CHAPTER 13

Motor Learning in Practice: Skill Acquisition

After completing this chapter you should be able to:

- explain the skill acquisition process;
- describe the stages of learning a skill;
- describe the types of feedback and their roles in skill learning;
- apply motor learning principles to teach a skill;
- describe the types of transfer and apply transfer principles to learning a skill;
- use effective practice methods when designing a learning environment.

Distinct changes that occur as a skill is learned and developed are easy to detect because the execution becomes swifter and more fluid and demands much less attention. Your own experiences provide an example of how motor skills change and develop. Your first steps may not have been perfectly executed, but look at you now, walking with the best of them. Certainly, your early attempts at playing the piano, serving a tennis ball, or shooting a basketball were not worthy of acclaim; but with practice and guidance, major improvements undoubtedly followed.

Skill Acquisition Process

Before individuals can become skilled in any activity, they must first acquire a basic movement repertoire, consisting of fundamental movement skills. The important questions to ask here concern the best time and conditions under which *movement intelligence* (discussed in Chapter 12) may be acquired (Figure 13.1). Research and practice have identified several factors that affect the development of an individual's movement intelligence: beginning at a young age, providing sufficient learning time, being taught by qualified instructors, following the right progression, and using good equipment. These factors are discussed in more detail in this section.

Starting the Learning Process at a Young Age

Education involving movement skills should begin at a young age, even as early as the preschool

Figure 13.1 Getting started early and using scaled-down equipment are two of the most important factors in developing movement intelligence.

years. Developing basic skills such as walking, throwing, catching, and climbing early on allows a child to incorporate these skills (which are the basis for numerous other activities) effectively into a repertoire of motor skills. Because movement patterns are still being established in young children, it is important to teach skills correctly the first time to avoid the development of bad habits early.

Providing Sufficient Learning Time

A large amount of time during the school day is traditionally dedicated to the acquisition of the more important cognitive skills (e.g., linguistic and mathematical). Similarly, in order to improve an individual's motor skill development, sufficient time must be allotted to participating in physical activities that enhance movement skills. Without physical experience, skills cannot be learned effectively and maintained.

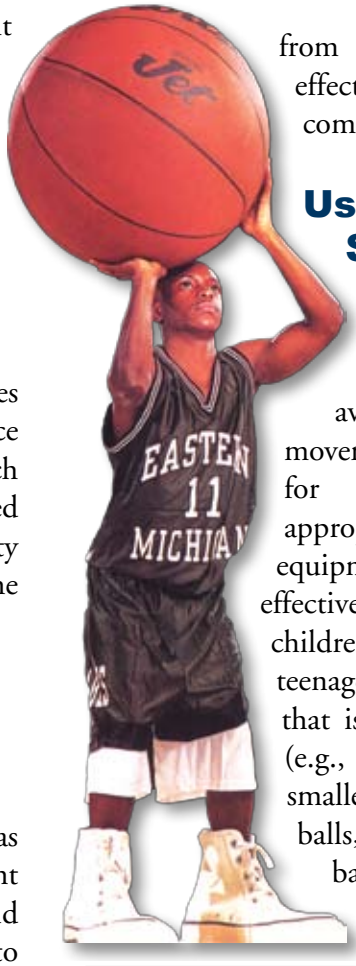
Being Taught by Qualified Instructors

Instructors, physical educators, and coaches must be properly trained and have experience with teaching physical activity in order to teach movement skills. But too commonly, unqualified staff are given the task in schools, community programs, and sports camps. Students deserve the best level of instruction available.

Following the Right Progression

Choosing the right progression to follow has a direct influence on acquisition of movement skills. In other words, the organized action and the sequence of drills ensure that skills are easier to grasp. For example, you might introduce children to baseball by playing tee-ball (which simplifies the game) and slowly incorporating a live pitcher for batting (slow-pitch first). The skills learned from simpler tasks can then be effectively transferred to more complex tasks (Figure 13.2).

Figure 13.2 When learning to ride a bicycle, beginners often start out with a tricycle or training wheels before graduating to the two-wheel version.



Using Good and Scaled-down Equipment

The quality of equipment available for teaching movement skills is also important for effective learning. Safe, appropriate, and well-maintained equipment makes learning most effective for students. For example, children have different needs from teenagers or adults. Equipment that is scaled down to their size (e.g., lower basketball hoops, smaller basketball and soccer balls, smaller soccer nets, lighter baseball bats, and so on) is essential (Figure 13.3).

Figure 13.3 Scaled-down equipment for children is a must for proper skill learning. How would you feel in an environment where everything was twice its normal size?

Many other factors in addition to the ones identified previously have an impact on the teaching and acquisition of motor skills. This chapter will review several related topics in order to provide a broad-based perspective on the skill acquisition process.

Stages of Learning a Skill

Research and practice have identified three general stages in learning a skill. We will outline the changes that occur as motor learning takes place and the important features that are unique to each stage (Figure 13.4). The three stages are the cognitive stage, the associative stage, and the autonomous stage.

Cognitive or Understanding Stage

This first stage, the **cognitive** or **understanding stage**, begins when the task is first introduced to the learner. As the skill is completely new, the first major goal for the learner is to determine cognitively the general shape of the particular skill and the goals to be achieved. Questions concerning what, when, and how predominate at this early stage as the learner tries to get a feel for the activity. Because much of the early ideas and instructions are verbally transmitted to the learner, this stage is sometimes referred to as the **verbal stage**.

Instruction, demonstrations, films, videos, and vivid descriptions serve to convey the general idea of the skill to the learner. Some learners even verbally guide themselves through skills by engaging in self-talk. Giving themselves some verbal reminders as they attempt a skill for the first time offers security and begins to instill the major ideas associated with performing the skill.

For example, a beginner in gymnastics may remind herself to tuck her head on the forward roll or to stay balanced on the beam. However, such a procedure demands concentration and does not allow other information to be processed simultaneously. But during this initial stage, verbal activity can give the learner a rough idea of what the skill is all about. In fact, it can also facilitate rapid learning and bring about considerable improvement.

Although performance at this stage may be slow, jerky, highly variable, and even awkward at times, it serves as a foundation on which a learner can build.

Associative or Practice Stage

With some practice, the learner can move to the second stage of learning, the **associative** or **practice stage**. This stage is focused on performing and refining the skill by organizing more appropriate movement patterns. Now that most of the stimuli related to the skill have been identified and defined, a greater amount of concentration can be directed to refining details.

For example, the learner can experiment with how timing can be improved by using environmental cues, as well as how movements can become more efficient and executed with increased speed. Practice allows the learner to make certain movements more automatic and controlled. The motor programs introduced in Chapter 12 can begin to develop skills that are specific to particular actions and make movements more fluid and consistent. Variability of performance from one attempt to another also begins to decrease. As performers discover what constitutes an effective performance, their confidence increases.

Performance improves rapidly at this stage. Self-talk diminishes considerably, and anticipation and consistency continue to improve. The ability of learners to detect some of their own errors in performing various skills represents an important development at this stage. Generally, the associative stage usually lasts longer than the cognitive stage for most individuals.

Autonomous or Application Stage

In the final **autonomous** or **application stage**,

Cognitive Stage: The task is first introduced. Performance may be initially slow, jerky, and awkward.

Associative Stage: Focus is on refining smaller details. Greater consistency and control is evident.

Autonomous Stage: Attention demands are reduced as movements become automatic.

Figure 13.4 Many changes take place as learners move from one learning stage to another.

movements have become almost automatic and very proficient. Attention demands are dramatically reduced, providing an opportunity to focus on other aspects of performance, such as creativity and strategy. The ability to analyze environmental stimuli is enhanced during this advanced stage, and relevant cues are quickly detected with increased accuracy.

At the peak of their careers, professional hockey players are clearly operating in the autonomous stage. Their hockey skills are so well developed from years of practice and experience that they are able to concentrate on creative plays on the ice that often seem impossible to the average player.

It is equally remarkable to see a refined pianist play with speed and fluidity, but also with creative or imaginative flair. Such performances are the result of a great deal of practice and dedication. Performance improvements during this stage, however, are relatively slow because the learner has already reached such a high level of proficiency before the stage begins. This is not to say that learning stops here, because other less obvious gains (such as a reduction in anxiety and the

Application of Learning Stages to Coaching Basketball

Stage 1:

Cognitive Stage

Players are introduced to basic basketball skills, such as dribbling, passing, and shooting, and perform them under simplified, undemanding conditions, initially while standing still and later while moving.

Stage 2:

Associative Stage

After much practice, the individual skills become more refined and are performed with fewer errors, which are increasingly self-detected and self-corrected. This ability is based on gradual development of muscle feeling that generates intrinsic feedback discussed in the next section. Gradually, the coach introduces skill variations according to game demands. Variations may focus on movement speed (ball or player), distance, movement direction, and so on. Scoring is attempted at higher speeds, from different distances, from different angles, and, if necessary, from both left and right directions.

Game-specific combinations in which several game elements are combined into a more demanding practice are gradually incorporated into training. Initially, the coach chooses combination elements/plays that occur immediately before or after the skill just learned. Then the easiest forms are chosen and are practiced in more demanding complex game forms. For example, when practicing dribbling, the ball can first be passed to a player in a standing position, then while running; and later, after dribbling, the ball can be played to another player.

In order to strengthen technical skills, the coach may then gradually introduce opponents, whose impact is guided by the coach. Initially the skill is practiced with inanimate opponents (objects such as cones or chairs) and then with passive opponents (players). Players have to learn to take an opponent into account. The passive opponent eventually turns into a semi-active opponent who agitates a player but still lets him or her finish the exercise. Players now have to broaden all technical skills in order to be successful.

The demands on a player become higher when the opponent becomes active, trying not only to disturb the flow of movement but also to hinder it. At this point, tactical training becomes important and is incorporated into practice gradually.

Stage 3:

Autonomous Stage

The players' skills have become almost automatic or habitual. Players have learned how to carry out the various skills and combinations of movements without much thinking, thus freeing their attention for other more tactical or creative aspects of the game. The goal of practice becomes learning how to apply the technical elements learned and complex combinations in a game situation within a determined tactical framework.

In the autonomous stage, basketball players' movements become spontaneous. Controlling their movements requires no attention or mental effort. This freed-up attention enables them to observe their opponents and teammates, consider tactical aspects of the game, and anticipate their own actions.

mental effort required for skill execution and an improvement in techniques) may result.

Information Feedback for Skill Learning

When we practice motor skills we are continually receiving information that is related to our movements, both during the performance and as a result of it. This constitutes **feedback** in the true sense. In motor learning literature it is often known as **information feedback**.

Research and practitioners have established that feedback plays a strong role in motivating, reinforcing, and shaping or regulating behavior in a skill-learning environment. Feedback informs the learner about significant strengths or weaknesses that may have been detected during performance. Without it, practice and, in turn, learning become far less effective.

There are various types of feedback, and the following section will highlight effective strategies instructors may use when providing feedback to learners.

Does Practice Make Perfect?

It may be said that practice alone does not make perfect, but practice with appropriate feedback does.

Feedback Classifications

Feedback is intrinsic or extrinsic and can be further subdivided into knowledge of performance and knowledge of results. These concepts are summarized in Figure 13.5.

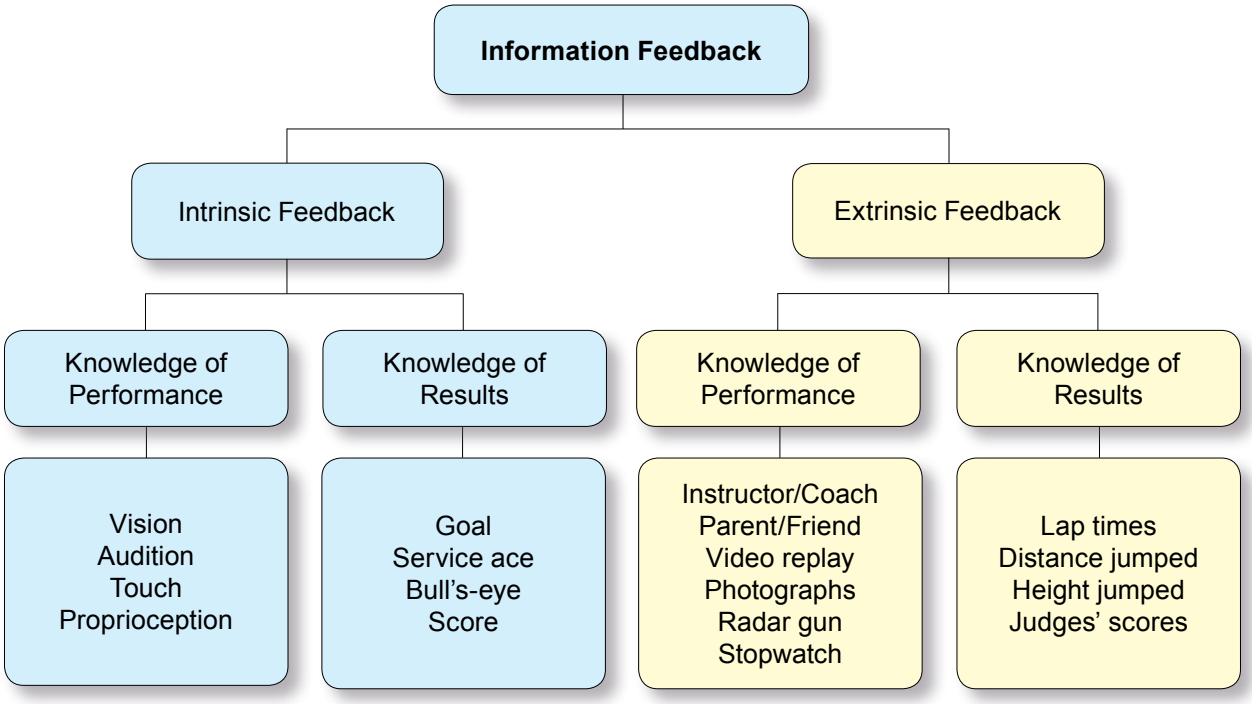
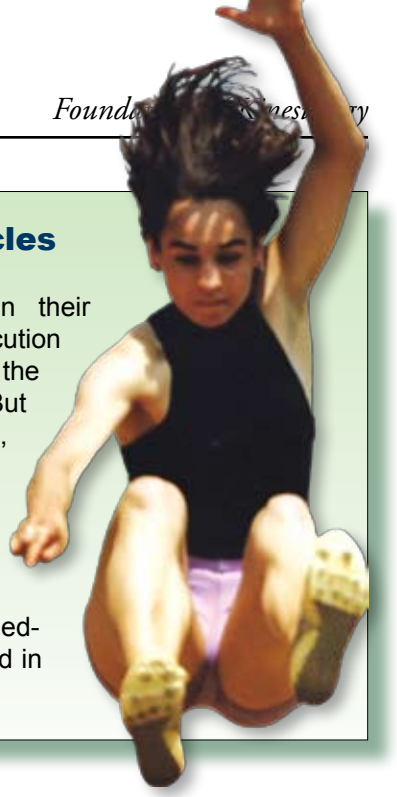


Figure 13.5 Information feedback family.

The "Secret" Language of the Muscles

Seasoned athletes can tell how good their performance was, almost as well as a panel of judges, by instinct, an infallible comprehensive measuring system. "On my first try, I knew deep down that it was a good jump as far as rhythm and takeoff. But the second try was even better, more powerful especially. I really noticed it." Good long and triple jumpers or even discus or javelin throwers can often tell with great accuracy how far they have jumped or thrown, without looking of course, if they "felt" the jump or throw properly.

Experienced athletes "measure" and judge the quality of their movements using those stimuli that are present in their bodies during execution of the movement – the *muscle feeling*. But even more important, the execution of these movements can be controlled by the information obtained from these stimuli within the closed-loop model discussed in Chapter 11.



Intrinsic Feedback

Information that is provided as a natural consequence of performing an action is considered **intrinsic feedback**. For example, when you throw a dart, you can feel your arm extend, you can see the dart fly through the air, and you can hear it make contact with the board as it hits the bull's-eye.

Knowledge of Results When you are practicing free-throw shooting, the success (or failure) of your shots provides intrinsic feedback. This constitutes an example of **knowledge of results (KR)** feedback. Other examples of this type include seeing the dart hit the bull's-eye, watching the tennis ball land in the opponent's court, or covering an excellent distance in a 12-minute walk/run test.

Knowledge of Performance The feel of your arm extension is related to information about your performance and is thus known as **knowledge of performance (KP)** feedback. This type of feedback involves the use of the senses for obtaining more or less direct information. Examples include the fine finger sensations felt when playing the piano (feeling of touch), or the crowd noise associated with college basketball games (audio sensation), or the pull in your shoulders when you are pulling on the oar as part of a crew. These sensations are related to the muscle feeling that athletes experience.

Particularly in the second learning stage, many of these movements are relatively easy to detect directly, without the need for verbal instruction from the instructor or coach.

Muscle Sense or Proprioception For any activity, several hundred muscles are normally involved in a highly specialized interplay. Without a well-developed **muscle sense**, or a good **muscle feeling**, as it is often called in sports, any athlete would have difficulty performing optimally. Without this sense, mastering any movement or even trying to execute movements already learned would be almost impossible.

This muscle sense, the intrinsic feedback, is the sum of all the sensations that result from every movement of all the limbs in the body. In the muscles, tendons, and joints of the body numerous receptors, called "spindles" because of their appearance, constantly supply information about the position of each joint (e.g., about fixed body positions and the course of the movements) (Table 13.1). The stimuli that cause these movements are the result of pressure and tension in the muscles and tendons.

The muscle feeling is not alone, however, in gathering information about movement