Review Article

Complex Coordination Psychomotor Skill

Edison Ikonomi,Klotilda Vrenjo,Kujtim Kapedani,Anesti Qeleshi.
Sports University of Tirana, Faculty of Movement Science,Albania

KEYWORDS
Development, Activity, Children, Exercise, High School.

ABSTRACT
In any physical activity, basic motor activities are very important and interdependent structures that appear with special features from which they have also taken the name, such as: walking, running, jumping, dragging, rhythm, orientation motor etc. In this context, coordinating skills have specific features as important as all other motor activities. Activities and sports taught in physical education classes generally involve multiple degrees of freedom (i.e., the entire body). This being the case, pupils generally will be using dual processes of coordination and control to learn skill in these activities. These distinct processes satisfy different requirements for production of skilled physical activity, and require different types of information for each of these to be learned. Knowledge of performance regarding movement coordination will likely be more beneficial early on in learning. KR facilitates control of movements and is likely to be your best bet later on in learning. However, factors such as the demands of activity being learned, level of skill that athlete is seeking to achieve, and how much retention of learning is needed also need to be kept in mind. Coordination skills are a necessary component for development of children's movements, which are developed and educated through time of concern that is devoted to them

1.Introduction

In motor tasks that involve relatively few segments of the body there are relatively few demands for coordinating many degrees of freedom of body. However, in whole-body tasks (i.e., playing basketball, baseball, soccer, etc.), such as are typically learned in physical education classes, human nervous system is faced with the challenge of how to coordinate many segments of the human body in a way to optimally meet what can be challenging task demands [1].

When a basketball player gracefully fakes out an opponent, spins and hits a jump shot, there are precise demands for the coordination of body in such a way as to pass defensive player and shoot ball so as to pass through the hoop. Learning abilities such as this require ability to coordinate and control body so as to produce skillful action that will achieve objective (i.e., making a basket) [2].

Motor coordination is regarded as a highly psychomotor complex skill that relies on other psychomotor skills and has interrelationships with motor skills and especially understanding.

Most authors consider coordination as a complex motor skill which is educated in order to improve different capacities:

- Ability to adjust and manage individual movements or actions involving the entire body
- Ability to control motor movement in any situation
- Ability to quickly change from some actions and relationships to another's, without being interrupted continuity and ease of motor acts and actions in line with ever changing requirements of environment (ambiance of a particular sport) [3].

1.1 Coordination

Process of human motor learning essentially consists in learning how to master the many redundant degrees of freedom in the human neuromuscular system so as to optimally meet the task demands in a given set of environmental conditions. The first aspect of this process is that of organizing the coordination between body segments. The nervous system simplifies the control of the neuromuscular system by constraining different parts of the body to work together. This constraining of body segments to act together is performed by coordinative structures, also known as *synergies,* and is called *coordination*. This simplification of control is similar to the way the two front wheels of your automobile are constrained to act together. Because of this, you only need control one steering while, rather than two [4].

Because coordinative structures simplify control the result is that coordination pattern are highly consistent. For example, when throwing a baseball, each person has learned a pattern of relative timing between shifting their body weight over his or her legs, which is timed with respect to *rotary, flexion* and *extension* movements of the trunk, shoulder, elbow, etc. The relative timing of each of these parts of the body is quite consistent. Learning how to produce such consistent movement patterns is the process of coordination [5].

1.1.1 Conditioning factors of coordination

- Quality of central nervous system (value of coordination processes and cortex plasticity). These allow the development of appropriate responses throughout the multiple motor action as reaction to stimulus received from both outside and inside of the body. A special role here plays the kinesthetic analyzer which offers the possibility of noticing and percepting precisely his own movements, which contributes to faster acquisition of new movement structure.
- Functional quality (sharpness, smoothness, precision) of analyzers receiving organs (kinesthetic, static-dynamic, visual, tactile, auditory). Five of the analyzers contribute significantly to motor coordination, influencing differently the guidance and regularization process of gestural acts. These analyzers cooperate between each other and complete themselves [6].

1.2.1 How forms of coordination manifest coordination occurs as

- General coordination which means ability to make rational, economically and creatively different motor actions. With increased multilateral physical training increases general coordination. Is the basic coordination on which it can be realized and build the specific coordination;
- Specific coordination which means ability to perform motor activities specific to sport branches or tests more easily. Specific coordination manifests differently from one individual to another, from one sport to another, from one segment of body to another. The athlete raise his specific coordination level through specifically targeted training [7].

1.2 Control

In order to meet task demands these coordination patterns may need to be scaled up or down (such as when throwing a ball closer or farther away). It can also be important to throw a ball accurately with respect to time and location. For example, a catcher in baseball may need to throw ball to first base while hitting a relatively small target (around the first baseman's glove) within a very short time window. The process of adapting coordination patterns to all these types of task and environmental demands is called *control* [8].

1.3 Skill

When athletes produce coordination patterns that they can adapt to meet the demands of the task and environment that they have to perform in, this is called *skill*. Skill may also involve elements such as producing movements that are efficient; that is, producing a high work: energy ratio. Skill may also involve elements such as the ability to produce smooth movements (e.g., 'minimum jerk'). However, in the end, skill is generally defined by the ability to meet some external demands (i.e., being able to beat an opponent) [9].

1.4 Physical Education

Understanding the processes of coordination and control to produce skilled action can be important to physical education teachers because this knowledge can help better assist students. Different types of help and information may be needed to facilitate coordination as opposed to control. Also, during different stages of the learning process either coordination or control may be of more importance. Additionally, the ability to retain and transfer motor learning can be different with respect to coordination and control. Knowing this can enable physical education teachers to better facilitate learning in their pupils [10].

In sporting events that involve multiple degrees of freedom, feedback from an instructor regarding performance (kinematic and/or kinetic) will likely be necessary in addition to feedback regarding the results of his or her performance [11].

Different types of augmented information are likely necessary during different stages of the learning process. Information regarding knowledge of performance (KP) is more likely to be beneficial in the early stages of learning (coordination), while knowledge of results (KR) is more beneficial in later stages [12].

Early in the learning process physical education teachers can provide information to facilitate the process of learning optimal coordination patterns (KP). This type of information may regard what is called moving with good 'form.' While some coordination patterns can be identifiable as being good or bad form, it is also worthwhile to keep in mind that (due to different properties of each person's body and nervous system) what is the optimal coordination pattern for one student may not be optimal for another [13].

Later in learning the process of control becomes of greater importance, as this involves adapting the already-learned coordination patterns to the task and environmental conditions. For this reason, providing 'knowledge of results' is more likely to be beneficial in later stages of learning as these relate more directly to the process of control [14].

For example, in the initial stages of learning baseball or softball pitching the learning of body coordination patterns may be more beneficial than would be worrying about accuracy. This represents the learning of *coordination*, while later focusing on accuracy reflects the process of *control*, which is best done after some learning of proper coordination patterns has been achieved [15].

Another relevant factor is level of skill that is sought by each particular student or athlete. If a moderate level of performance is goal only a relatively short apprenticeship in coordination may be necessary before moving on to the process of improving control. However, to reach a high level of ability, a more extensive amount of time may need to be spent learning the optimal coordination patterns necessary before moving on to hone the ability to control these patterns [16].

1.5 Coordinative capacities at different ages

We believe it is necessary that in coordinative capacity development should be take into account:

- Multiple gesture experience shortens the time of learning and makes more efficient the training in the context of the new gestural abilities. So, it is necessary to give great importance to developing a gestural repertoire as comprehensive as possible;
- Coordinative skills are the base of all learning motor skills at all ages;

- Coordinative skills do not admit the development; unless complex forms, continuous and variable;
- The coordination capacity has to be developed quite early [17].

1.5.1 Preschool age

Iivonen, et al. 2015 [18] thinks that in the individual evolution is no chronological concordance between optimal training capacity of the coordinative faculty and conditional qualities. Biologically speaking, the land is better suited for gestural development coordination than improving conditioning physical factors of performance. According to recent research, guidance and regulation of neuro-muscular or sensory-motor gestures manifestly belongs to the domain of these basic functions, where the adequacy and successful development occurs.

Coordinative discordant faculties are result of inadequate provisions occurred early in life. Great differences observed between the trained and untrained children clearly show that the potential of existing coordinative skills development is not at all exhausted at preschool age [19].

1.5.2 The first school age (6/7-10 years)

High plasticity of the cerebral cortex allows at this age a huge coordinative skills development, the differential inhibition still underdeveloped, these constitute a preponderance of excitation processes in relation to the inhibition processes. Kinesthetic analyzer is still little developed and accuracy suffers as its spatial and temporal aspects
http://www.wooster.edu/physics/JrIS/Files/Satti.pdf[20]. .

Predominance of excitation processes it's translated through a marked irradiation of excitation, so, the still unfixed traces of neuronal activity can be easily erased and cerebral cortex is unable to retain functional connections - brain centers excited gestures curls together or successively. For this reason at this age, high capacity learning is not associated to equal faculty to retain a long period of time learned movements [21].

1.5.3 Second school age (10-14/15)

Achieving motor brain maturity, which comes in second school age, allows better involuntary motor cooperation (bulb, stem encephalitis) and voluntary (the cortex).
Plasticity of the cerebral cortex which is still elevated and improved ability of perception and processed information allows children to learn new gestures skills very quickly. Same happens if the force-lever ratios are developed favorably at this age [22].

1.6 Retention and Transfer of Motor Learning

Retention of motor learning is the degree to which improvements in performance are kept despite passage of time, and even layoffs from practice. Research in motor learning has shown that the learning of coordination is better retained than is the scaling of these patterns to meet task demands (i.e., control). This fact may also play a role in the teaching strategy of physical education teachers. For example, if students are going to be having somewhat long periods of time without practice it may be desirable to spend more time on the process of coordination, which will be better retained than practice focusing on control [23].

It has also been found that the need to warm-up before performing optimally (such as right before a game) affects control more than it does coordination. For this reason, warming up before a competition may better focus on control and accuracy of movements while not focusing on the coordination patterns to be produced [24].

Transfer of motor learning is the degree to which performing or learning one task affects performance of another task. Transfer can be positive, negative or neutral, meaning that performing one task might either help or hurt (or have no effect on) one's ability to perform another task [25].

Research on transfer in motor skills has shown that positive transfer is most commonly associated with control, while negative transfer has generally been found to occur when two tasks involve the use of conflicting coordination patterns. What this means is that it would not be a good idea to have students or athletes perform a task involving a different coordination pattern right before competition (such as playing ping pong right before competing in tennis). However, over the long term this type of negative transfer is unlikely to persist [26].

1.7 Task Constraints

It is important to remember that the processes of coordination and control operate within the context of the constraints of the task (sport) to be performed. For this reason physical educators would be well served to take this into account when teaching motor skills. In some tasks the definition of skill carefully and specifically considers the coordination pattern to be produced [27].

For example, in diving, dance, and gymnastics the production of certain coordination patterns may largely be the objective of performance, rather than external criteria such as putting a ball through a hoop. In sports such as these an extensive amount of time may likely be needed to ensure the development of the coordination objectives, while there may be much less need to focus on the control of movements [28].

Other tasks rely minimally on coordination patterns and depend much more on control processes. For example, throwing darts requires the coordination of a relatively small number of body parts in a highly repetitive fashion. In this type of task it would likely be more beneficial to focus on control and accuracy with little concern for coordination [7].

2. Methodology

In order to fulfill the purpose of this review we are using methods of literature analysis, and is made combination of data from different works and authors of various articles. To successfully realize this review paper we studied and analyzed contemporary scientific literature provided by various Internet-based research sectors such as: "Jab Ref" "Pub Med" "Google Scholar" "Medline" and "Research Gate", physical activity statistics, conclusions and recommendations.

3. Conclusion

Based on content of our material, we reached some basic conclusions, which we are listing as follows:

- Coordination skills are a necessary component for pupils' motor preparation.
- The effects of coordinative skills derive from time and preoccupation devoted to them.
- Coordinative skills are in specific relationships with other motor skills. These reports appear in accordance with psychological, technical, educational, volitional, etc. component.
- Coordination skills, without underestimating other motor skills, is one of most important skills.
- Coordinative skills are basis of preparation for achieving satisfactory results in various educational, physical and sports activities.

References:

[1] Cattuzzo, M.T., Henrique, R.S., Ré, A.H.N., de Oliveira, I.S., Melo, B.M., Moura, M.D.S., de Araújo. R.C., & Stodden, D. (2016). Motor competence and health related physical fitness in youth: *A systematic review. J. Sci. Med. Sport.* 19, 123–129. DOI: 10.1016/j.jsams. 2014.12.004.

[2] Barnett, L.M., Lai, S.K., Veldman, S.L., Hardy, L.L., Cliff, D.P., Morgan, P.J., Zask, A., Lubans, D.R., Shultz. S.P., & Ridgers, N.D. (2016). Correlates of gross motor competence in children and adolescents: *A systematic review and meta-analysis. Sports Med.* 46, 1663–1688. DOI: 10.1007/s40279-016-0495-z.

[3] Holfelder, B., & Schott, N. (2014). Relationship of fundamental movement skills and physical activity in children and adolescents: *A systematic review. Psychol. Sport Exerc.* 15, 382–391. DOI: 10.1016/j.psychsport.2014.03.005.

[4] Robinson, L.E., Stodden, D., Barnett, L.M., Lopes, V.P., Logan, S.W., Rodrigues, L.P.,& D'Hondt, E. (2015). Motor Competence and its Effect on Positive Developmental Trajectories of Health. *Sports Med.* 45,1273–1284. DOI: 10.1007/s40279-015-0351-6.

[5] Stodden, D., Goodway, J.D., Langendorfer, S.J., Roberton, M.A., Rudisill, M.E., Garcia, C., & García, L.E. (2008). A Developmental Perspective on the Role of Motor Skill Competence in Physical Activity: An Emergent Relationship. *Quest.* 60, 290–306. DOI: 10.1080/00336297.2008. 10483582.

[6] Hardy, L.L., Reinten-Reynolds, T., Espinel, P., Zask, A., & Okely, A.D. (2012). Prevalence and Correlates of Low Fundamental Movement Skill Competency in Children. *Pediatrics.* 130, e390–e398. DOI: 10.1542/peds.2012-0345.

[7] Gaul, D., & Issartel, J. (2016) Fine motor skill proficiency in typically developing children: On or off the maturation track? *Hum. Mov. Sci.* 46, 78–85. DOI: 10.1016/j.humov.2015.12.011.

[8] O'Brien, W., Belton, S., & Issartel, J. (2015). Fundamental movement skill proficiency amongst adolescent youth. *Phys. Educ. Sport Pedagog.* 21, 1–15. DOI: 10.1080/17408989.2015. 1017451.

[9] Sigmundsson, H., Trana, L., Polman, R., & Haga, M. (2017). What is Trained Develops! Theoretical Perspective on Skill Learning. *Sports.* 5, 38. 10.3390/sports5020038.

[10] Dudley, D., Okely, A.D., Pearson, P., & Cotton, W. (2011). A systematic review of the effectiveness of physical education and school sport interventions targeting physical activity, movement skills and enjoyment of physical activity. *Eur. Phys. Educ. Rev.* 17, 353–378. DOI: 10.1177/1356336 X11416734.

[11] Renshaw, I., & Chow, J.Y. (2018). A constraint-led approach to sport and physical education pedagogy. *Phys. Educ. Sport Pedagog.* 24, 103–116. DOI: 10.1080/17408989.2018.1552676.

[12] Harvey, S., Pill. S., & Almond, L. (2017). Old wine in new bottles: A response to claims that teaching games for understanding was not developed as a theoretically based pedagogical framework. *Phys. Educ. Sport Pedagog.* 23, 166–180. DOI: 10.1080/17408989.2017.1359526.

[13] Grissmer, D., Grimm, K.J., Aiyer, S.M., Murrah, W.M., & Steele, J.S. (2010). Fine motor skills and early comprehension of the world: Two new school readiness indicators. *Dev. Psychol.* 46, 1008–1017. DOI: 10.1037/a0020104.

[14] Whittle, H.D. (1961). Effects of Elementary School Physical Education upon Aspects of Physical, Motor, and Personality Development. Res. Quarterly. Am. Assoc. *Health Phys. Educ. Recreat.* 32, 249–260. DOI: 10.1080/10671188.1961.10613141.

[15] Smith, T.L. (1982). Self-Concepts and Movement Skills of Third Grade Children after Physical Education Programs. *Percept. Mot. Ski.* 54,1145–1146. DOI: 10.2466/pms.1982.54.3c.1145.

[16] Jiménez-Díaz, J., Chaves-Castro, K., & Salazar, W. (2019). Effects of Different Movement Programs on Motor Competence: A Systematic Review with Meta-Analysis. *J. Phys. Act. Health.* 16, 657–666. DOI: 10.1123/jpah.2018-0179.

[17] Ulrich, D.A. (1985). Test of Gross Motor Development. ProEd; Austin, TX, USA.

[18] Iivonen, S., Sääkslahti, A., & Laukkanen, A. (2015). A review of studies using the Korper koordinations test fur Kinder (KTK) Eur. *J. Adapt. Phys. Act.* 8, 18–36. DOI: 10.5507/ euj.2015.006.

[19] Logan, S.W., Ross, S.M., Chee, K., Stodden, D., & Robinson, L.E. (2017). Fundamental motor skills: A systematic review of terminology. *J. Sports Sci.* 36, 1–16. DOI: 10.1080/ 02640414. 2017. 1340660.

[20] http://www.wooster.edu/physics/JrIS/Files/Satti.pdf

[21] Martin, E.H., Rudisill, M.E., & Hastie, P.A. (2009). Motivational climate, and fundamental motor skill performance in a naturalistic physical education setting. *Phys. Educ. Sport Pedagog.* 14,227–240. DOI: 10.1080/17408980801974952.

[22] Kalaja, S.P., Jaakkola, T., Liukkonen, J.O., & Digelidis, N. (2012). Development of junior high school students' fundamental movement skills and physical activity in a naturalistic physical education setting. *Phys. Educ. Sport Pedagog.* 17:, 11–428. DOI: 10.1080/17408989.2011. 603124.

[23] Miller, A., Christensen, E., Eather, N., Gray, S., Sproule, J., Keay, J., & Lubans, D.R. (2015). Can physical education and physical activity outcomes be developed simultaneously using a game-centered approach? *Eur. Phys. Educ. Rev.* 22, 113–133. DOI: 10.1177/1356336X 15594548.

[24] Jarani, J., Grøntved, A., Muca, F., Spahi, A., Qefalia, D., Ushtelenca, K., Kása, A., Caporossi, D., & Gallotta, M.C. (2015). Effects of two physical education programmes on health- and skill-related physical fitness of Albanian children. *J. Sports Sci.* 34:1–12. DOI: 10.1080/02640414. 2015.1031161.

[25] Lander, N., Morgan, P., Salmon, J., & Barnet,t L.M. (2017). Improving Early Adolescent Girls' Motor Skill. *Med. Sci. Sports Exerc.* 49, 2498–2505. DOI: 10.1249/MSS.0000000000001382.

[26] Dalziell, A., Booth, J.N., Boyle, J., & Mutrie, N. (2019). An evaluation of how a novel approach to teaching physical education can impact children's physical activity, coordination, and cognition. *Br. Educ. Res. J.* 45, 576–591. DOI: 10.1002/berj.3514.

[27] Hallal, P., Andersen, L.B., Bull, F.C., Guthold, R., Haskell, W., & Ekelund, U. (2012). Global physical activity levels: Surveillance progress, pitfalls, and prospects. *Lancet.* 380, 247–257. DOI: 10.1016/S0140-6736(12)60646-1.

[28] Smits-Engelsman, B.C.M., Blank, R., Polatajko, H.J., Wilson, P.H., van der Kaay, A.-C., der Meijs, R.M.-V., & Brand, E.V.-V.D. (2012). Efficacy of interventions to improve motor performance in children with developmental coordination disorder: A combined systematic review and meta-analysis. *Dev. Med. Child Neurol.* 55, 229–237. DOI: 10.1111/dmcn.12008.