts of motor learning and how I would apply them in a neurological population, but what other profs are doing within their course or being able to regulate it across all of our faculty is, I guess, a limitation. (Respondent 4)

The majority of schools taught ML in the first year of the programme. One school reported delivering ML content in an introductory course.

We first present it in their foundations course.... It is their foundational skills for ... all domains of physiotherapy.... When we talk about motor learning we explicitly say, as physios, like this is really important because everything we are trying to do is change behaviour and part of changing behaviour, especially function, you have to consider motor learning. (Respondent 4)

One school stated that further ML content had been incorporated into an elective course.

As students progress through the program, they have options for these professional electives ... that are meant [to] bring the student to a higher level of understanding in the chosen area. Then there's a whole course called motor control ... so someone with an interest in neuro ... rehab would take that, and ... there is a lot of motor learning stuff discussed there. (Respondent 1)

One respondent discussed how she believed that ML was a concept that should be introduced earlier in the curriculum and applied to all areas of PT practice.

I would ... introduce motor learning as a concept when they're first in the physio program ... so that it's more related, or they think about it more as ... this ... underlies everything that we do in physiotherapy, rather than just something that applies to the neuro population. (Respondent 2)

Table 2 Universities' Responses to ML Content, Delivery, and Area of Study ($n = 8$)

Question	No. (%) of respondents
Content	
Approximately how many hours of ML instruction do students receive?	
<5	4 (50.0)
5–10	2 (25.0)
>10	1 (12.5)
I don't know	1 (12.5)
Delivery methods	
For the ML content you deliver, which of these delivery methods do you use?	
Clinical skills laboratories	7 (87.5)
Self-study	6 (75.0)
Didactic lecture	8 (100.0)
Case study	6 (75.0)
Small group discussions	5 (62.5)
Are there any opportunities for students to apply MLPs in a hands-on or clinical setting?	
Yes	7 (87.5)
No	1 (12.5)
Area of study	
Where is the concept of ML taught in your PT curriculum? (respondents selected all that applied to their programme)	
Anatomy	0 (0.0)
Physiology	1 (12.5)
Musculoskeletal	4 (50.0)
Electrophysiological agents	1 (12.5)
Neurological	8 (100.0)
Cardiorespiratory	0 (0.0)
In what year of your PT programme is ML currently taught? (respondents selected all that applied to their programme)	
First	5 (62.5)
Second	3 (37.5)
Other*	1 (12.5)
Respondents' beliefs	
Do you feel that adequate time is devoted to ML in the PT programme?	
Yes	5 (62.5)
No	2 (25.0)
I don't know	1 (12.5)
How prepared do you think students are with respect to applying MLPs in clinical practice on graduation from your programme? (0–10 scale)	
0–5	0 (0.0)
6	2 (25.0)
7	1 (12.5)
8	5 (62.5)
9	0 (0.0)
10	0 (0.0)
To what extent do you agree that ML is an integral part of what students should be learning for their future practice?	
Strongly agree	7 (87.5)
Agree	1 (12.5)
Neutral	0 (0.0)
Disagree	0 (0.0)
Strongly disagree	0 (0.0)

*Some schools have two points of entry to a Master of Physical Therapy programme: direct entry and indirect entry, through an undergraduate component leading to a master's programme.

ML = motor learning; MLPs = motor learning principles; PT = physical therapy.

Several respondents also expressed the belief that ML concepts should be reinforced throughout the programme by integrating ML into other units and areas of practice.

I think that motor learning has applications to all aspects of physiotherapy practice, not just neurological, so I do think there is value in the students learning about it with respect to ... people who don't have a damaged nervous system but maybe are learning, retraining, how their scapulohumeral rhythm works. (Respondent 2)

Delivery methods

The majority of schools used didactic lectures to deliver ML content (see Table 2). Interviews revealed variability in the methods used to promote the clinical application of MLPs. Some respondents mentioned using case studies, in which students discussed how they would use MLPs with a patient: "For the neuro course, ... they do a case study, and they have to talk about how they would change or incorporate some of the motor learning principles" (Respondent 5).

One school recreated an ML experiment, outlined by Winstein and colleagues,¹⁹ in which students practised teaching each other a weight-bearing task while varying the types of feedback they gave each other. Some schools reported bringing in people from the community to practise applying MLPs. The strengths they identified for using clinical labs were the opportunity to practise applying MLPs and designing an intervention in a controlled environment: "So in labs, for example, when they're, say, designing an intervention, ... we're always questioning them. 'Okay, well, what would you do next?' or 'How can you keep that exact intervention you're doing but progress your motor learning?'" (Respondent 4).

Some respondents mentioned that a potential barrier for consistent ML delivery was that different instructors taught clinical labs: "I would like to try and incorporate it [ML content] into the clinical labs. That's taught by a different person within the unit that I teach in, so that's why it hasn't been done just yet" (Respondent 2).

Some respondents noted administrative and logistical barriers to implementing the best methods of teaching the clinical application of MLPs. For example, one respondent described barriers to creating and delivering video content.

There's a lot of logistical barriers or policy barriers that impact my ability to create mediums that can be used for learning tools for people with various types of learning styles. ... All this ... related to privacy, then you're also supposed to actually have written consent from every single student. (Respondent 3)

Some respondents noted limitations in relying on clinical placements as a mechanism for teaching students about the clinical application of MLPs: "In their clinical placements ... they encounter therapists that do not use these principles, so then they're a little bit lost, the students, because they know what they've learned, but they don't always see it put into practice" (Respondent 1).

Educational factors related to the knowledge–practice gap

When questioned about what educational factors might contribute to reports that clinicians might not be applying MLPs appropriately in practice, the respondents identified several potential factors. Some believed that some clinicians who had been practicing for a long time (e.g., >10 y) had a lack of knowledge because ML had not previously been included in Canadian PT programmes. Several respondents stated that ML had not been incorporated into programmes until experts in the topic started to teach at their school: "Before I came ... into this ... department, probably nine years ago, ... it [motor learning] ... was not explicitly taught" (Respondent 5).

Some respondents believed that the methods they used to teach MLP might not adequately prepare students to apply MLPs when they enter clinical practice:

"I think we fall short of the practical side of things. So we talk about the concepts and the theory behind it, but they don't have an opportunity at the moment to actually put it into clinical practice" (Respondent 2).

Other respondents identified the potential for continuing education to address the apparent lack of ML application in clinical practice: "I do think also there's been limited education, post-grad kind of education, related to this. There's been some ... sort of continuing education in other areas, but not in this area as much" (Respondent 6).

One school noted that the popularity of the continuing education course in ML it offered was evidence of the knowledge gap identified by clinicians.

We do offer one ... motor learning continuing education course, ... and it always sells out each year. So it's certainly an area [that] people are interested in, and interested in seeing how they can improve their education in it because they know that they might not be up to speed on that. (Respondent 5)

DISCUSSION

This study aimed to describe the content and delivery of ML education in Canadian PT programmes and instructors' beliefs about how ML is currently taught. Although other studies have explored how PT clinicians are using MLP in practice, this study describes how ML is being taught in Canadian schools to prepare PT students for practice.

All respondents identified ML as an underlying area vital to PT practice. However, it was not necessarily taught in a way that reflected this principle. The Curriculum Content Framework produced by the Canadian Council of Physiotherapy University Programs (CCPUP) includes ML in the foundations dimension, which "supports and informs the entire entry-to-practice curriculum."^{14(p.8)} Therefore, ML content is expected to be used to inform all areas of physiotherapy practice rather than only one field, such as neurology. However, although one school introduced ML in a foundations course, the majority of schools delivered ML content predominantly in their neurological curriculum. It is interesting to note that, in the clinical practice chapter of the CCPUP guidelines, ML is included in theory or foundation knowledge for neurological but not for CR or MSK PT practice;¹⁴ this, perhaps, leads to the emphasis of ML in the neurological area in PT curricula.

Respondents were largely unaware of whether ML content was included in the MSK and CR components of their curriculums. The results from our online search, which returned course descriptions and syllabi, supported this view; ML as a topic was predominantly included in neurology-focused courses. Although respondents believed that ML should be incorporated into these other practice areas, the reported lack of communication

among instructors across departments was perceived as a barrier. Improving this communication might improve consistency in how ML content is delivered and reinforce the concept that ML is a foundation for all PT practice.

Schools delivered similar ML content, framed by the CCPUP guidelines.¹⁴ The fact that they met these guidelines suggests that Canadian schools are providing content that meets the entry-to-practice standards. However, the respondents believed that changes were needed in ML content and delivery methods to help reinforce the clinical application of MLPs. Schools providing fewer hours of ML content (≤ 5 h) suggested that changes be made to the amount and depth of the content. Similar perceptions of time as a limiting factor for content delivery are shared by educators in other health care professions.²⁰ Schools that allocate more time to ML (≥ 6 h) had suggestions for changing not the content but rather the organization of ML in the programme. The instructors believed that practicing the clinical application of MLPs was important in preparing students for entry-level practice.²¹ They identified online modules and instructional videos as one approach to providing ML theoretical content, thus allowing more time in the curriculum for students to practise MLPs. However, identified barriers such as institutional policies on uploading content would need to be addressed.²²

Respondents also acknowledged reports of limitations in clinicians' content knowledge and clinical application of MLPs, and they suggested that this could limit opportunities for students to practice applying MLPs during clinical placements. Continuing education was suggested as one approach to addressing the reported knowledge-practice gap and one that would subsequently open up opportunities for students to practise the clinical application of MLPs. Continuing education was also identified in a previous survey of practicing Canadian physical therapists as a means to facilitate clinical application of MLPs in practice.¹⁰ Our study identified only one institution that provided a specific ML continuing education course, but to what extent clinicians are able to apply or use this knowledge clinically is unknown. Future work should investigate the potential for ML continuing education to increase the use of MLP by physical therapists in practice and to facilitate student learning on placement.

Our study had several limitations. First, the method of recruitment, although necessitated by ethical considerations, restricted our ability to identify the most appropriate respondents. It is possible that faculty members other than those identified by programme directors were also teaching ML in other areas of the PT programme. In addition, although the option to respond in French was provided, no French-language PT programmes participated in this study. Moreover, only half of the 14 Canadian PT schools responded; therefore, our conclusions may not be generalizable across all Canadian PT programmes or across

different courses in the same programme. Finally, we are affiliated with two Canadian PT schools; therefore the codes and themes we developed had a like-minded perspective.

CONCLUSIONS

This study provides unique information about ML education in Canadian PT programmes. As with past research, our study identified ML as a fundamental aspect of PT practice; however, the current methods of delivering ML may not provide optimal opportunities for PT students to practise applying MLPs in a clinical context. The participants suggested that continuing education was one way to remediate the knowledge-practice gap and to ensure that ML was being applied appropriately for both students and practicing clinicians. Furthermore, educators said that it was equally important to discuss and specify how ML should be integrated into all areas of PT, both in entry-to-practice education and in clinical practice.

Future studies are needed to investigate best practices for integrating ML education across all practice areas and to facilitate the clinical application of MLPs. Students' perspectives on their understanding of ML, MLPs, and self-efficacy for entry to practice should also be explored.

KEY MESSAGES

What is already known on this topic

There is a general consensus that motor learning (ML) is a core concept that physical therapists should integrate into practice to enhance rehabilitation and outcomes for their patients. However, physical therapists have realized that there is a gap between their knowledge of ML and applying it to clinical practice.

What this study adds

Canadian entry-to-practice PT programmes are using a similar definition of ML and teaching similar ML principles, predominately in the neurological units of their curricula. Instructors agreed on the importance of ML to PT practice but reported different opportunities to practice the clinical application of ML principles. They identified two opportunities for improving ML education: integrating ML across different areas of practice and using continuing education.

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