COMPARATIVE STUDY ON THE DEVELOPMENT OF COORDINATION CAPABILITIES OF MALE STUDENTS FROM F.S.P. AND F.A.C.S.E.E.E.

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Abstract
Achieving the complex objectives set for higher education by the physical education and sports programme means a thorough knowledge of the effects on the human body triggered by these physical exercises during the educational process, at different time intervals. Practising different sports, according to individual choice, and improving the level of general and specific physical training are the main activities, primarily scheduled for students from faculties which do not specialise on sports. In this regard, the present study focuses on students from The Faculty of Automation, Computer Sciences and Electrical and Electronics Engineering (F.A.C.S.E.E.E.). As for the students from The Faculty of Sports and Physical Education (F.S.P.E.), the demands are much greater with respect to the volume of work, the intensity and the specificity of the efforts, the students being constantly subjected to the adaptation processes proper to the different sport branches they practise. Regardless of the university specialty, the physical effort entails coordination processes. The present paper will perform a comparative analysis and interpretation of the level of development of the coordination capabilities elements, with the aim of tracing the significant differences between the two groups of male students under study.
Key words: *general and specific coordination, motor aptitudes, the quality of the moves, energetic efficiency.*

INTRODUCTION

The concept of coordination is quite controversial in terms of approach and significations within the scholarly literature, the current term of coordination capabilities being adopted by more and more specialists; this so happens due to the fact that it encompasses more areas of manifestation of the coordination processes. The terms used in the past (ability, precision, skill, agility etc) did include such a wide range of characteristics/aspects which accompany the coordination processes [2, 4, 12, 16, 19].

The majority of the motor aptitudes fall within the category of conditional ones – speed, strength, endurance – which depend heavily on the state of the major body systems and functions and for which the effort loads with priority through the increase of volume and intensity. Coordination, however, has some distinctive features, one of them being the strong influence of heredity; what is more, the basis of its developments is the complexity of the effort undergone. Since the psychic determination is very powerful, the progress in improving and manifesting it is not as spectacular as in the case of force or endurance, for instance. It is considered that the transfer/influence of coordination on conditional aptitudes is entirely a positive one, making decisive contributions to their being performed extremely well, taking into consideration the fact that, more often than not, theirs is a combined manifestation. It is coordination which conditions the quality and the efficiency of all the executed moves, being involved in the execution of every motor structure, regardless of its degree of difficulty. The moves which are precise, stable and energetically efficient represent a superior level of development of the coordination capabilities [1, 3, 5, 9, 10, 14, 15].

The development of the elements of coordination capabilities is a process closely connected to the evolution stages of motor skills, being highly involved in the early stages of initiation into the execution technique, in the stages of consolidation of dynamic stereotypes but also in the superior moments when the skills are perfected and applied to various and difficult conditions and when the automated moves start combining and adapting to new situations which call for creativity and quick problem solving.

By studying the specialists [6,11], one can conclude that the elements of the coordination capability are organized and act like the elements of a system. Their structure includes *three components derived from general coordination*, namely the motor learning capability, the capability to control and direct the moves, the capability to use and adapt the skills. All the distinct elements deriving from these form the system of special coordination capabilities: the capability to combine the moves, the capability to transform the moves, the precision

of the moves, the static and dynamic balance, the spatial and temporal orientation, the kinaesthetic differentiation, ambidexterity, the rhythm sense, the quick reaction. While different motor activities are being performed all the above mentioned capabilities can act separately or in combinations, according to the specific tasks of the activities (see Figure 1).

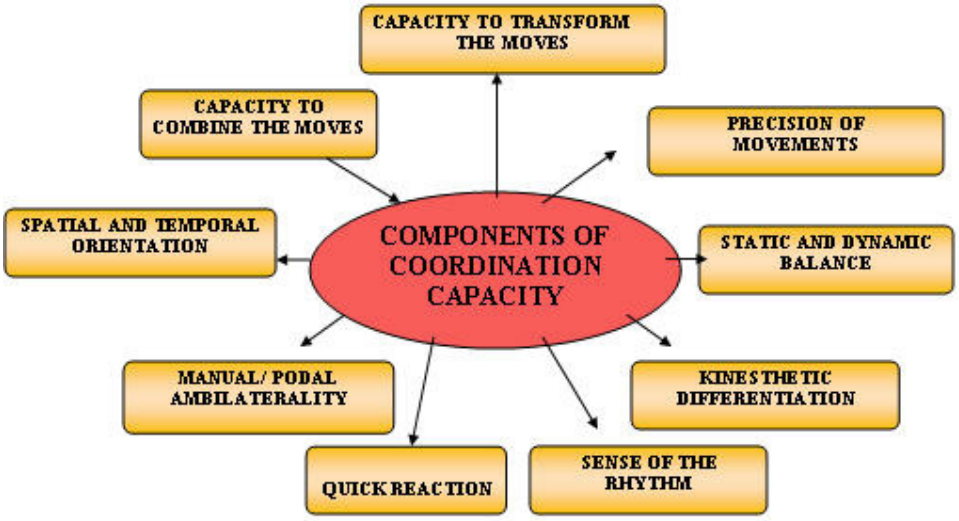

Fig. 1 Defining elements of coordination capacity

PROBLEM STATEMENT

The motor tests to which students have been lately subjected have demonstrated a gradual decline of their performance, even if one has evaluated either the motor aptitudes or the motor skills. The reasons why this has happened are various: the modification of the school curriculum which meant fewer hours of physical education for both lower and higher education systems (such decision does not comply with the regulations of previous specialized programmes), less and less time spent on outdoors physical activities, faulty eating habits and living styles, spending a lot of time on social networking sites etc. Thus, it becomes really important to investigate the level of development of the students' coordination capability, by analysing the strong positive influence it has on the efficiency of all motor activities.

PURPOSE OF STUDY

The aim of this paper is to objectively determine the level of development of the coordination capability of first year students from F.A.C.S.E.E.E. (in the case of whom, prior to the analysis of the physical tests data, one has observed a general lack of interest towards practising different sports) and then comparing it to that of first year students from F.S.P.E., most of whom are involved in competitive or recreational sports activities. By data comparison and statistic interpretation, one will be able to locate those elements which can act favourably for improving progress, but also the elements where the limiting genetic factors, together with previously insufficient training, mean that the activity can no longer be improved. In this regard, one can conceive separate training programmes for the two batches, focused on those elements which can be improved.

WORKING HYPOTHESIS

The students' limited performances from the past years, concerning the accuracy of the execution technique and the low quantity and quality of mastered sports skills, together with the negative results in the case of the other tested motor skills can all be accounted for by the insufficient development of the coordination processes.

RESEARCH ORGANISATION

The scientific research concentrated on the following methods, in accordance with the instructions presented by the scholarly literature [7, 8, 13, 17, 18, 20, 21, 22]: analysis of the methodical and scientific scholarly literature, investigation based on questionnaire and interview, pedagogical observation, measurements and tests method, statistical and mathematical methods of representing and interpreting the results.

The two batches of students (39 boys from F.S.P.E. and 83 boys from F.A.C.S.E.E.E.) have been subjected to a set of 9 tests focused on determining the level of coordination capability elements throughout the 2012 – 2013 academic year, while using the F.S.P.E. material resources and equipment. The respective tests are:

1. **Motor coordination structure:** (explained and demonstrated twice). Evaluates the capacity to understand and learn new moves, the sense of rhythm and the quality of the intersegmental coordination for moves made on different levels and directions, the capacity to combine moves. The initial standing position: T_1 – jumping to a standing

frontal position with legs open and the left/right arm simultaneously raised ahead; T_2 – come back; T_3 – idem T_1 with arms raised in different directions T_4 – come back; T_5 – jumping to a standing position with the left/right foot ahead simultaneously with raising the arm corresponding to the foot stretched ahead and with the other arm raised laterally ; T_6 – come back;T_7 – jumping to a standing position with legs open and the opposite foot ahead than the one used in T_5- arms raised in different directions;T_8 – come back to the initial position. Grading the motor coordination structure: for each uneven time (T_1, T_3, T_5, T_7) performed correctly, one point is assigned- maximum of 4 points.

2. **Psycho motor Coordination Test:** This is done with a control *test on distance appreciation and space orientation.* The individual has her eyes covered with an opaque strip and is placed at one end of a 7 meter long line, drawn on the ground. The test is to walk the entire length of the line with the eyes covered. The individual stops when she considers to have reached the end of the line. An X sign is marked on the place where the individual stopped and the rest is measured up to the end of the line. The results are evaluated as follows: if the individual has bypassed the line or did not reach the end of the line, then the difference is measured up. The values are then interpreted: 0-10 cm very well, 11-30 cm well, 31-50 cm satisfying, more than 50 cm not satisfying. When the calculations are made, plus values + (the one that go beyond the end of the line) and minus values - (the one that do not reach the end of the line) are considered the same. The less is the value, the better the performance.

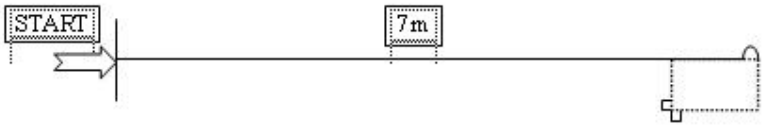

Figure 2. Evaluating distance

3. **Matorin Test** Evaluates *general coordination* and is made up of a standing jump, followed by as many spins turning along the axis of the body as possible and landing in the same place. The individual faces North, with her legs on a 35cm line drawn on North-South direction. Spins to the left, then to the right need to be done and then the values on both directions are registered. The measurements are done for each jump and are calculated with the help of a compass or with a set square and are expressed in degrees: $< 180^0$ – insufficient; $180 – 270^0$ – sufficient; $271 – 360^0$ – well $> 360^0$ – very well.

4. **Touch the Plates Test** *Is represented in Picture 2 and measures the coordination from the point of view of speed and precision of the upper limbs.* The individual is in a standing spread position, in front of a table with plates on and has to put a hand in the centre of the rectangular plate (20 x 10 cm). The other hand (the skilful hand) needs to go quickly and alternatively from one plate to another (the 20 cm plates- placed 40cm away from the table centre). The move needs to be done above the hand placed on the rectangular plate and the skilful hand has to touch the other two plates with the entire hand, 25 times (therefore 50 successive contacts). It is important that the table is not higher than the umbilical region and that the individual does some tests before deciding on the skilful hand. It is recommended that two persons do the examination (one measures the time and the other counts the contacts). If a plate has not been touched, then an additional execution is required. There are two tries and only the better one is registered. The test can begin by touching any plate. (be it A or B) (Eurofit Test). The less time spent on the exercise, the better the performance.

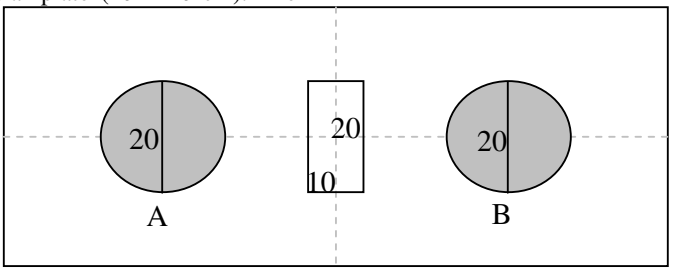

Figure 3. Touch the Plates Test

5. **The square test** (*used for dynamic balance, agility, kinaesthetic discrimination and spatio-temporal orientation*). Nine 50 cm squares are drawn within a 150 cm square while two other 50 cm squares are drawn on the opposite sides. The subjects, placed within square 0, will perform two-legged jumps on counting; they are required to jump as fast as they can within the squares, without bypassing or stepping on the lines. The time used for performing the exercise is recorded, each error being penalised by 2 points. Subjects are allowed to practise several times before the official timing so as to remember the track. The less time spent on the exercise, the better the performance.

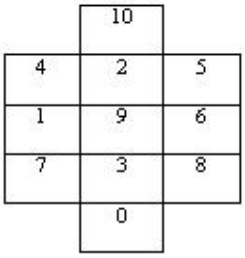

Figure 4. The square test

6. **The single-leg test** is a psychomotor test which *evaluates static balance*. The subject stands on one leg while the other is bent at knee level touching with the heel the knee of the leg on the ground; the arms are extended forward, fingers opened, eyes closed (blind-folded). Time is kept for the number of seconds that the subjects manages to maintain balance (she keeps the squat leg off the ground and does not lose balance); this is done for the left leg first and then for the right one.

7. **The small ball test** looks at *movement precision, eye-hand coordination, ambilaterality and repetition speed*. The subject stands at a distance of 2,5 m from a perfectly flat wall, holding a tennis ball; she successively throws the ball at the wall (5 times with each hand), catching it with the same hand used for throwing it and without letting the ball touching the ground. One records the time necessary for the execution of 10 correct tosses. A shorter amount of time indicates a better performance.

8. **Throwing a ball at a target while staying with the back at it.** *This test evaluates spatial orientation, the precision and the capacity to adjust movements.* Materials: measuring tape, 6 tennis balls, a free hip circle with an 80cm diameter, a gymnastics ball (1kg), a gymnastics mattress. The subject stays at the throwing line with the back at the target (this is the mattress in the middle of which there is the circle while the medicine ball is placed in the centre of the circle). The task is to throw the tennis balls over the head (or the shoulder) and to hit the 2 m far target (the mattress). After the exercise has been explained and demonstrated, subjects are allowed to try throwing once; 6 successive control tosses then follow. After each throw, the student is informed on the points obtained so that she could adjust her movements for the next throw. The result is evaluated as follows: ball within the mattress – 1 point; ball on the bar of the hip circle – 2 points; between the circle and the medicine ball – 3 points; on the medicine ball – 4 points. The final result is the sum of the points taken after each of the 6 throws.

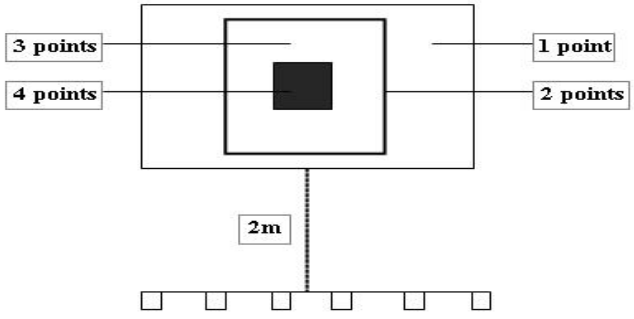

Figure 5. Throwing at target test

9. **Barrow's motor skill test** focuses on *agility, spatial and temporal orientation, precision, dynamic balance and kinesthetic discrimination.* The subject covers a track framed by a 10/15m

rectangle which has signal cones in its corners and in its centre. The starting position coincides with the finishing one (which is one of the corners). The track is covered against the clock, first bypassing the cone in the centre by running diagonally, then the 2 cones in one of the short side, then the cone in the centre again, then the 2 cones in the other short side of the rectangle. If a cone is not bypassed or if it is touched, the subject is charged with 1 second. So as to have a good score, the subject has to cover the track as fast as she can.

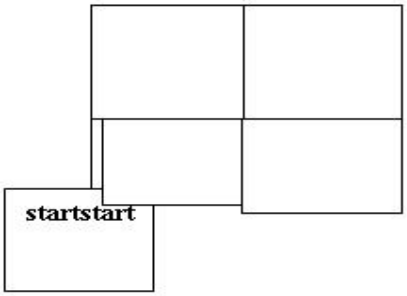

Figure 6. Barrow test

FINDINGS AND RESULTS, CONCLUSIONS AND RECOMMENDATIONS

The processing of the measurements data has been done with the help of SPSS [Statistical Package for the Social Sciences] programme, so as to be able to interpret the significance of the differences registered between the two independent batches. The data resulted from the statistical calculation are represented in Table 1, highlighting the superiority of the F.S.P.E. students' average test results. Even so, such differences are significant only for part of the tests, according to t values and the significance thresholds connected to it.

Table 1. Statistical analysis of data obtained in tests of coordination

No.	Test	Group type/no. of cases	Average	Average difference	Std. error average	Std. deviation	t	P
1	**Coordination structure**	Băieţi FEFS (39) Băieţi ACIEE (83)	1,13 ,95	,176	,198 ,121	1,239 1,103	,791	**,430**
2	**Evaluating distance**	Băieţi FEFS (39) Băieţi ACIEE (83)	63,69 89,60	-25,910	8,245 5,960	51,492 54,300	-2,498	**,014***
3	**Left Matorin**	Băieţi FEFS (39) Băieţi ACIEE (83)	351,67 323,43	28,233	9,744 5,411	60,853 49,293	2,732	**,007****
	Right Matorin	Băieţi FEFS (39) Băieţi ACIEE (83)	340,00 309,10	30,904	8,212 5,348	51,286 48,722	3,213	**,002****
4	**Touch the plates**	Băieţi FEFS (39) Băieţi ACIEE (83)	12,4385 14,4693	-2,03082	,21169 ,27184	1,32200 2,47656	-4,802	**,000****
5	**Square test**	Băieţi FEFS (39) Băieţi ACIEE (83)	9,4821 10,6723	-1,19024	,29988 ,25175	1,87278 2,29359	-2,826	**,006****
6	**Left one-leg test**	Băieţi FEFS (39) Băieţi ACIEE (83)	10,0205 10,7651	-,74455	1,85494 2,02645	11,58409 18,46184	-,231	**,818**
	Right one-leg test	Băieţi FEFS (39) Băieţi ACIEE (83)	16,2897 13,6928	2,59697	5,25603 3,10843	32,82387 28,31917	,449	**,655**
7	**Small ball test**	Băieţi FEFS (39) Băieţi ACIEE (83)	15,6462 16,8036	-1,15746	,92447 ,62615	5,77334 5,70446	-1,041	**,300**
8	**Throwing at target test**	Băieţi FEFS (39) Băieţi ACIEE (83)	8,69 7,30	1,391	,683 ,399	4,268 3,635	1,863	**,065**
9	**Barrow test**	Băieţi FEFS (39) Băieţi ACIEE (83)	13,2308 14,3584	-1,12766	,16491 ,09619	1,02986 ,87631	-6,261	**,000****

***(P<0,05) ; **(P<0,01)**

Concerning the *Coordination structure* test, the F.S.P.E. boys are ,176 points ahead , the value of t = ,791, corresponding to a significance threshold = ,430 value > 0,05, thus, the *resulted difference is insignificant*. One can explain this by the fact that the moves were imposed in a succession which is not consistent with many sports branches; therefore, the students of both batches could not use and transfer structures they already knew, having problems with memorising the succession of

requested times and the restrictions regarding the execution plans of the movements and their combinations. The only boys who obtained maximum scores were the ones who practise dance sport, which frequently deals with both combinations of hand and feet movements and quick memorising.

In the *Evaluating distance* test, the difference between the averages of the two groups is -25,91 cm and the value of t = - 2,498, corresponding to a significance threshold P = ,014*, value < 0,05; the difference is, thus, significant. This so happened because in the majority of sport braches, there is a strong need for the capacity to quickly assess the distances and a good space orientation, regarding different benchmarks, all these components being used by those with a rich motor experience to succeed in this test. However, both groups fall within the unsatisfactory category, registering values higher than 50cm, and even 2 metres in some individual cases.

The *Left Matorin şi Right Matorin* tests present average differences of 28, 233 degress, 30, 904 respectively, with values of t=2, 732, then t=3,213, leading to the significance thresholds P=,007** and P=,002**. Since both values are lower than 0,01, *the resulted differences are significant*. Even if the difference is important in this test, the average performance of both groups can be marked as 'good', the rotation movement around the axis of the body being a less common one in sports activities.

In the *Touch the plates* test, the differences are average, of -2,03 seconds, with the value of t=4,802, corresponding to a significance threshold P=,000*, value which is < 0,001, so *the resulted difference is significant.* In this case, the F.S.P.E. students make good use of hand eye coordination, frequency and precision of movements, which they have developed by practising sports games, especially because the test requires the use of the most skilled arm.

Regarding the *Square test*, the differences are again medium, of -1,19 seconds, where t=-2,826, corresponding to a significance threshold P=,006**, value which is < 0,01, so *the resulted difference is significant.* Here too the difference can be explained by the capability to adapt the changes of direction (used so frequently in all sports games) through a better precision of movement, kinesthetic differentiation, space orientation and superior dynamic balance.

The *Left one-leg test* and *Right one-leg test* present average differences of -,7445 seconds and 2,59697 respectively, with t=-,231, then t=,449, which correspond to significance thresholds P=,818 and P=,665. Both values are > 0,01, so *the resulted differences are insignificant*. The poor results both groups had on these tests can be accounted for by the fact that the static balance is important for some gymnastic elements, activity with which boys are not too familiar, tha majority of the motor actions relying first and foremost on the dynamic balance. The same study carried on on groups of girls within the same faculties led to significant differences due to the fact that some F.S.P.E. girls were practising gymnastics and, thus, greatly increased the average of their group.

The *Small ball test* presents differences of -1,157 seconds, with value of t=-1,041, corresponding to a threshold of significance P=,300, value >0,005, so the *resulted difference is insignificant.* The problems one cam point to here are related to the manual ambilaterality, both groups encountering problems when they had to throw using their less skilled arm, which resulted in frequent errors, throws on too high or too low trajectories and imperfectly coordinated moves.

The *Throwing at target test* shows differences between averages of 1,391 points, with t=1,863, corresponding a threshold of significance P=,065, value >0,05, so the *resulted difference is insignificant*. In this case as well, the motor task to be performed is less common in real situations, throwing something while staying with the back at the target being quite rare, anticipating and choosing the right trajectory for every throw making it even more complicated.

The *Barrow test* indicates differences of -1,127 seconds, values of t=-6,621, corresponding to a significance threshold P=,000**, value which is < 0,001, so *the resulted difference is significant.* Covering the track for this test is easier for those who can transfer: the capability to accelerate and decelerate used in athletic activities and sports games, the space orientation according to some signal objects, quick direction changes, movements which rely on the dynamic balance.

The results of the present study confirm the working hypothesis, highlighting the coordination problems for each group and providing a basis for their future improvement. Even if F.S.P.E. boys performed better in all tests, the differences are significant only in the case of those activities where they could transfer and use motor structures or skills already in use in their day to day sports activities. With regard to the tests which did not focus on familiar elements and introduced new structures, the differences still favoured the F.S.P.E. group, but they were no longer statistically significant.

There are few tests which can separate the elements of the coordination capabilities from other motor skills, most cases dealing with combinations between coordination and speed, strength or endurance, as it happens in all competitive activities. From this viewpoint, the F.A.C.S.E.E.E. group were disadvantaged from the start, as their training of speed, strength and endurance is certainly inferior to that of the F.S.P.E. students.

Nevertheless, the tests which din not necessitate a very good physical condition and focused strictly on some elements of coordination capabilities – for instance *Coordination structure, Evaluating distance, Left one-leg test and Right one-leg test, Small ball test, Throwing at target test* – make it difficult to F.S.P.E. boys to score significant differences. One can, thus, conclude that the students have positive results on coordination in those tests where they can take advantage of what they have learnt while training for other sports activities, but they cannot have amazing results in the tests which require capabilities never trained before – for example, *Coordination structure.*

Even so, the poor results of F.A.C.S.E.E.E. students demonstrates that the lack of preoccupation for the development of the coordination capability elements at a suitable age (that is during primary and secondary school) will lead to losses impossible to overcome during high school or later on. This happens because what is lost is represented by exactly those critical moments favourable to influences related to coordination. It is imperative, thus, to reconsider the importance attached to coordination activities throughout school life, through constant preoccupations to educate this motor skill, essential in the superior execution of general and specific motor abilities.

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