and level group, as well as relative quantization, with upper and lower limits (e.g., 2-4 series x 6-10 attempts) which allow the teacher to adjust the education process to the available material resources, and especially to the students' response to these means.

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A COMPARATIVE STUDY ON THE DEVELOPMENT LEVEL OF THE COORDINATION ABILITY ON FEMALE STUDENTS OF PHYSICAL EDUCATION AND SPORTS FACULTY (F.E.F.S) AND AUTOMATION, COMPUTERS, ELECTRICAL ENGINEERING AND ELECTRONICS FACULTY (A.C.I.E.E.)

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Abstract
The study aims to do a comparative analysis on the development level of elements of the coordination skills, on female students of different specialties: Physical Education and Sports Faculty and Automation (FEFS), Computers, Electrical Engineering and Electronics Faculty (ACIEE). As coordination skill is considered a fundamental element of motor aptitudes, which conditions and takes motility to its highest level, the results of this study help interpreting the performance level obtained by both groups, the reasons that caused them and the measures that need to be taken to improve motor activities.
Keywords*: coordination skills, specific tests, motor potential, adjusting and adapting movevements.*

INTRODUCTION

For the majority of specialties in the academic system, physical education is focused on students' aptitudes and needs for different physical activities and sports. At this level of education, meeting

physical education's objectives means improving physical skills, as well as achieving and maintaining a strong physical condition, which is confirmed by the superior indicators of motor aptitudes.

Coordination has a special status among motor aptitudes analysed by the specialised literature, being mainly characterised by a complex effort and by the possibility to make different moves with a high efficiency and reduced energy consumption. It has an important role in bringing other aptitudes to a superior level - strength, speed, resistance, flexibility- that also have a great impact on it. [Prescorniță A/2002, Albu V./1999, Dragnea A., Bota A./1999, Bompa T./2001, Harre D./1973, Ludu V./1969].

The approach on this subject has varied a lot from one author to another; this aptitude has received a diversified terminology in time, which grasped its main features and the situations when it was strongly used: dexterity, agility, ability, mastery, handiness, stability, coordination, precision, competence etc [Alexe N./1993, Carstea G./2000, Mitra G., Mogos A./1977]. The term handiness, even though frequently used in the past, has been replaced, as it limited the activity only to the upper limb, whereas the *current notion of coordination or coordination skills* involves a wider area and is composed of more diversified and complex elements.

The factors that influence it, physical, biological and motor, are extremely diversified, and even today there are debates on the limitation of its development, if it is compared to other motor aptitudes, considered perfectible: strength, mobility, resistance. It is closely related to the process of motor learning during the stages of initiation and new skills assimilation, when it is approached and learnt as an elementary motor skill. It is however used in a superior stage when the skills assimilated in different situations are used in a creative way, thus requiring superior motor skills. This proves the close relationship between coordination capacities and the degree of assimilating and using motor skills, no matter the skill type or the learning stage, but keeping in mind that automating a skill at a superior level requires less coordination processes. Summarizing the authors' opinions *[Manno R./1992, Dragnea A., Teodorescu M.S./2002, Rata G., Rata B.C./2006]* results that the elements of coordination skills are organised and used as a system and can be divided into *three skills belonging to the general coordination* that correspond to the methodical stages of learning motor skills. These skills are also made up of distinct elements, which form the special coordination skills system: the capacity to combine moves, the capacity to transform movements, the precision of movements, the static and dynamic equilibrium, spatio-temporal orientation, kinaesthetic discrimination, ambidexterity, sense of rhythm, quick reactivity.

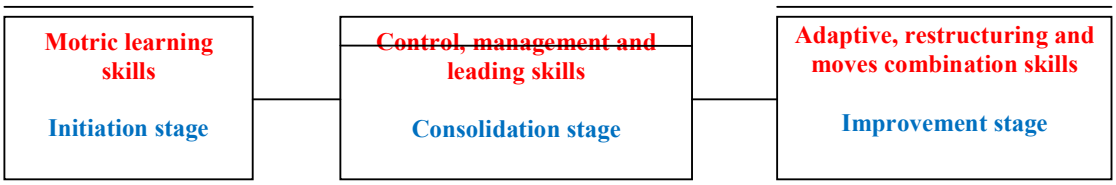

Figure1. Organising the general coordination skills and its relationship with the stages of motor skills teaching

PROBLEM STATEMENT

The problem statement is related to the insufficient investigation on the development degree of coordination skills elements on students, even more so it plays a fundamental role in improving human motor and physical activities output. Sedentary life, the high number of hours spent by students in front of the computer, the reducing number of physical education hours in the curriculum to 1 hour/week and only in the first year of study, the poor nutrition - are factors that affect motor performances as well, the element of the coordination skills included.

PURPOSE OF STUDY

The **scope of the research** is represented by an objective analysis on the development level of coordination skills on female students of Automation, Computers, Electrical Engineering and Electronics Faculty, who do not have a constant care for physical activities and by a comparison of these results with the ones belonging to Physical Education and Sports female students, who constantly practice different sports. The results of this study will help improving the motor activity of both groups, by finding the main weaknesses and strengths and by creating some training programs correlated with the current state of the performances. This group study will show which elements of the coordination skills are harder to develop because of genetics and which can be influenced by subsequent actions, having thus a perfectible character.

Working hypothesis: Weaker results at physical strength and endurance tests and a low technical level at different sports, obtained throughout the years by students belonging to different specialties, which can be the results of deficient coordination processes and a low interest in developing them during physical education and training cycles.

METHODS

The scientific research has used the following methods, as per the instructions presented in the specialised literature [Epuran M., Marolicaru M. /2002, Simion G., Amzar L./2009, Niculescu I.I./2006, Stan Z./2009].

The analysis of the specialised scientific-methodical literature: The selected and analysed works facilitated the understanding of the subject analysed in the research.

The questionnaire-based investigation and the interview: The answers helped drawing a realistic picture of the importance, weight and role of physical activities in students' lives.

Classroom observation: Helped analysing the reactions to the suggested test, the degree of difficulty they were rated with and finding solutions to improve future motor activities.

Testing and measuring method: The two groups of female students (31 girls from Physical Education and Sports and 30 girls from Automation, Computers, Electrical Engineering and Electronics) gave 9 tests about the level of coordination skills elements, in the academic year 2011/2012, by using Physical Education and Sports Faculty's material supplies and equipment from Galati. These 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.

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.

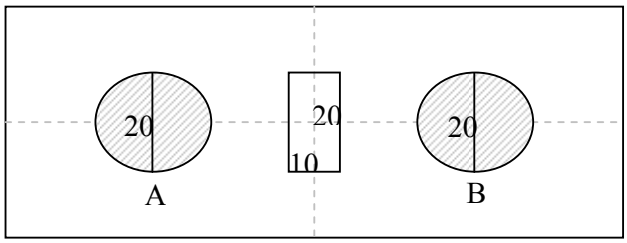

Figure 2. Touch the Plates Test

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.

	10	
4	2	5
1	9	6
7	3	8
	0	

Figure 3. 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.

9. Barrow's motor skill test focuses on *agility, spatial and temporal orientation, precision, dynamic balance and kinaesthetic 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.

Statistical and mathematical methods of representing and interpreting the results: They facilitated the statistical processing of the registered data using the computer program SPSS [Statistical Product and Service Solutions] to interpret the significance of the differences between the two independent samples.

FINDINGS AND RESULTS

The statistical calculation revealed that the group of girls from FEFS had better results than the girls from ACIEE at all tests. The differences observed, the values of **t,** as well as the significance thresholds for each test are presented in Table 1. The results obtained by the two groups are not surprising; in fact, they are in keeping with the motor potential displayed by the students of these two specialties along the years. Nevertheless, there are significant differences in reference to some tests such as: the 'touch the plates' test, the square test, the right single-leg test, the small ball test and Barrow's test (in some cases, the values of t correspond to certain thresholds of significance P <0.05, P <.01).

Several arguments validate these results. The group of girls from FEFS have developed in time all these skills related to coordination due to practicing different kinds of sports; their skills were put to good use during the required tests. Examples: the group average result for the right static balance test was considerably improved by the superior scores of the girls practicing gymnastics (for this sport, the execution of static elements requires a very good sense of balance).

The girls who practice team sports (where using their arms, the eye-hand coordination and the accuracy of movements are essential) improved the average for the 'touch the plates' test and for the small ball test; they performed better because they could use automatic motor skills such as catching and passing or dexterity and precision movements of the active arm.

One can also provide explanations to account for the significant differences in the case of Barrow's test and of the square test: some of the athletic tests and all of the sports games lead to a strong development of the ability to accelerate, of the endurance force used for successive jumps or of the necessity of positioning, of permanent adjustment to reference points and of spatial orientation with abrupt changes of direction. Furthermore, game sports also help to discipline the ability to accelerate or decelerate, to permanently correct movements based on the context, to keep dynamic balance and to rapidly solve fluctuant tasks. All these already acquired skills facilitated the girls' superior results.

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**	Girls FEFS (31) Girls ACIEE (30)	1,58 1,03	0,547	0,244 0,212	1,361 1,159	1,688	**0,097**
2	**Evaluating distance**	Girls FEFS (31) Girls ACIEE (30)	89,90 93,70	-3,797	13,707 11,238	76,319 61,555	-0,213	**0,832**
3	**Left Matorin**	Girls FEFS (31) Girls ACIEE (30)	337,26 310,00	27,258	7,390 11,594	41,147 63,504	1,996	**0,051**
	Right Matorin	Girls FEFS (31) Girls ACIEE (30)	335,48 315,17	20,317	8,858 10,382	49,318 56,865	1,492	**0,141**
4	**Touch the plates**	Girls FEFS (31) Girls ACIEE (30)	13,65 15,51	-1,858	0,217 0,407	1,210 2,229	-4,063	**0,000****
5	**Square test**	Girls FEFS (31) Girls ACIEE (30)	8,77 10,77	-2,000	0,237 0,512	1,324 2,809	-3,579	**0,001****
6	**Left one-leg test**	Girls FEFS (31) Girls ACIEE (30)	21,17 12,88	8,294	9,976 3,194	55,546 17,496	0,781	**0,438**
	Right one-leg test	Girls FEFS (31) Girls ACIEE (30)	23,80 10,51	13,293	6,099 2,157	33,960 11,816	2,028	**0,047***
7	**Small ball test**	Girls FEFS (31) Girls ACIEE (30)	20,99 24,69	-3,693	1,111 1,486	6,188 8,143	-1,998	**0,050***
8	**Throwing at target test**	Girls FEFS (31) Girls ACIEE (30)	8,19 6,53	1,660	0,814 0,626	4,534 3,431	1,608	**0,113**
9	**Barrow test**	Girls FEFS (31) Girls ACIEE (30)	15,21 16,04	-0,827	0,208 0,229	1,158 1,258	-2,672	**0,010****

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

The differences between the two groups were not as significant (P>0,05) in the case of the tests, which were something of a novelty for the FEFS girls as well so that they could not rely on already known structures and they could not fully use the coordination skills developed during their sports training. The requested 8 steps coordination structure is based on simple movements but they are linked by strict plans, directions and combinations which generate problems and do not

allow the transfer of automatic skills. The distance assessment test which invalidates the visual perception highlights the importance of this sensor with regard to the quality of movements and also the fact that both groups had unsatisfying results at this test. A good score was registered by the two groups at the Matorin test, turning along the axis of the body being a movement rarely used in motor activities. The fact that the FEFS girls had slightly superior results in this case is due to their better takeoff level which, nevertheless, cannot considerably change performances. As far as the target throwing test is concerned, both groups found it difficult to perform from the unusual position of staying with the back at the target; thus, they were unable to visualise the target, the differences between their averages being in this case, as well, irrelevant.

CONCLUSIONS AND RECOMMENDATIONS

The present study confirms the hypothesis of research, the recorded results highlighting the development level of the coordination ability for each group. Since the elements of the coordination skills are highly influenced by heredity but also by the motor skills acquired by each person, the lack of preoccupation for their development from an early age can have a negative impact on the long term evolution of individual motor learning; thus, more vigorous actions are necessary within primary and secondary schools systems so as to take advantage of the critical ages of development.

When explaining the results obtained by the two groups, one should also mention the fact that these tests did not assess the students' development level of the conditional motor skills (force, speed, endurance) as well; the high or low level of the latter could either worsen or improve the coordination performances. It is obvious that the effort specific to various sports branches lead to the FEFS girls having superior results of the explosive power, of the reaction, execution and repetition time or of the muscular endurance which improved the outcome of the coordination tests. A constant concern to improve those deficient components of the coordination skills is recommended for both groups. This goal can be achieved through: constantly learning new movements, trying to practice other sports branches so as to acquire new techniques, changing and alternating exercises, making familiar movements more difficult by including them in complex structures, introducing some restrictions in the regulation of sports games, exercising with the non-active segment so as to develop ambidexterity, adding supplementary tasks to increase the effort necessary for the execution, confronting opponents who have a different game style and training level, doing exercises at height, reducing the size of the game areas, training on various areas and with various objects, changing the tempo and the manner of performing exercises.

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