Implications for Variability of Practice from Pedagogy and Motor Learning Perspectives: Finding a Common Ground

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The discourse contained in this article is the result of an on-going discussion about “providing variability of practice” between professionals from different areas of study within kinesiology. The impetus for this discussion arose from a lack of common terminology, differing views, and the sometimes contrasting research and professional practices promoted in the areas of pedagogy and motor learning. Since many undergraduate and graduate level students enroll in courses in both motor learning and pedagogy, it is imperative that professionals seek a common ground that leads to an understanding of the areas where the two perspectives converge or differ. A question and answer format, from the viewpoints of pedagogy and motor learning, was used to guide the discussion related to variability of practice and its research and practical applications in the teaching and learning process of motor skills.

One of the challenges routinely faced by motor learning specialists and teacher educators/pedagogists is the translation of motor learning concepts and research into practical teaching applications. Historically speaking, the task of translating motor learning research into practical pedagogy practices is difficult and the debate among colleagues on this issue has continued for over a decade (see Quest, 1990, Vol. 42, special feature edited by J.C. Harris for the many viewpoints on this topic). While there are many issues that make this process problematic (e.g., lack of a common terminology, differences in research findings and subsequent applications vs. common teaching practices, differences in contexts—public school vs. research environments, and success related to skill acquisition), it is in the best interest of the profession to find a common ground, so that our future teachers can begin to understand and even apply some of the research findings to practical teaching settings. This article addresses the topic of “variability of practice” in motor skill acquisition and discusses differences in terminology, instructional settings, and its
impact upon the teaching/learning environment from both pedagogical and motor learning perspectives.

**Variability of Practice of Motor Skills**

One of the fundamental theories of motor learning was proposed by Richard Schmidt in the mid-1970s, and is referred to as the schema theory (Schmidt, 1975). Schema theory proposed the existence of two constructs, the generalized motor program (GMP) and the schema. The GMP, composed of invariant features (which define the program) and parameters (which define how to execute the program), functions to control the sequencing and timing of muscle activity while the schema is used to specify the correct parameters for a given situation (Sherwood & Lee, 2003). A fundamental notion of this theory is that learning is a function of the amount of variable practice provided. More specifically, by practicing a wide variety of program parameters, the schema is strengthened and a performer can better specify the parameters that will accomplish the movement goal given the constraints imposed.

Given that motor skill acquisition can be enhanced through variable practice, several questions should be addressed when preparing pre-service physical educators for its implementation. Those questions include: (1) How do you introduce variability of practice when teaching motor skills? (2) When should variability be introduced? (3) How much variability is appropriate to apply to a skill? and (4) How should practice be organized when covering a series of motor skills? The answers will reveal more common ground between pedagogy and motor learning perspectives than one might assume.

**How Do You Introduce Variability of Practice When Teaching Motor Skills?**

According to schema theory, one way to create variable practice in physical education teaching involves the manipulation of a skill such that the invariant features of the GMP are retained, while providing variety in the parameters. Parameters are those elements, which can be changed to provide variations in how a particular skill is performed, and include three elements: overall force, overall timing, and the muscles used. For example, side-arm striking with light or hard force relates to the overall force, striking at a quicker or a slower speed relates to the overall timing and striking with the dominant or non-dominant hand relates to the muscles used. In each of these instances, the parameters of the strike are manipulated, but the invariant features are kept constant so that the same GMP controls the movement.

The manipulation of movement parameters, from a pedagogical perspective, involves the use of task extensions (Graham, Hale Holt & Parker, 2004). Task extensions refer to the process of making the skill either easier or harder depending on the learner’s current level of skill performance. Task extensions or changes to the skill can be achieved in several ways. First, the use of movement concepts that describe how a movement or skill should be performed is one way to introduce
variability at the elementary school level. For example, bouncing a ball using your
dominant or non-dominant hand (a.k.a., muscle use parameter in the GMP) while
stationary focuses solely on the bouncing skill; or a teacher could also ask students
to use different movement concepts such as bouncing a ball with hard force (a.k.a.,
force parameter in the GMP); or bouncing it slow or fast (a.k.a., timing parameter
in the GMP) (for a more complete discussion on movement concepts, see Graham
et al.). This type of variability is directed towards changes or modifications of a
single skill. Not all movement concepts fall directly under the GMP parameters
timing, force, and muscles used), but many movement concepts do.

A second way to vary skill practice is through the use of challenges. Challenges
are task extensions with a criterion attached to them that help delineate when a
student achieves a task/skill. For example, the teacher may ask students to dribble
a basketball for 30 s without looking down at the ball, or hit 20 serves into the
service box in tennis. The same guidelines associated with the parameters related
to the GMP would apply to challenges as well as task extensions.

A third way to make practice more variable is to add additional motor skills to
an existing skill to further modify the movement pattern. For example, dribbling
with your feet could be extended or modified by asking students to dribble, pass,
and receive a ball while moving. These additional skills, added to the initial skill,
address several skills at once. In a similar vein, Rink (1998) has provided teachers
with ways to extend the skills (introduce practice variability) by requiring the use of
additional skills attached to a primary skill (e.g., dribbling with passing, receiving,
and moving) and the provision of different movement parameters (different speeds,
directions, distances, etc.—similar to Graham’s movement concepts).

A fourth way to introduce variability is to practice motor skills in a variety of
settings or contexts (Graham et al., 2004; Magill, 2004). Guidelines for determin-
ing context variations from a motor learning perspective are offered in terms of
manipulating regulatory and non-regulatory conditions (Gentile, 2000). Regulatory
conditions are defined as the environmental conditions (contexts) that specify the
movement characteristics necessary for the successful performance of the skill (e.g.,
performer’s position on the court, speed; direction, and trajectory of the ball; loca-
tion and actions of defenders). Non-regulatory conditions are those factors that are
not inherently related to performing the skill itself (e.g., crowd noise, distractions,
fatigue). Pedagogy applications adhere to these guidelines as context variations
which usually consist of using skills in a game situation or in a planned routine
found in dance or gymnastics. Examples include: (1) practicing a dance routine in
isolation and then practicing this routine in front of the class (a.k.a., non-regulatory
condition) or (2) dribbling a ball in isolation vs. dribbling in ball in a game down
court while avoiding defenders (regulatory condition). These contexts can often
take the form of situations that mimic how the skill will be used in the future, such
as in a lead-up or official game (both terms used in secondary pedagogy) or in a
culminating activity (a term used in elementary pedagogy, similar to the secondary
terms). Secondary pedagogy refers to those heuristic practices applied to middle
school through high school level students. In contrast, elementary pedagogy refers
to the heuristic practices that apply to students at the elementary level.

Finally, while all of the ways to create variability in skill practice thus far
have been planned by the teacher, there exists a fifth way that variability occurs.
It occurs naturally as a part of the teaching/learning environment. This type of variability is inherent in many skill practice situations particularly those involving open skills (Schmidt & Lee, 2005). For example, unplanned variability is present when two third graders practice catching. While the teacher in this scenario has probably asked the students to toss the ball to a partner, this tossing motion is fairly variable because the ball arrives at different levels, speeds, and pathways. This is also true for ninth graders practicing forehand and/or backhand drives in tennis with a partner who is instructed to hit or toss the ball to their receiving partner. In both of these examples, variability occurs naturally and while teachers are aware of this variability they do not control it, nor is there little they could do to prevent it. This issue of inherent variability experiences by learners in skills settings is one that warrants study related to the amount of variability experienced by learners and its impact on learning.

Summary of How to Introduce Variability

The discussions of how to introduce variability from both perspectives seem to have a common theme. Variability that is introduced through the use of task extensions and challenges via movement concepts (e.g., speed, force, dominant/non-dominant, with a partner in a game situation, etc.) would be similar to extending the same GMP by varying the parameters of overall timing, force, and/or muscles used while maintaining the integrity of skill by holding the invariant features constant. The adding of other skills to the primary skill (e.g., dribbling and passing a soccer ball) and the practice of skills under different contexts (e.g., lead-up game, culminating activity, and performance in front of an audience) would also be other ways to apply variability within a single GMP related to regulatory and non-regulatory conditions. These types of variations promote skill development in a way that would facilitate how the skill would ultimately be performed in a game, dance, or gymnastics situation.

When Should Variability Be Introduced?

The next question the practitioner must consider is when to introduce variability of practice. That is, how much initial experience should be provided with the fundamental skill before variations are introduced? Guidance can be drawn from an understanding of the learning stages through which an individual will navigate as learning progresses.

In the first stage of learning, the student attempts to understand the movement characteristics of the skill. In the motor learning literature this stage is known as the Cognitive Stage (Fitts & Posner, 1967) or as Getting the Idea of the Movement (Gentile, 2000). A parallel to Gentile’s Getting the Idea of the Movement is Bressan’s (1987) notion of Perceiving. In the pedagogy literature, Graham et al. (2004) describe this as the precontrol level for elementary students and it is often referred to as the beginner level for secondary level students.

Regardless of the model used, the first stage of learning is characterized by the initial development of a movement pattern or motor program for that skill. At first, the motor program may be very crude and haphazard, “containing just enough
details to allow the [student] to make a ‘ballpark’ response” (Coker, Fischman & Oxendine, 2006; p. 19). Furthermore, there are likely to be errors in the program in the beginning with no two skill attempts looking the same and even a look of surprise if the learner actually accomplishes the skill (Graham et al., 2004). With practice and feedback, students gain the ability to perform the skill with increasing efficiency and a higher degree of consistency within a relatively short amount of time and will transition to the next stage of learning. Graham et al. described this as the control level while secondary pedagogists referred to this as the advanced beginner stage. It is during the early part of this control level that teachers routinely introduce variability. Motor learning scholars agree with this practice, indicating that variability of practice should not be introduced until the student understands the basic dynamics of the task and can replicate a basic/crude motor pattern (Gentile, 2000; Rose & Christina, 2006).

Moving learners from the precontrol (beginner stage) to the control (advanced beginner stage) can be accomplished relatively quickly (within the first 10-15 min of a class period for a simple skill, with more complex skills taking longer) if the following conditions are met: (a) sufficient skill demonstration and explanation, (b) adequate feedback that guides the learning process, (c) lots of practice at an appropriate level of difficulty, and (d) teaching a skill that is developmentally appropriate for the learner. A quick admonition here: the preceding discussions were predicated on the notion that the skill(s) were developmentally appropriate for the learner. For example, skipping is probably not developmentally appropriate for a pre-school age child, while running at different speeds would be appropriate for children in this age group.

Research in the area of contextual interference (CI) further supports the notion of allowing students to develop a rudimentary motor program before introducing variability in practice. Contextual interference is defined by Magill (2004) as “the interference that results from practicing variations of a skill within the context of practice” (p. 311) and studies investigating this phenomenon provide guidelines as to how to organize variable practice. It has been suggested that low contextual interference (created when one skill variation is practiced repeatedly before practice attempts are given on another variation) may be more effective for beginners (pre-control level) while they are getting the idea of the movement (Del Rey, Wughalter & Whitehirst, 1982; Hebert, Landin & Solomon, 1996) whereas high CI (created when multiple task variations are practiced in a random order) may overwhelm beginning level students. Furthermore, Brady (1998), citing the work of Bandura (1977), contends that initial success achieved under low CI conditions may enhance self-efficacy and provide positive reinforcement. Once a rudimentary movement pattern has been established, however, higher levels of CI should be introduced by practicing multiple variations of the skill across trials. Pedagogical literature offers the attainment of around an 80% success rate (Berliner, 1984; Rosenshine, 1983) before changing to a new skill or making the existing skill more difficult. Further, supporting the motivational considerations offered by Brady (1998), many scholars believed that about an 80% success rate was needed to encourage students to stay engaged in the practicing and learning of skills (Berliner, 1987; Brophy, 1983; Rosenshine, 1983; Siedentop, 1991; Solmon, 2003). However, 80% may not always be an appropriate level of difficulty for all motor skills. For example, Rink
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(1996) pointed out that it would be ridiculous to expect an intermediate basketball player to be successful at free throw shooting 80% of the time. However, teachers can help their students approach an 80% success rate in many cases by: (a) reducing the skill’s complexity by breaking skills down (e.g., in a jumping front kick in karate—teaching the front kick without the jump); (b) changing conditions of practice (e.g., moving students closer to the volleyball net for a serve); and/or (c) modifying the equipment (e.g., for elementary children, use lacrosse sticks with shorter handles, large baskets, and a bar across the bottom of the basket) to increase the chances of success (Rink, 1996).

Ideas for Teachers Who Are Attempting to Individualize Variability for Learners at Different Skill Levels

When teaching learners at different skill levels, the teacher must view students on an individual basis. Not only do students differ from each other related to their respective skill levels, but they also vary in their own respective competence levels across skills. In other words, just because a student is highly proficient in soccer does not mean that he/she is a great tennis player. These varying capacities differ in terms of skill, fitness, and cognitive levels and the key is matching these differences with appropriate levels of task extension (task variability) for each student. The process of addressing individual differences can be accomplished through two instructional delivery techniques, teaching by invitation and intratask variation (Graham et al., 2004). Teaching by invitation can be described as a teacher offering a task extension or challenge (skill variation with criteria) and then letting the student decide to accept or reject the suggested skill variation. For example, the teacher could say “If you think you have mastered the basketball lay-up from your dominant side then you could try to perform the lay-up from your non-dominant side.” The intratask variation technique is different from the invitational option in that the teacher, not the student, decides when individuals are ready for task extensions or challenges. Both of these individualization techniques require the teacher to know their students’ abilities and to match task extensions with individual students to help students succeed.

Summary of When Should Variability Be Introduced

The notion of when to introduce variability is one of readiness. It appears from the preceding discussion both pedagogists and motor learning specialists would agree that the introduction of variability into a practice situation is usually done after a learner has the basic idea of the skill and has moved from the precontrol/beginner level (where movement is awkward and haphazard) to the control/advanced beginner level (where skill repetitions are similar and students can replicate a basic/crude motor pattern). Along with this notion of when it is appropriate to introduce variability, the idea of not overwhelming the precontrol/beginner with too much variation too early in the learning process is also mutually agreed upon. The role of success can motivate learners to actively engage in skill practice as well as enhance self-efficacy and provide positive reinforcement.
How Much Variability is Appropriate?

The third question relates to how much variability is appropriate for skill competence to develop. Again, we turn to the literature in contextual interference for guidance as to how to organize or schedule variable practice. As indicated in the previous section, once a rudimentary motor program has been established, higher levels of CI should be introduced. How high those CI levels should be for optimal skill development, according to Landin and Hebert (1997), may be contingent on skill level. Hebert (1995) proposed that low CI should be used with those who are low skilled, moderate CI levels for medium skilled learners, and higher CI levels for those considered highly skilled.

While this continuum provides a starting point, schema theory provides additional direction for assessing when CI levels created are appropriate. When variation is introduced into skill acquisition sessions, the immediate effect is often either a depression in skill acquisition as measured by immediate changes in performance or even a transitory decrease in the demonstrated skill. In other words, variable practice is associated with greater performance error during practice (Magill, 2004). However, this enhances schema development as learners discover relationships among environmental conditions and outcomes leading to greater generalizability to future performances. Furthermore, by allowing individuals to explore the full range of a movement, they will be better prepared to correct errors. For example, one might advocate teaching beginning tennis players to hit the ball not only at targets but also to the right, left, straight, long, or short of the target areas, so that they know what it takes to produce an appropriate response. The concept here is that students learn about producing appropriate muscle action by producing intentional mistakes and learning from them. In other words, the student may more easily learn to identify a correct shot if he or she had previously experienced alternate target goals by deliberately hitting too far to the left and right or too long or short (Kerr, 1980).

While it would appear that motor learning specialists advocate the production of errors in the learning process, an important distinction must be made. Although errors will occur when variability is introduced, the key is that with variable practice, the GMP remains intact. In other words, when organizing variable practice, it is important that “learners’ movements do not exceed the boundaries of the generalized motor program that they are developing” (Schmidt & Wrisberg, 2004; p. 265). If the varied practice induces a change in the GMP, the amount of variability has exceeded the student’s capabilities and adjustments should be made. Pedagogists attempt to prevent this through the provision of appropriate practice that tries to match learner skill level with task difficulty. When teaching learners at different skill levels, the teacher must view students on an individual basis. These varying capacities differ in terms of skill, fitness, and cognitive levels and the key is matching these differences with appropriate levels of task extension or task challenge (task variability) for each student. At the elementary level, learners are encouraged to explore the boundaries of skills through the provision of task extensions/challenges (i.e., bounce the ball as high as you can, or at a very low level) whereas at the secondary level teachers try to get learners to adhere to the movement pattern that approximates the skill as it would be used in a game situation. In the example of bouncing (dribbling) the ball as high as you can in the elementary setting, the
secondary teacher would probably not encourage this high bouncing (dribbling) because this high bounce technique would probably result in losing control of the ball in a game situation. However, the placing of the bouncing/dribbling skill in a game situation where the environment is constantly changing, challenges the learners to explore the dribbling pattern under a different set of variations. Of course, the same can be said of the culminating activity (modified lead-up game) at the elementary level.

One general guideline that can be applied across all students and/or classes, regardless of their levels of skill competence, is to simplify the initial skill and then provide more complex variations (task extensions and/or challenges in a variety of contexts) as the students become more proficient. Students’ skill development will regress somewhat when they are required to perform more complex skill patterns under progressively difficult variations. However, errors are present anytime a student attempts to master a new skill or modify an existing one; the trick is to allow students enough practice time to succeed. The provision of intermediary steps, ranging from simple to increasingly difficult, will help allow students to experience some degree of success while variability is introduced and re-introduced as the motor pattern continues to develop and broaden. The other trick is to realize when tasks are too challenging and to simplify these tasks until the learners are ready to re-visit these tasks with increasingly difficult variations. Teachers routinely deal with the issue of difficulty and/or simplicity in groups as well as with individual students.

**Summary on How Much Variability Is Appropriate to Apply to a Skill**

The notion of how much variability is too much (inappropriate) can be summed up in the statement related to the total loss of the general motor pattern if too much variability is applied. In other words, if the varied practice induces a change in the GMP, the amount of variability has exceeded the student’s capabilities and adjustments should be made. Again, teachers try to balance the provision of variability by implementing steps to increase difficulty while refining yet broadening the learners’ ability to adjust to changes or demands made to motor patterns.

**How Should Practice Be Organized When Covering a Series of Motor Skills? Differentiate Between Performance and Retention?**

The previous questions have focused on variability as it related to the development of a single motor skill. Another important issue is how to design practice to optimize the acquisition of a variety of skills. Practical implications can again be drawn from the CI literature. If the learning environment is structured such that one skill is practiced multiple times in a row or for an entire practice period (blocked practice schedule), it often produces superior short-term performance compared to practicing multiple skills in a random order. However, with respect to skill learning, research suggests advantages of random practice for long-term retention and transfer to new skills or situations (Goode & Magill, 1986; Shea & Morgan, 1979; Wrisberg & Lui, 1991). By practicing multiple skills, the learner
is working on the storage and retrieval of those skills, thus increasing the effort required during practice (Magill, 2004). When skill is assessed immediately after practice, often the blocked group performs better and is mistakenly thought to have learned more; however, when assessed after a period of rest (retention interval) the random group is superior. This apparent reversal of results from random practice is referred to as the contextual interference effect (Battig, 1979; Landin & Hebert, 1997; Magill & Hall, 1990). As indicated previously, moderate levels of CI may be appropriate depending on the skill level of the learner (Landin & Hebert, 1997). This can be accomplished by using a repeated-blocked practice schedule. Rather than doing 10 attempts at the volleyball set and then 10 at the volleyball serve, then 10 attempts at the volleyball dig (blocked), or practicing the three skills in an unpredictable order (random), repeated-blocked could be created by performing five trials of each skill and repeating the rotation twice.

In many elementary settings students learn skills sometimes referred to as skill themes, as separate units (e.g., hopping, galloping, balancing, weight transferring, kicking, and striking). This type of curriculum is referred to as a movement-based curriculum pattern and is heavily used in elementary school settings (Harrison, Blakemore & Buck, 2001). The teaching units are not taught consecutively. For example, even though an elementary physical educator may spend a total of 10 class periods on the skill of throwing, those 10 days are not covered in the same consecutive time period. Instead, the concept of revisiting is applied and the elementary teacher might cover throwing for 2 days (class periods; blocked practice), then spend several class sessions on other skills, and then use the remaining 8 days of the throwing days or parts of those days covering throwing using different task extensions, challenges, and contexts to strengthen the motor skill’s development. In most instances the skill of throwing is revisited using other skills as part of this teaching/learning process. Usually, the initial day of skills practice is dedicated to throwing with variations on the skill itself. However, toward the end of each class session the teacher usually uses a culminating activity that uses the primary skill (e.g., throwing) in conjunction with other skills (e.g., catching, running, etc.). For the remaining 9 days/class periods (or partial days that total 8 class periods), the teacher would use the skill of throwing either by itself or more likely with other skills as a part of the class instruction. Sometimes teachers devote parts of these remaining days to review this skill, as well as other skills in a station format (also referred to as learning centers) where students practice a series of skills within the course of the class period. This practice structure would be similar to a repeated block schedule of practice. In other instances, modified game(s) that use the target skill, in this case throwing, as well as other skills are incorporated to help practice this skill as a part of a game situation. A higher level of contextual interference would be found in this context, because the learner would have to use multiple skills in a random order depending on the demands of the game. Therefore, during the revisited days the practice of the primary skill is performed in conjunction with other skills. In addition, fitness activities are also covered as a part of curriculum and this content area is usually interspersed as an activity within the skill.

The curriculum in the secondary setting is predominantly activity based (Harrison, et al., 2001) and consists primarily of units in sports (e.g., volleyball, soccer, softball, archery) or fitness activities (weight training, aerobics, Pilates) lending itself more easily to the implementation of repeated-blocked or random scheduling. The activity-based units typically span 2-5 weeks depending on the
unit and grade level. Middle school students tend to experience shorter units (2-3 weeks in duration) while high school students would experience longer units (3-5 weeks in duration). These units are covered in consecutive days or days that follow a block time class schedule and focus on a variety of skills that make up the sport activity. For example, a softball unit could cover many motor skills (batting, base running, catching, throwing, fielding, etc.). Because the class time periods are longer in secondary settings (especially in a block time class schedule), the teacher can cover a variety of skills within one class period. Blocked class time refers to class periods that last anywhere from 90 to 120 min. Usually, this extended class period is accompanied with classes that meet every other day. Practice variability is used primarily as it relates to how the skill will ultimately be used in a game situation and is applied in combination with other skills. For example, in the game of softball the teacher may have students practice different defensive scenarios to help students use a variety of skills (fielding and throwing to the correct base, catching and tagging an offensive player and possibly throwing to another base). In addition, the use of stations as an organizing element for the class would allow students to practice a set of skills related to softball and are an excellent way to incorporate repeated-blocked or random practice (Coker, 2004). The practice of multiple skills helps students develop motor patterns for use in improving their game or lead-up game play. Lastly, there are many situations where practice is both variable and random in nature. For example, in modified game play (lead-up or culminating activity), the defensive person must react to the offense by using a series of skills that are dependent on the offensive tactics. Also, in tennis, the forehand and backhand (multiple skills) could be practiced in the same practice session in addition to varying the type of ball feed, target location, and/or area on the court from which the learner hits (Jackson, 2001). By combining variable practice interspersed with trials of different classes of movements (multiple skills, i.e., forehand, backhand, lob, smash) learners are forced to retrieve a different GMP each trial in addition to selecting the appropriate parameters for that particular situation which, in turn, is thought to lead to greater learning gains (Bortoli, Spagolla & Robazza, 2001; Schmidt & Wrisberg, 2004).

Summary of Practice Organization for Multiple Skills

The use of game or culminating activities that allows learners to practice skills in different orders depending on the natural progression of the game is a type of random practice schedule. Further, the use of teaching stations or learning centers is another way to vary the order of practice of multiple skills which is similar to a repeated blocked practice schedule. Both of the aforementioned examples (game/culminating activities and teaching stations/learning centers) are ways that teachers routinely introduce practice variability using a variety of skills.

Summary

In summary, a great deal of practice variability is present in many physical education classes. This variable practice is both planned (task extensions, challenges, varied contexts) and unplanned (the use of partners as a part of skills practice which creates its own special variability). While a great deal of the variability is directed at the individual skill (e.g., running in a variety of pathways), many times
additional skills are used in conjunction with the primary skill (skill that is the main topic of the lesson) to build a stronger skill pattern (i.e., in a game of tag football moving and throwing the pass are both crucial elements of game play). In addition, there also exist many situations where practice is both variable and random in nature such as playing defense in a game situation. In addition to the variability of skill practice, the physical educator must organize the practice to help ensure a level of success that is appropriate for the given skill. This is accomplished through reducing the complexity of the skill and individualizing learning to account for individual differences.

This article was developed with guidelines provided by the two co-authors, who were both motor learning specialists, and a pedagogist in hopes of becoming brokers of this information from both theoretical as well as practical standpoints. The appendix included with this article compares pedagogical and motor learning terms and concepts and is provided to further explain the similarities and differences between the two content areas.

References


Pedagogy and Motor Learning Concepts


## Appendix

### Comparison of Pedagogy and Motor Learning Terms/Concepts Related to Practice Variability

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<td>Once learner develops crude GMP</td>
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<td>Performance assessed at the end of the unit; learning assessed after a rest interval (retention)</td>
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