

INQUIRY QUESTION

How can movement skills be analysed?



Movement skills

Movement skills can be classified in many different ways and are influenced by individual, task and environmental factors. Understanding different types of skills and skill development helps to analyse and improve your own skill level, and that of others.

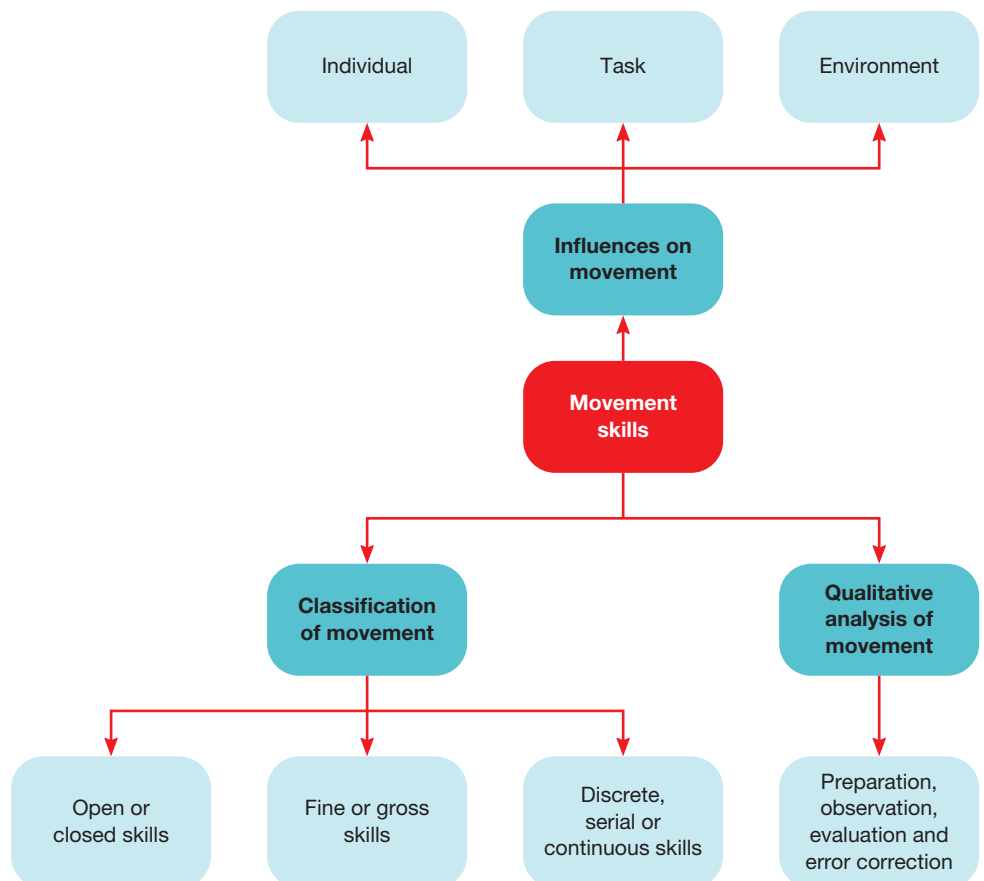
KEY KNOWLEDGE

- ▶ Classification of movement skills including fundamental movement skills, sport-specific skills, open and closed skills, gross and fine skills, and discrete, serial and continuous motor skills
- ▶ Influences on movement including individual, task and environmental constraints on motor skill development
- ▶ The link between motor skill development and participation and performance
- ▶ Qualitative movement analysis principles (preparation, observation, evaluation and error correction)

KEY SKILLS

- ▶ Analyse and classify movement skills
- ▶ Analyse individual, task and environmental factors influencing movement skill development
- ▶ Analyse the link between motor skill development and participation and performance
- ▶ Perform a qualitative analysis of a movement skill using video and systematic observation to analyse and improve a variety of movement skills

CHAPTER PREVIEW



1.1

Classification of movement skills



KEY CONCEPT Some movements are performed in an environment where there are very few factors that affect the outcome of the movement. Other movements are more complex. The complexity of a movement skill is determined by the level of coordination required and the external factors that influence the movement. Researchers of skill acquisition use these factors to categorise types of movement skills.

Types of movement skills

Skill is required for all movement. The nature of the skill varies depending on the type of movement, the required outcome and the environment in which the movement is performed.

Not all movements are the same. Some movement skills require a small number of muscles and others require the coordination of full body movements. For example, darts requires few muscle groups compared to a forward roll in gymnastics, which requires many muscle groups. The external environment affects some skills while others are performed in an closed environment where the performer has full control of the outcome.

Movement skills can be classified as open, closed, gross, fine, discrete, serial or continuous. The classification of a skill is based on:

- ▶ the way that the movement is organised
- ▶ the importance of the motor and cognitive elements
- ▶ the level of environmental predictability.

study on

Unit 3

AOS 1

Topic 1

Concept 1

Fundamental and sport-specific movement skills

Summary screen and practice questions



FIGURE 1.1 Elite archers can practise their delivery action in a reasonably controlled environment.

Fundamental movement skills (FMS) are movement patterns that involve different body parts. They are the foundational movements to more specialised sports-specific skills.

Fundamental movement skills and sport-specific skills

Fundamental movement skills (FMS) are the skills that are the basis of all movements in sport. They are basic movement patterns that are learned and form the foundation for further sport-specific skills. There is no single list of skills that are universally understood to be fundamental movement skills. Skills that are identified as fundamental

movement skills can vary, depending on the institution/researcher that is identifying the skills or the context in which the skills are performed. For example, fundamental movement skills identified in the Canadian education system include some skills that are performed on ice and in snow. Fundamental movement skills in Australia do not typically include these skills. The figure below shows the list of skills that the Australian Sports Commission identifies as being fundamental movement skills.



FIGURE 1.2 The fundamental movement skills according to the Australian Sports Commission

These skills are often the priority of primary school physical education programs and coaching of primary school-aged children. Fundamental movement skills are sometimes categorised for the purposes of teaching, research or professional discussion.

Sport-specific skills often utilise a range of fundamental movement skills in a sequence of movement; for example, a kick in AFL football requires running, balance, control of the ball in the hand and coordination of the leg muscles to perform the kicking action. For this reason, successful skill execution in sports requires well-developed fundamental movement skills and a knowledge of the specific requirements and techniques associated with the particular sporting skill.

Fundamental movement skills form the basis of sport-specific skills. Can you think of a sport-specific skill and identify the fundamental movement skills that are used for it?

Figure 1.3 is an example. The sport-specific skill of rebounding in basketball requires the fundamental movement skills of running, jumping, catching, dodging other players, dynamic balance, stopping, landing and twisting.

Sport-specific skills utilise a range of fundamental movement skills in a sequence.



FIGURE 1.3 The sport-specific skill of rebounding in basketball uses a range of fundamental movement skills.

1.1 Classification of movement skills

Physical literacy is a term that is used in the field of motor learning and performance.

Physical literacy is the ability of an individual to move competently and confidently in all types of environments — it is the literacy of movement. The key components of physical literacy — the letters and words, if you will — are the fundamental movement skills. When children are in primary school, they learn the basics of reading and writing so that they can go on to read books and write essays. In relation to movement skills, children who are of primary school age learn the fundamental movement skills so that they can then go on to learn sport-specific skills which enable them to participate in and enjoy physical activity and sports.

‘Individuals who are physically literate move with competence and confidence in a wide variety of physical activities in multiple environments that benefit the healthy development of the whole person.

- Physically literate individuals consistently develop the motivation and ability to understand, communicate, apply and analyse different forms of movement.
- They are able to demonstrate a variety of movements confidently, competently, creatively and strategically across a wide range of health-related physical activities.
- These skills enable individuals to make healthy, active choices that are both beneficial to and respectful of their whole self, others and their environment.’

Source: PHE Canada, www.phecanada.ca, 2016

Closed motor skills are motor skills that are performed in a predictable, self-paced environment.

Open motor skills are motor skills that are performed in an environment that is constantly changing and is externally paced.

Closed and open skills

Closed motor skills are performed in a predictable, self-paced environment where there are no interruptions or changes in the surroundings; for example, in indoor archery. The skill being performed is often a static one where there is little movement observed, such as a stationary softball on a T-stand in T-ball, and is internally paced. The athlete often tries to replicate the exact movement each time in a closed skill; for example, a gymnast tries to perform the exact same vault with perfect form, or a golfer tries to replicate their best swing when teeing off.

Open motor skills are performed in a constantly changing and externally paced environment; for example, the changing proximity of an opponent, the changing speed and height of a wave in surfing or the varying speed of a ball in hockey. These changes force the performer to adapt his or her basic motor skills (figure 1.4).



FIGURE 1.4 A spectacular manoeuvre gives Taj Burrow a win at the Billabong Pipe Masters in Hawaii — a reward for adapting his surfing skills to the variable wave conditions.

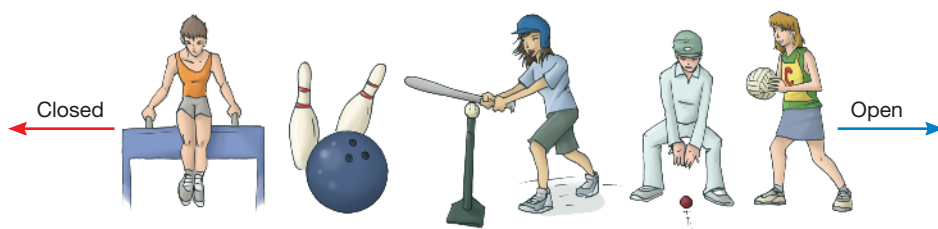
Closed/open skill continuum

Not all sports skills, whether classified as closed or open, are identical in their ease or difficulty of execution. Some skills can be classed as more closed than others. For example, ten-pin bowling is more closed than outdoor archery as it does not have external wind conditions to contend with. Equally, netball seems much more on the

open scale than windsurfing. The netballer must contend with the unpredictability of both opponents and team mates, whereas the windsurfer has no one else to consider, but must respond to the different wind conditions.

It is clear that most sports and skills lie somewhere along a continuum, with classically closed and open skills being at each end of the continuum (figure 1.5). Indeed, the same skill can vary in its position along the continuum depending on circumstances. For example, practising batting using a T-stand is a more closed skill than facing a pitched ball from a ball machine which, in turn, is more closed than facing a pitcher on the mound.

Closed skills are simpler to learn as they are practised under predictable conditions and lack the external pacing of open skills. This means that the learner can concentrate on the skill components or subroutines themselves, without having to worry about where their team mates or opponents are. In addition to this, the learner can perform the skill in their own time, learning the correct sequence and timing of the motor program. Open skills should be 'closed down' as much as possible for beginners so that they have more control over the skill they are practising.



As skill development progresses, the learner should practise the skill in situations that more closely resemble the game situation. This is called 'opening up' the skill and is essential if the athlete is to correctly and effectively apply the skills in the real game. For example, the beginner tennis player should first drop the ball and hit it over the net. Once this skill is mastered then the coach could hit the ball to the learner while they practise their forehand. The next stage would be to hit forehands from a tennis ball machine. The final stage of learning would have the athlete hitting forehands randomly to a variety of positions from all corners of the court. In this way they are mimicking the demands of the real game.

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Concept 2

Closed and open skills

Summary screen and practice questions

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Interactivity

Open and closed skills

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FIGURE 1.5 The closed/open skill continuum



FIGURE 1.6 Performers exhibiting open and closed skills

1.1 Classification of movement skills

Fine motor skills are delicate, precise movements that engage the use of small muscle groups.

Gross motor skills are movements involving the use of large muscle groups that result in a coordinated action.

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Interactivity

Gross and fine motor skills

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Fine and gross motor skills

Skills can also be classified according to the number of muscles or muscle groups involved in the activity. The two major classifications are fine and gross motor skills.

Fine motor skills involve the cooperative use of small muscle groups and the senses of sight and touch (visual motor tracking). The performer must also balance the use of force and fine touch control. Examples include writing by hand and typing on a keyboard (predominantly fine touch control), or shooting in archery (predominantly force).

Gross motor skills involve a combination of large muscle actions that result in a coordinated movement. Examples include skipping, break dancing, throwing, hitting, kicking, catching and tumbling in gymnastics. Many sporting activities combine fine and gross motor skills, so fine motor skills may indirectly improve. Spin bowling, for example, requires both gross movements and the precise manipulation of the ball by the spinning fingers.



FIGURE 1.7 There is a clear difference between fine and gross motor skills.

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Discrete motor skills

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Discrete motor skills involve movements of brief duration that are easily defined by a distinct beginning and end.

Serial motor skills are a series or group of discrete skills strung together to create a more complicated, skilled action.

Discrete, serial and continuous motor skills

Another method of classifying skills is to determine whether the phases of movements are discrete and/or serial, or continuous.

- ▶ **Discrete motor skills** involve movements of brief duration, and they are easily defined by a distinct beginning and end; for example, a throw, kick or catch.
- ▶ **Serial motor skills** are a series or group of discrete skills strung together to create a more complicated, skilled action. The duration of the activities is prolonged but each individual movement in the series has a definite beginning and end. Examples include performing a gymnastics routine or dodging your opponent, leading to the ball, jumping to catch the ball and throwing the ball to a team mate in netball.



FIGURE 1.8 Swimming is an example of a continuous skill.

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- Unit 3** Fine and gross motor skills
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- Unit 3** Discrete, continuous and serial motor skills
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- Concept 4**

Continuous motor skills have no distinct beginning or end. These movements may continue for several minutes, often involving tracking movements. Examples include swimming, running and pedalling a bicycle. Figure 1.9 summarises the classification of skills.

Continuous motor skills have no distinct beginning or end.

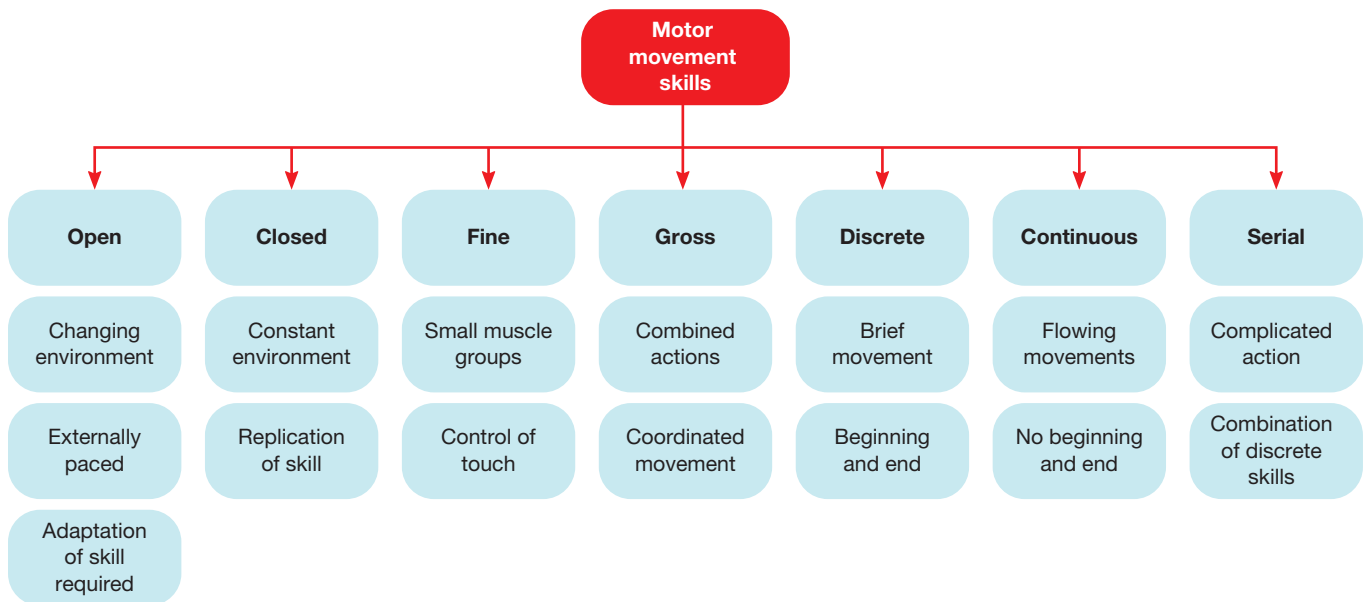


FIGURE 1.9 Summary of skill classifications

1.1 Classification of movement skills



TEST your understanding

- 1 Provide examples of one fine and one gross motor skill and compare the characteristics of these skills.
- 2 What is the difference between a discrete and continuous motor skill?
- 3 Which type of skills would be easier to develop: discrete or serial? Explain your answer.
- 4 Identify the type of skill that you perform most regularly: discrete, serial or continuous.
- 5 Choose a team sport and identify eight skills that are required. Categorise each of those skills as discrete, serial or continuous.
- 6 Identify two sports for which gross motor skills are important for performance.
- 7 Choose two sports, and provide examples of how fine motor skills are important for performance in each.

APPLY your understanding

- 8 Create a table into which you can place the following sports or actions according to whether they are open, closed, fine, gross, discrete, serial or continuous skills. They may fit into more than one category.

| | |
|-----------------------------|----------------------|
| (a) Archery | (i) Platform diving, |
| (b) Table tennis | outside |
| (c) Darts | (j) Netball |
| (d) Tennis doubles | (k) Netball training |
| (e) Tennis singles | (l) Track cycling |
| (f) Squash | (m) Tour de France |
| (g) Springboard diving | (n) Gymnastics, |
| (h) Platform diving, inside | uneven bars |
| | (o) Gymnastics, |
| | horizontal bar |
- 9 **Learning activity: classification of skills, part A**
Examine the photographs in figure 1.6.
 - (a) Which images are examples of open skills? Which are closed skills?
 - (b) For each activity, what characteristics of the movements involved justify your classification?
 - (c) A continuum is a line with two open ends, like a number line. The two extreme descriptors indicate the most 'open' or the most 'closed' examples used,

as shown in the figure below. Delivering a lawn bowl would be at the closed end of the continuum, for example, and making a save in water polo would be towards the open end of the continuum.

Closed ←————→ Open

Copy the continuum from the figure above and then make a list of open and closed skills along the line.

10 Practical activity: classification of skills, part B

- (a) Participate in a tabloid sport competition comprising eight different sports skills from different sports.
For example, students participate in each of the following activities for 10 minutes.
 - Station 1: Earthball
 - Station 2: Tug of war and three-legged bands
 - Station 3: Parachute
 - Station 4: Communication games
 - Station 5: Modified sports
 - Station 6: Ropes, hoops and quoitsAfterwards, brainstorm for a few minutes about the physical skills you used during the tabloid sports.
- (b) Draw up a table allocating a column to each of the skill classifications, then list the tabloid skills in the relevant columns. Do any skills fall into two categories? If yes, explain why this occurs.
- (c) Name some different activities you participate in during your recreation time. Classify your skill level in these activities as novice, beginner, competent performer or expert. Identify two or three skills that are important for each activity and classify each of these skills as open or closed.

EXAM practice

- 11 **ACHPER Trial Exam, 2015**
Outline the difference between open and closed skills, using shooting in basketball as an example of each. **2 marks**
- 12 Using the sport of hockey, outline how a particular skill would be taught in a closed environment before progressing to an open environment. **3 marks**
- 13 Using gymnastics as an example, explain the difference between a discrete and a serial skill. **4 marks**

1.2 Influences on movement



KEY CONCEPT Performance of movement is dynamic. It is often difficult to determine the factors that influence performance.

Physical Education teachers and experts in motor learning often refer to Newell's model of **movement constraints** (figure 1.11) to explain the individual differences in movement patterns and skill development and as a tool to assist players to improve performance. This model shows that there are three main factors that influence a movement: individual constraints, task constraints and environmental constraints.

Movement constraints are factors related to the individual, task and environment that influence movement.

Individual, task and environment

Individual constraints are those that are internal to the performer. These include body structure, fitness, psychological factors and genetics.

Individual constraints can be categorised as being structural or functional. Structural constraints relate to the body structure of the individual. Individual growth patterns, body size, flexibility, physiological capacity and body composition are examples of structural constraints.

Functional constraints relate to behaviours. Skill learning, attention, anxiety and perceptual ability and information-processing skills are examples of functional constraints.

Task-related constraints include the rules of the game, equipment used and the speed and accuracy required.

Environmental constraints are those that are external to the individual such as the weather, sociocultural restraints and gravity.

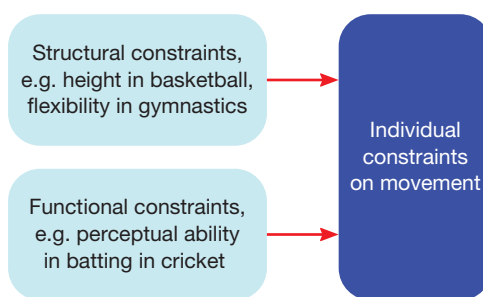


FIGURE 1.10 Individual constraints on movement

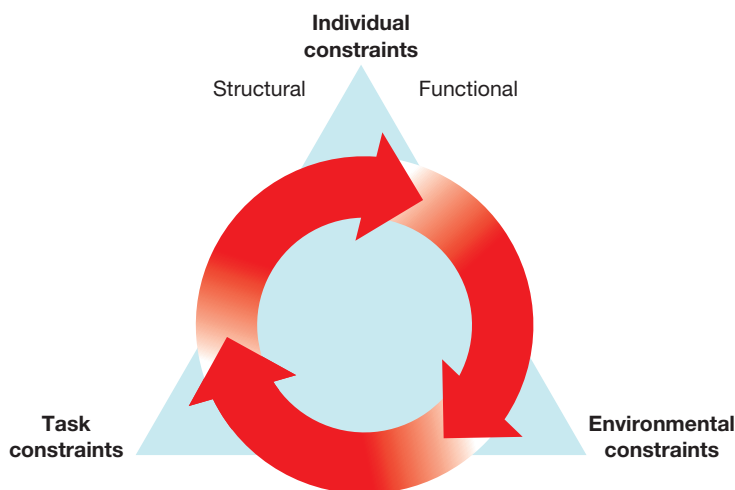


FIGURE 1.11 Newell's Model of Constraints

Applications of Newell's Model of Constraints

Coaches. A coach may have an athlete who has an unorthodox yet effective technique. A coach may come to the realisation that the body structure of this athlete is the reason for their style (individual constraint — structural). Instead of forcing the athlete to use a more traditional technique, they may work with the uniqueness of the individual and adapt their coaching to make further improvement.

1.2 Influences on movement



FIGURE 1.12 An understanding of the constraints on movement can affect a coach's ability to teach skills and tactics.

Physical Education teachers. A Physical Education teacher who is teaching softball to a group of primary school students may change the environment by using a tee rather than having a pitcher. This change to the environment will help the students to experience success and improve their skill. A teacher may also change the task by reducing the boundaries of the field to provide students with the opportunity to develop the skills of completing offensive plays in a confined space (task constraint).

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Influences on movement

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FIGURE 1.13 Modifying the task can help children to improve skills.

Athletes. If athletes are able to understand the factors that affect performance, they are able to 1) make the correct decisions and 2) adapt their technique in various conditions. If an athlete is able to gather information about their environment,

including weather conditions and proximity of a team member, then they are able to select the appropriate skill to use (environmental constraint). For example, when kicking a soccer ball in the wet, a player will need to change the way he or she kicks the ball because the ball will bounce differently when it lands.



FIGURE 1.14 Environmental constraints such as weather conditions can affect the skills that are performed by athletes in a range of sports.



TEST your understanding

- 1 Provide examples of one individual, one task and one environmental factor that influence movement skills.
- 2 For each of your examples in question 1, explain how they affect the outcome of the movement.
- 3 Using a softball hitter who is standing at the base facing a pitch as an example, explain how individual, task and environment interact to determine the outcome of the skill.
- 4 Use the information that you have learnt about factors that affect movement to describe how you would teach a basketball free throw to three year 9 students.

APPLY your understanding

5 Practical activity: modified sport

Participate in a modified (small-sided) version of AFL, soccer or hockey. Identify the task constraints that have been modified and provide a justification for the use of constraints-based coaching for junior athletes.

6 Practical activity: tennis

Participate in a doubles and a singles match of tennis. Following your participation, compare (similarities and differences) the constraints for the doubles and singles matches.

EXAM practice

- 7 The Kellysville Kolts Baseball Club has programs for people of various ages. Their Modball competition is for under-10 boys and girls. The game is played on a diamond with 60-foot base paths, with minor, age-appropriate variations to rules to provide a deeper learning opportunity. The game introduces the player to a pitched ball, developing their understanding of the strike zone, as well as introducing the position of catcher with proper protective equipment. A parent of the batting team pitches the ball to the batter, thus encouraging the player to hit, rather than a pitcher trying to strike the batter out.
 - (a) Choose three of the modifications that have been made and identify whether they are related to task, individual or environmental constraints on movement. **3 marks**
 - (b) Individual constraints can be assigned to two categories. Identify and explain these categories. **2 marks**
 - (c) The Modball program has been designed to assist the under-10s to progress towards regular baseball. Explain two ways in which the introductions that have been made to the Modball program can help the players to overcome movement constraints in the game of baseball. **4 marks**

1.3 The link between motor skill development, participation and performance



KEY CONCEPT Motor skill development is related to participation in physical activity, sport and exercise.

An **enabler** is something or someone that has a positive effect on one's movement skills.

A **barrier** is something or someone that has a negative effect on one's movement skills.

Motor skills, participation and performance are interrelated. Central to this relationship is the fact that motor skills can be an **enabler** or a **barrier** to movement. For a person to participate in sports and some forms of physical activity, they need to have a basic level of skill. It is also true that people are more likely to enjoy these activities if they have the skills that are required for a level of success in the activity. The more they enjoy the activities, the more likely they are to participate and hence the more likely they are to further develop skills — and so it goes on. This relationship is discussed in section 1.3.

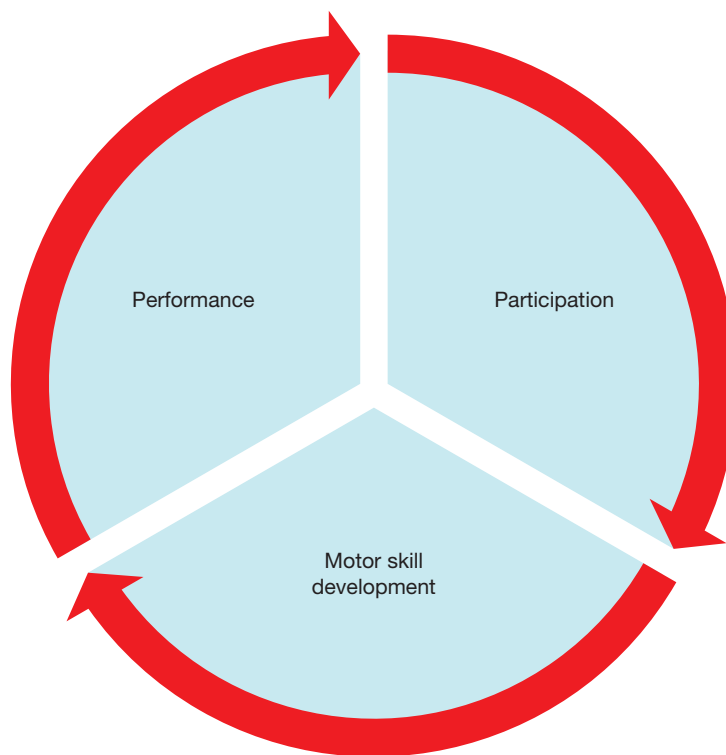


FIGURE 1.15 The development of motor skills will enable a person to participate, participation will lead to greater development of skills and, hence, better performance and maybe to increased participation.

A person who was not given the opportunity to develop their motor skills at a young age may not have the confidence to participate in sports and exercise. This may mean that they are less likely to develop the fitness and confidence required to participate in sports. Their lack of engagement in activity at a young age may have led them to develop habits associated with a sedentary lifestyle. In this regard, their lack of motor skills would have reduced their performance and been a barrier to participation in sport, exercise and physical activity.

The link between motor skills, performance and participation is an important consideration for Physical Education teachers. Some school programs focus on participation, others on developing an understanding of strategies and tactics,

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The relationship between movement skills, enjoyment and lifelong physical activity

and others prioritise the development of fundamental motor skills. Many schools try to achieve all of these objectives. The objective that most schools have in common is to provide students with the knowledge and experience necessary to maintain a healthy, active lifestyle.

Primary and secondary school students who develop their fundamental motor skills — for example, running, kicking and throwing — are most likely to increase their performance and participation in physical activity, sport and exercise. This fact has been supported by many recent studies that have shown participation in physical activity is most likely by students who have been taught by Physical Education teachers who are skilled at increasing the fundamental motor skills of students.

The quotes below are taken from Australian and international studies into the relationship between the development of motor skills in Physical Education classes and participation in physical activity.

- ‘Fundamental motor skill proficiency has been associated with subsequent physical activity and also with change in physical activity over time, highlighting that children with high fundamental motor skill proficiency show little decline in physical activity. In addition, positive associations have been established between fundamental motor skill proficiency and objectively measured physical activity in overweight children’ (Morgan, 2014).
- ‘If these fundamental motor skills are not mastered first, then children will not be able to perform in major games or feel confident enough to participate in other forms of physical activity’ (Bryant et al., 2013).
- ‘We contend that the development of motor skill competence is a primary underlying mechanism that promotes engagement in physical activity’ (Stodden, 2008).
- ‘Youth with better motor abilities may find it easier to be physically active and may be more likely to engage in physical activity, compared with peers with poorer motor competence’ (Brian H. Wrotniak, 2006).
- ‘It is clear from this review and other research that movement skill development needs to remain a key focus of PE curriculum for children and adolescents to acquire the movement skills necessary to lead physically active lives’ (Sallis and McKenzie, 1991; Pate et al., 1995).

Familial advantage

Familial advantage is the term used to explain the influence that parents and/or siblings can have on movement skill development. Most people who follow sport would be aware of siblings or families who are elite sportsmen or -women. The research is inconclusive when it comes to quantifying the advantages of growing up as a son or daughter of an elite sportsperson or as a brother or sister of a talented athlete. It could, however, be proposed that having elite performers in the family who role model effective technique and competitiveness, convey a positive self-concept, provide support or set up deliberate play or age-appropriate modifications would enhance the development of movement skills.



FIGURE 1.16 The improvement of motor skills in Physical Education classes has an impact on performance and participation.

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Family support for sporting success

1.3 The link between motor skill development, participation and performance

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Link between motor skill development, participation and performance

Summary screen and practice questions

The excerpt below was taken from Adelaide newspaper *The Advertiser*. Gretel Tippett, who is an elite netball player, has two brothers who play AFL football. It provides an insight into familial advantage.

'If Gretel Tippett seems exceptionally physical and aggressive playing in the Australian Youth Olympic Festival, she says to blame her footy star brothers, Sydney Swans forward Kurt and North Kangaroos player Joel. "They've been a major influence on me. I've been looking up to them all my life. I've been watching how aggressive they are, how much they want the ball and it has helped my game."



TEST your understanding

- 1 In your own words, explain the relationship between movement skills, participation and performance.
- 2 Your school has asked you to complete a literature review for a paper on the relationship between movement skills and participation in physical activity. Use the statements made in section 1.3 to develop this review of the literature. As an extension task, you could do further research using the papers quoted in this section.
- 3 Outline the possible limitations of physical education programs that focus solely on participation.

APPLY your understanding

- 4 Research sporting families within Australia and internationally and investigate 'familial advantage', whereby parents and siblings influence skill development. Discuss the relationship between motor skills development, participation and performance among sporting and non-sporting families.

5 Practical activity: training session

Choose a sport and participate in a training session that is aimed at increasing the skills of the chosen sport. Participants then complete a survey and report the results to the class.

Assign class members to the following roles:

- ▶ ICT specialist — will investigate the type of survey that could be used and be responsible for managing the survey

- ▶ Survey developers — will develop the survey questions
- ▶ Coach — will run a training session
- ▶ Survey analyst — will analyse the results of the survey
- ▶ Reporter — will report the findings to the class.

The purpose of this task is to collect feedback about the influence that skill development has on participation. For this reason, the survey should contain questions related to each person's perceptions about their skill level, if the training session helped them to improve their skill and if they felt those improvements would make them more likely to participate in that sport in the future. Here's a tip... put some thought into the questions and develop a minimum of five.

After the activity, each class member could complete the following tasks:

- (a) A summary of what the results showed about the relationship between skill development and participation. If the results did not show a clear relationship, you could comment on what you would expect to see if this training was to occur more regularly, drawing on your knowledge of the relationship between motor skills, participation and performance.
- (b) The individual (structural and functional) constraints that determined the difference in skill between players.

1.4 Qualitative analysis of movement skills



KEY CONCEPT Analysis and feedback are important for the improvement of movement skills. Qualitative analysis provides coaches and sports scientists with a structured approach to the analysis and improvement of movement.

When a spectator says ‘great catch’ at a cricket match, they are using a simple and incomplete form of **qualitative analysis**. A more thorough qualitative analysis involves observing a movement and using a set of principles to provide feedback about the effectiveness of the movement. Many of the movements performed in sports are performed at a high speed. For this reason, video and other technology is used to collect the data.

Qualitative analysis is the systematic observation of the quality of human movement for the purpose of providing the most appropriate intervention to improve performance.



Feedback about skills is an important aspect of skill development, and injury prevention and rehabilitation. It is important that coaches have the knowledge, skills and equipment necessary to assess a performer’s technique so that they can make recommendations for improvement. Qualitative analysis is a method of movement analysis. Qualitative analysis involves a series of tasks that are widely recognised and used within the sports science community. These tasks provide sports scientists, coaches and medical staff with a template to analyse movement.

FIGURE 1.17 Qualitative analysis provides coaches with a framework to observe performance and provide feedback to an athlete.

Coaches need an understanding of what the skill should look like. They must observe the athlete performing the skill and then use their knowledge of the skill to make recommendations to the athlete about possible improvements.



FIGURE 1.18 Coaches can make observations in real time but often require specialised equipment to film the athlete and then analyse the results for qualitative analysis.

1.4 Qualitative analysis of movement skills

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Qualitative analysis of movement skills

Summary screen and practice questions

The four tasks of qualitative analysis

Several models of qualitative analysis exist within the sport science community. In this text, we use the four task model. This model provides a simple four task structure: preparation, observation, evaluation and error correction. This model of qualitative analysis can be used to improve athletic performance or in injury rehabilitation.

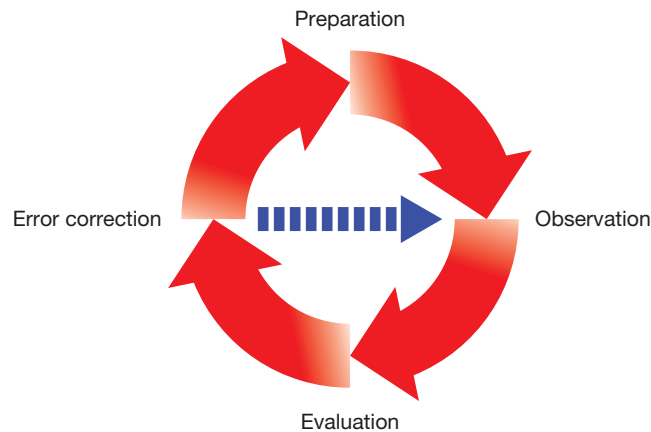


FIGURE 1.19 The four task model of qualitative analysis

Preparation

The first task in performing a qualitative analysis is to gather the relevant knowledge. During this phase, the analyst who is conducting the analysis should gather information about:

- 1 the critical features of the skill (parts of a movement that are important for success)
- 2 information about the performer/s
- 3 details about the observation stage
- 4 what constitutes effective instruction.

- 1 Information about the *critical features of the skill* can be gathered from experience, expert opinion or scientific research. The range of correctness of these features should also be considered — this is to cater for inherent variations in performers. At this time, a model of performance such as that shown in figure 1.20 may be established.

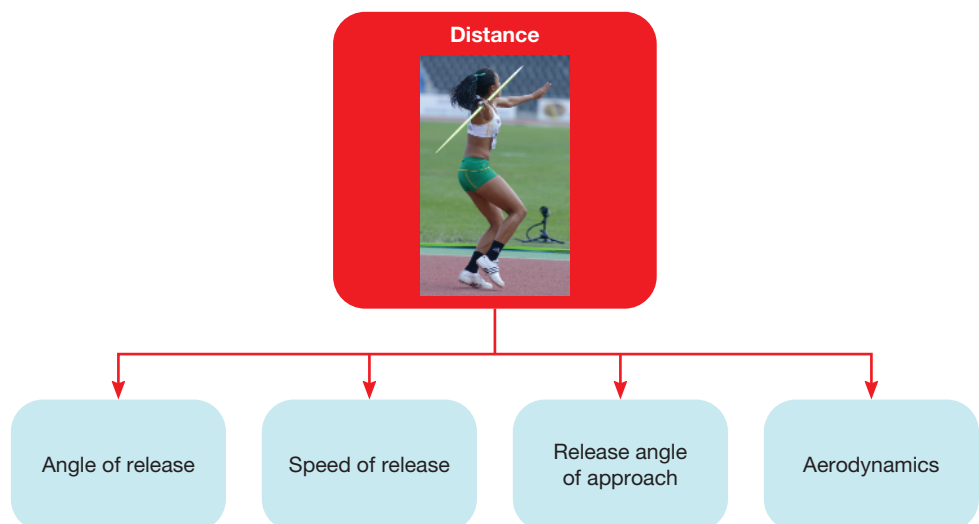


FIGURE 1.20 Model of performance of a javelin throw. This version has been simplified for the purpose of this text. The critical features for javelin are angle of release, speed of release, release angle of approach and aerodynamics. There are many factors that in turn affect each of the four critical features. A more detailed model would include these factors as well.

- 2 A coach will be most effective in analysing a skill if they have an understanding of the *physiological and psychological variables that influence movement skill performance*. Factors such as age, gender, strengths and weaknesses, skill level and body dimensions can affect the performance expectations, as well as the type of analysis and feedback given to the performer.
- 3 *Details of the observation strategy* will be outlined during the preparation stage. Those conducting the analysis will decide whether an individual player or a whole play will be recorded. They will also consider the vantage point from which the observation will occur, whether the data will be collected in the field or the laboratory and the number of observations made.
 - The analyst will document whether cameras will be used to make the observation. If so:
 - how many cameras will be used
 - which position will they be set up in
 - will they film the whole field or just the player?
- 4 The *type of instruction and feedback* provided to the performer will vary dependent on their cognitive ability, knowledge of the sport, experience and motivation. In addition to this, there are different ways of presenting the information. During the preparation, consideration must be given to the best way to communicate. The analyst should consider how they will show results, how much information will be shared and the specific tools that they will use to help the performer improve their skill.

Observation

During this task, the skill is recorded/measured. This can occur by watching the performer or digitally recording them performing the movement. The details of the observation will have been planned during the preparation. The purpose of this task is to gather and organise the information. The observation task involves the actual recording/measurement of the skill.

Evaluation

The critical features that were established during preparation and the observations made during observation are used to identify errors and positive aspects of the performer's technique. This is achieved by using the sequential method or the mechanical method.

The sequential method involves comparing mental pictures of body positions throughout each phase of the movement. This is a common strategy for coaches, as it allows them to picture desirable body positions during the phases of a skill. The mechanical method involves the application of various mechanical principles, such as sequential rotation of body segments, optimal body positions for force development and joint range of motion.

Evaluation should be based on a small number of critical features (usually between four and eight). The performance of each critical feature can then be ranked as inadequate, within the desirable range or excessive. Critical features that are within the desired range are regarded as strengths and those outside the range are regarded as weaknesses.

Error correction

Now that the strengths and weaknesses of the performer's technique have been established, the analyst can use this information to improve the player's performance. They can provide verbal feedback and/or any of the following: physical conditioning, modified practice or provide the performer with a visual model, manual or mechanical guidance. Whichever method is chosen, error correction is an important part of the qualitative analysis and needs to be carefully planned, accurate, practical and relevant to the age and skill of the performer.

Feedback — providing verbal feedback is a common method of error correction. It can be given as corrective instruction with the aim of providing the performer with knowledge of performance and advice about how to improve their technique.



FIGURE 1.21 Verbal feedback is a common method of error correction.

1.4 Qualitative analysis of movement skills



FIGURE 1.22 A basketball player can modify practice by concentrating on a particular part of the shooting technique.

For optimal results, feedback should be concise, specific, immediate and it should be given often. It is also important that a positive approach is maintained.

Modify practice — during practice, the task can be broken into parts, made easier or there can be less focus on the outcome and more on the technique. Practice can be undertaken in a closed environment to focus on skill development.

Exaggeration or overcompensation — small modifications to a technique are difficult. For this reason, some coaches ask the performer to exaggerate the aspect of the skill that they need to learn. For example, a basketball player who needs to get more height when they shoot may be encouraged initially to shoot with a high arc.

Visual model — the instructor could demonstrate the correct execution or could show footage of correct technique. Video replay can also be considered as a video model.

Manual guidance — the coach can physically move the body parts of the performer so that they can work kinaesthetically to experience the correct action.

Mechanical guidance — a mechanical aide such as a brace could be used to help the performer maintain correct body position.



FIGURE 1.23 A tennis coach can help a player to get the feeling of a correct grip by providing manual guidance.

Qualitative analysis of movement skills in action — tennis serve

Biomechanical Analysis of Stroke Production

Introduction

- How do I modify stroke production to improve performance? That is, how does the player:
 - a. hit the ball more powerfully with control;
 - b. manoeuvre the ball to different parts of the court in order to create a better tactical game situation.
- How do I reduce the potential for injury in the following situations?
 - a. During player development as the body matures
 - b. For the tournament player, who is required to repeatedly perform — how do I reduce the incidence and severity of overuse injuries?

To achieve these results requires an effective analysis structure. A systematic approach to analysis generally requires five stages (figure 1.24) to permit the coach to 'see and then evaluate' what is happening during stroke production. Such an approach enables the coach to confidently analyse movements at all levels of development.

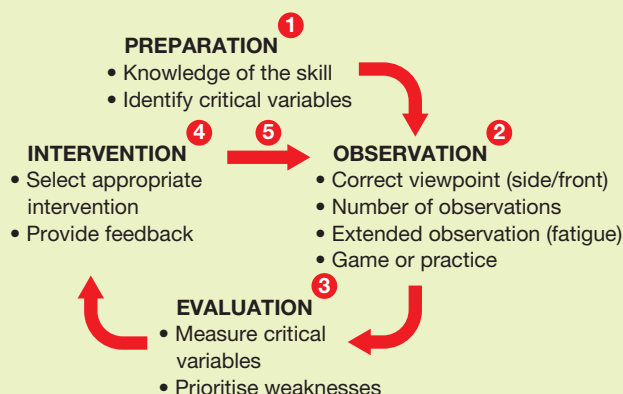


FIGURE 1.24 5-stage analysis process — a key to effective analysis (modified from Knudson & Morrison, 2002)

The Preparation Phase of the analysis process involves identifying the critical mechanical variables that underpin stroke development. Armed with the knowledge of these critical variables or key ingredients prepares you to observe and evaluate the performance of any stroke. Some of these critical variables include:

- level of rotation of the hip and shoulder alignments in ground strokes (separation angles)
- racket trajectory pre- and post-impact in creating 'heaviness' in stroke production
- level of knee flexion prior to the drive phase of the serve
- positioning of the 'line of drive' from the feet through the lower limbs to the trunk in the serve
- the alignment of the racket and hand in a volley.

All of these must be formatted in your mind prior to commencing the actual analysis and will likely change with player age (or even gender).

Remember:

- These critical features of stroke production will vary depending on the stage of player development. For example, in the serve, rhythm may be the most important

aspect of early learning, whereas internal rotation at the shoulder may be an area needing development as players mature (i.e. for a 16-year-old).

- The need for variability in stroke production will dictate that selected mechanical factors be emphasised at various stages of development (Elliott, Reid & Crespo, 2009). For example in 'building' a forehand, it is important that this be achieved by hitting balls of various heights, spin types and court locations.

In the world of biomechanics a coach may approach the analysis of stroke production in a number of ways:

- Qualitative analysis: use of the eyes attached to a thinking mind (here, video may be used in the observation phase to provide more detailed and repeated viewings of performance). This is the type of analysis used by coaches on an everyday basis.
- 2D quantitative analysis: use of a video linked with appropriate software (e.g. Dartfish or Siliconcoach) to measure features of performance that are clearly 2D — that is, the movement is in one plane or by definition is planar. Obviously the software packages mentioned above may also be used to assist in qualitative analysis. For example you may draw a line on a sequence of frames (the head in a forehand drive) to qualitatively appraise some aspect of balance. Make sure that you place your camera perpendicular to the line of motion if you intend to measure any 2D angles or distances from the video.
- 3D quantitative analysis: this level of analysis would only be used with national level programs, where a player has problems with injury or power generation. Coaches can use data from 3D analyses of players to improve their ability to qualitatively analyse performance.

How then can a coach use biomechanics and the methods of analysis most readily available to them (Qualitative and 2D Quantitative) to shape their approach to technique development? Let me use a series of images from Andy Roddick's serve to explain. As a coach you may do some or all of the following. The points listed are examples of what may be performed and a comprehensive list can be found in Elliott, Reid & Crespo (2003, 2009).

With a sound understanding of the biomechanics of stroke production (preparation), the coach can analyse movement effectively (observe and evaluate) and then start the very difficult task of modifying motion (intervention) — by far the hardest part of the analysis structure. Remember, the learning pathway requires you to look for different mechanical aspects of stroke production at the various stages of development.

References

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- Elliott, B., Reid, B. & Crespo, M. (2009). *Technique Development in Tennis Stroke Production*. Valencia, Spain: ITF Publications.
- Knudson, D. & Morrison, C. (2002). *Qualitative Analysis of Human Movement*. (2nd Ed.) Champaign, IL: Human Kinetics.

Bruce Elliott (Winthrop Professor of Biomechanics, The University of Western Australia)

ITF Coaching and Sport Science Review 2010; 50 (18): 5–6

1.4 Qualitative analysis of movement skills

Roddick sequence Mechanical feature of interest

Qualitative analysis

2D quantitative analysis



- ▶ Balance
- ▶ Position of the racket and ball to body
- ▶ Position of the feet relative to each other
- ▶ Position of the hips and shoulders
- ▶ Alignment of the trunk

- ▶ The distance between the feet
- ▶ Alignment of the trunk (hips and shoulders)



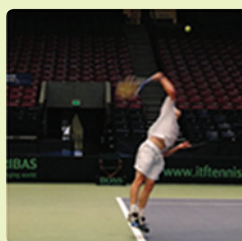
- ▶ Angle of the front arm (a characteristic of the Roddick serve, where he positions the ball closer to the body — permits good back-hip drive)
- ▶ Knee flexion and position of both knees (drive-line to the ball)
- ▶ Hip and shoulder alignment rotations (both horizontal and vertical)
- ▶ Position of the back to the front foot

- ▶ The inclination angles of the shoulder and hip alignments
- ▶ Rotation of hip and shoulder alignments
- ▶ The height of the ball toss compared with player standing height
- ▶ The level of knee flexion



- ▶ Position of the racket relative to back (away from the back and with respect to the hips)
- ▶ Level of external rotation at the shoulder
- ▶ Leg and particularly back-hip drive
- ▶ Position of the head and front arm

- ▶ The position of the racket to the back
- ▶ The velocity of the back-hip during the upward drive
- ▶ Alignment of the forearm to the court (indicator of maximal external rotation at the shoulder)



- ▶ Position of the head
- ▶ The rotation of the trunk from A to D (check movement of the trunk about the 3 axes of rotation, particularly shoulder-over-shoulder)
- ▶ Presence of internal rotation

- ▶ Flexion angle of the trunk
- ▶ Hip alignment
- ▶ Position of the back compared with front hip joint



- ▶ Body positions at impact (vertical, forward-back and laterally with respect to body)
- ▶ Alignment of racket and forearm
- ▶ Shoulder abduction angle
- ▶ Trunk flexion
- ▶ Position of head and non-racket arm

- ▶ Impact position (vertical, forward-back and laterally with respect to body)
- ▶ Alignment of the racket and the forearm
- ▶ Shoulder abduction angle



- ▶ Follow through of racket (include forearm pronation and shoulder internal rotation)
- ▶ Landing position and preparedness for next stroke
- ▶ Arabesque of back leg (following landing — not in image shown here)
- ▶ Balance

- ▶ Landing position in the court — both forward and lateral
- ▶ Flexion angle of the trunk



TEST your understanding

- 1 Describe the key features of the preparation stage of qualitative analysis.
- 2 You will notice that figure 1.19 on page 18 has a dotted line between 'error correction' and 'observation'. Explain why this dotted line may be included in the model.
- 3 List the methods of error correction.
- 4 Identify four critical features of a golf swing.

APPLY your understanding

- 5 Choose a closed skill to analyse. You will then film the skill and complete a qualitative analysis. You should compile this as a report that uses the following headings: preparation, observation, evaluation and error correction.
 - You should write a preparation document, conduct an observation and evaluation and then document some

feedback for the performer in the evaluation section.

- Please note: you may not have the specialised equipment necessary for an accurate analysis; however, follow the steps and do your best with the resources that you have available.
- Use the content of section 1.4 as a guide for what is required for each part of your analysis.
- Once you have completed your report, it may be helpful to compare it to those of your classmates so that you can help each other correct errors in your knowledge and extend your understanding of qualitative analysis of movement.

EXAM practice

- 6 Define the term *qualitative analysis*. **1 mark**
- 7 List in order the four tasks of a qualitative analysis. **4 marks**

KEY SKILLS MOVEMENT SKILLS

KEY SKILLS

- ▶ Analyse and classify movement skills
- ▶ Analyse individual, task and environmental factors influencing movement skill development
- ▶ Analyse the link between motor skill development and participation and performance
- ▶ Perform a qualitative analysis of a movement skill using video and systematic observation to analyse and improve a variety of movement skills

UNDERSTANDING THE KEY SKILLS

To address these key skills, it is important to remember the following:

- ▶ To perform a qualitative analysis of a movement skill, it is important to have an understanding of the four tasks. You would also have to identify the critical features of the skill.
- ▶ In order to classify movement skills, you would need to consider the factors in the environment that may affect the movement; for example, you could consider if there other players on the field, is there a crowd, would the physical environment affect the skill? The number and size of muscle groups required should also be considered.
- ▶ Identify the factors that influence a particular skill and classify them as individual, task or environment
- ▶ Consider how a coach, teacher or athlete may use their knowledge of the factors that affect a skill to modify training or improve performance
- ▶ Explain how each factor may influence performance
- ▶ Understand and explain the interrelationship between motor skills development, participation and performance
- ▶ Use practical examples to demonstrate the relationship

PRACTICE QUESTION

The winner of the long jump at the 2016 Australian Track and Field Championships was Fabrice Lapierre from NSW. His winning jump was 8.27 metres. In second place was Henry Frayne from Queensland; his best jump was 8.16 metres. Henry's current personal best is 8.23 metres — he achieved this in 2012.



Henry has qualified for the Olympics and is currently working with his coach to improve his jump. Henry's coach will make some changes to the training program and knows that these changes need to be based on a **systematic observation** of Henry's technique.

- Identify** a type of analysis that Henry's coach could perform and **outline** the tasks that he would undertake during this analysis. (5 marks)
- Identify** two **critical features** of a long jump. (2 marks)
- Select one **critical feature** identified in part b and **outline** a possible **error correction** method that could be used to improve Henry's performance. (2 marks)

SAMPLE RESPONSE

- Henry's coach would perform a **qualitative analysis**. **Qualitative analysis involves four tasks: preparation, observation, evaluation and error correction.**

Preparation — during this phase, the coach will research the **critical features** of the movement and have an understanding of times or other measures that Henry needs to achieve for each of these aspects of the skill. The coach may adapt these performance expectations to what he knows about Henry. He will also outline how the analysis will take place and the type of feedback that will be given.

Observation — this phase involves the **actual recording** of Henry's technique in accordance with what was outlined in the preparation stage. It would most likely involve using high speed video.

Evaluation — once the footage has been recorded, it will be evaluated. The data collected during the evaluation will be compared to the performance expectations outlined in the preparation phase. **Each critical feature will be analysed.** This will provide information about aspects of the performance that are adequate or those that could be improved.

Error correction — once the critical features that could be improved have been identified, the coach will provide Henry with **feedback** and make changes to his training regime. For example, he may modify practice.

- Take-off speed and height of jump
- Physical conditioning** — Henry could train to increase his running speed, which would help him to increase his velocity at take-off.

- **yellow** identify the action word
- **pink** key terminology
- **blue** key concepts
- **light grey** marks/markings scheme

STRATEGIES TO DECODE THE QUESTION

- **Identify the action words:**
 - Outline** — general description but not in detail
 - Identify** — determine the key characteristics or features
- **Key terminology** — **systematic observation, critical features, preparation, observation, evaluation, error correction, qualitative analysis**
- **Key concepts** — **Qualitative analysis involves four tasks, critical features, actual recording, Each critical feature will be analysed, feedback, physical conditioning**
- **Marking scheme** — 9 marks — always check marking scheme for the depth of response required, linking to key information highlighted in the question

HOW THE MARKS ARE AWARDED

- 1 mark:** identifying that the type of analysis is qualitative analysis
- 4 marks:** correctly identifying each task and providing the key components of each
- 2 marks:** one mark for each component correctly identified
- 1 mark:** choose from one of the methods listed in text
- 1 mark:** provide practical example of what could be done to improve performance

CHAPTER REVIEW MOVEMENT SKILLS

CHAPTER SUMMARY

Classification of movement skills

- ▶ A motor skill is any activity involved in moving the body (or some parts of the body) to achieve a specific goal.
- ▶ Movement skills can be classified as:
 - closed skills performed in a predictable environment (e.g. gymnastics moves)
 - open skills performed in an environment that is constantly changing (e.g. a sport in which the speed of a ball varies)
 - fine skills that involve the cooperative use of small muscle groups and the senses of sight and touch (e.g. writing by hand)
 - gross skills that involve a combination of muscle actions which result in a coordinated movement (e.g. skipping and throwing).
- ▶ Generally, skills can be classified as:
 - discrete movements with a short duration and a distinct beginning and end
 - continuous — cyclic movement with no distinct beginning or end that may flow on for several minutes (e.g. swimming or running)
 - serial — a series or group of discrete skills joined together to create a more complicated action (e.g. a gymnastics routine) or in other words, fundamental movement skills combining to form a sports-specific skill.

Influences on movement

- ▶ The influences on movement can be classified as related to individual constraints, task constraints or environmental constraints.
 - Individual — internal factors such as body structure and fitness
 - Task — factors that are related to the nature of the task; for example, rules of a game and the equipment
 - Environmental — factors related to the external environment such as the ground surface and weather

The link between motor skill development, participation and performance

- ▶ Motor skill development is related to participation and performance.
- ▶ Factors such as familial advantage can influence participation and skill development, which can improve performance.
- ▶ Motor skill development is an important factor in determining lifelong participation in physical activity.

Qualitative analysis

- ▶ Qualitative analysis involves observing a movement and using a set of principles to provide feedback about the effectiveness of the movement.
- ▶ There are four tasks involved in a qualitative analysis. They are preparation, observation, evaluation and error correction.
- ▶ During the preparation phase, the investigator identifies critical features, compiles information about the performer and outlines the tasks that they will undertake during the observation, and prepares a plan to provide feedback to the athlete.
- ▶ During the observation phase, the data are collected.
- ▶ The purpose of the evaluation is to analyse the data that have been collected.
- ▶ These data are then used to provide feedback to the athlete and develop a strategy to correct errors in their technique. This fourth phase is called error correction.

EXAM PREPARATION

MULTIPLE CHOICE QUESTIONS

- 1 Select the correct definition of a motor skill.
 - (A) An activity involved in moving the body (or some parts of the body) to achieve a specific goal
 - (B) Skills that are the basis of all movements in sport. They are basic movement patterns that are learned and form the basis of further sport specific skills.
 - (C) A skill that is innate and largely determined by genetics
 - (D) Skills that utilise a range of fundamental movement skills in a sequence of movement

eBookplus

Interactivity

Movement skills quiz

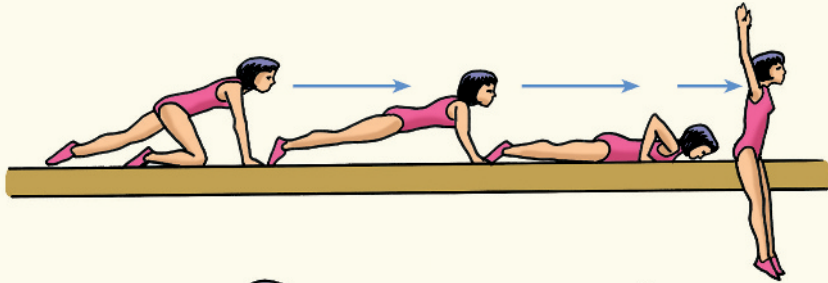
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- 2** Which of the following is an example of an individual (functional) constraint?
 (A) The inability of a child to use a full-size tennis racquet
 (B) The placement of fielders too close to the batter in cricket
 (C) The no-tackling rule in junior rugby
 (D) An older adult who has a slower reaction time when taking off for a sprint
- 3** Identify the list of skills that contains the most fundamental movement skills.
 (A) Tennis serve, spike in volleyball, running, kicking
 (B) Tennis serve, jumping, spike in volleyball, running, rebounding
 (C) Tennis serve, kicking, walking, spike in volleyball, running
 (D) Tennis serve, kicking a soccer ball, walking, spike in volleyball, running, marking a football
- 4** The following list shows a mixture of open and closed skills in a game of soccer. Which list below best reflects the correct order from closed to open?
 (A) Penalty kick, dribbling the ball down the wing, kick off, passing the ball to a team mate
 (B) Kick off, penalty kick, dribbling the ball down the wing, passing the ball to a team mate
 (C) Penalty kick, kick off, dribbling the ball down the wing, passing the ball to a team mate
 (D) Kick off, penalty kick, passing the ball to a team mate, dribbling the ball down the wing
- 5** The following statement applies to which of the qualitative analysis tasks?
The performance of each critical feature can then be ranked as inadequate, within the desirable range or excessive. Critical features that are within the desired range are regarded as strengths and those outside the range are regarded as weaknesses.
 (A) Preparation
 (B) Observation
 (C) Evaluation
 (D) Error correction
- 6** A cricket coach who chooses to use a tennis ball rather than a cricket ball for primary school children is demonstrating an awareness of which type of constraint on movement?
 (A) Environment
 (B) Task
 (C) Individual (structural)
 (D) Individual (functional)
- 7** During practice, tasks can be broken into parts or made easier, or there can be less focus on the outcome and more on the technique. Practice can be undertaken in a closed environment to focus on skill development.
 This statement relates to
 (A) feedback.
 (B) manual guidance.
 (C) modified practice.
 (D) the visual model.
- 8** An elite cricket player has to modify his technique to prepare for the Twenty20 games. His aim is to be able to hit more balls over the fielders' heads.
 The most appropriate method of error correction would be
 (A) manual guidance and feedback.
 (B) mechanical guidance, visual model and feedback.
 (C) feedback and over compensation/exaggeration.
 (D) feedback, visual model and modified practice.
- 9** The most likely list of critical features for a high jump would be
 (A) vertical angle at take-off, height of jump, angle of approach.
 (B) vertical angle at take-off, height of jump, velocity at take-off.
 (C) vertical angle at take-off, angle of approach and velocity at take-off.
 (D) vertical angle at take-off, height of jump and angle of approach.
- 10** A psychologist who is working with an AFL player to improve his goal kicking in important moments in games in front of large crowds is attempting to overcome which kind of constraint?
 (A) Individual (functional)
 (B) Individual (structural)
 (C) Environment
 (D) Task



TRIAL EXAM QUESTIONS

Question 1



For each of the four images above, identify whether they are a more open or closed skill. Outline the reason for each of your selections. **8 marks**

- a. _____
- _____
- b. _____
- _____
- c. _____
- _____
- d. _____
- _____

