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The assessment of eye-hand coordination of students during the pandemic

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Abstract

The pandemic was a difficult time for everyone, both students and teachers, and the adaptation to the online environment was different. Because physical tests for motor skills assessment were more difficult to perform, one aspect of online assessment was eye-hand coordination.

The purpose of this study is to find an alternative to the assessment of psychomotor skills (especially eye-hand coordination) in the online environment during the pandemic. For the elaboration of the study, we established the following hypotheses:

H1: There are gender differences in eye-hand coordination

H2: Instruments used in the online environment cause changes in assessment eye-hand coordination

Material and methods: The assessment was done by applying specific online tests that allowed participants to self-assess. The study was attended by 80 students (40F, 40B) from the "Sport High School Szasz Adalbert" from Targu Mures, Romania. The study was conducted during the 2020-2021 school year. The tests for eye–hand coordination were Sequence memory test, Chimp test, Aim trainer, Typing, Verbal memory, Number memory, Visual memory, and Reaction Time and which were conducted on the site www.humanbenchmark.com. Subjects participated voluntarily in this study and must submit online, by completing a table in Excel, the results of specific tests for initial and final assessment.

Results: The Excel database was exported to Statistical Package for the Social Sciences (SPSS 24 I.B.M. for Windows). It included descriptive statistics of mean, standard deviation, and the frequency of occurrence expressed in absolute values or percentages. A T test for independent sample and T-test for pair sample was applied. The results obtained were significant for *p*-value under 0.05

Conclusion: Hypothesis H1 that there are gender differences in terms of hand-eye coordination- the obtained results deny this. Only 2 tests out of 8 showed that there are significant differences between boys and girls. In this case, we can say that the hypothesis is not confirmed. Regarding the second hypothesis H2, if there are improvements in hand-eye coordination between the two moments of the test, we can say that yes, there are, and this is confirmed in the result of both girls and boys. So the hypothesis is confirmed.

***Key words**: pandemic, physical education, assessment, eye-hand coordination, students*

Rezumat

Pandemia a fost o perioadă dificilă pentru toată lumea, atât studenţi, cât şi profesori, iar adaptarea la mediul online a fost diferită. Deoarece testele fizice pentru evaluarea abilităţilor motorii au fost mai dificil de efectuat, un aspect al evaluării online a fost evaluaea coordonării ochi - mână.

Scopul acestui studiu este de a găsi o alternativă la evaluarea abilităţilor psihomotorii (în special a coordonării ochi – mână) în mediul online, în perioada pandemiei. Pentru elaborarea studiului am stabilit următoarele ipoteze:

H1: Există diferenţe de gen în coordonarea ochi - mână

H2:Instrumentele utilizate în mediul online provoacă modificări în evaluarea coordonării ochi - mână

Material şi metode: Evaluarea s-a realizat prin aplicarea unor teste specifice, online, care au permis participanţilor să se autoevalueze. La studiu au participat 80 de elevi (40F, 40B) de la „Liceul Sportiv Szasz Adalbert” din Targu Mures, Romania.

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Studiul a fost realizat în cursul anului şcolar 2020-2021. Testele pentru coordonarea ochi-mână sunt: Testul memoriei secvenței, Testul cimpanzeului, Antrenorul de țintire, Dactilografierea, Memoria verbală, Memoria numerelor, Memoria vizuală, Timpul de reacție și care au fost efectuate pe site-ul www.humanbenchmark.com.
Subiecţii au participat voluntar la acest studiu şi trebuie să transmită online, prin completarea unui tabel în Excel, rezultatele testelor specifice pentru evaluarea inițială și finală.
Rezultate: Baza de date Excel a fost exportată în Pachetul Statistic pentru Ştiințe Sociale (SPSS 24 I.B.M. pentru Windows). Acesta a inclus statistici descriptive ale mediei, abaterii standard şi frecvența de apariție exprimată în valori absolute sau procente. A fost aplicat un test T pentru eșantioane independentă (fete si băieti) şi testul T pentru esantioane pereche (acelasi test in momente diferite – testare inițială si finală). Rezultatele obținute au fost semnificative pentru valoarea p sub 0,05
Concluzie: Ipoteza H1 că există diferențe de gen în ceea ce privește coordonarea mână-ochi, rezultatele obținute neagă acest lucru. Doar 2 teste din 8 au arătat că există diferențe semnificative între băieți și fete. În acest caz putem spune că ipoteza nu este confirmată. În ceea ce privește a doua ipoteză H2, dacă există îmbunătățiri în coordonarea mână-ochi între cele două momente ale testului, putem spune că da, există, iar acest lucru se confirmă în rezultatul ambelor, fete și băieți. Deci ipoteza este confirmată.

***Cuvinte cheie**: pandemie, educatie fizică, evaluare, coorodnare mână-ochi, elevi*

Introduction

According to the Social report of Quality of Life Research Institute (QLRI) (2020), the pandemic caused by the COVID-19 virus has made its impact in Roumania since March 2020, and it affected as much the lives of the students and the teachers as well.

Technology, especially video games, are becoming more common in our lives, especially among young people. The pandemic was a period in which young people were forced to use the virtual environment due to online school but also the conditions imposed by the rulers - isolation in order to reduce the spread of the virus. Thus, their socialization was achieved through computers, tablets, or phones. The use of technology can also have positive aspects on individuals. In our case, the use of the virtual environment can contribute to the fulfillment of specific objectives for physical education, namely, the development of psychomotor and cognitive skills (Achtman et. al, 2008): improved hand-eye coordination (Griffith et al., 1983), increased processing in the periphery (Green & Bavelier, 2006), enhanced mental rotation skills, greater divided attention abilities (Greenfield et al., 1994) and faster reaction times (Castel et al., 2005).

The Covid-19 pandemic has led to a digital revolution in education with the use of online learning environments, digital books, teleconferences, and virtual classrooms.

Physical education teachers must be considered essential health professionals during pandemic period because they can guide and stimulate individuals to practice physical exercise routinely in order to keep and improve their health.

Online practical classes in physical education (PE) are not easy to teach or learn for educators and students (Yu & Jee, 2020).

The pandemic was a difficult time for everyone, both students and teachers, and the adaptation to the online environment was different.

Because physical tests for motor skills assessment were more difficult to perform, one aspect of online assessment was eye-hand coordination.

By its very definition, eye-hand or eye-foot coordination is a fast, precise, and balanced motor reaction of the nervous and musculoskeletal system that can be evaluated by measuring and comparing the reaction time obtained both in eye-hand coordination and in eye-foot coordination (Corbin et al, 2000; Lopes et al, 2012, Szabo et al., 2020).

Visual attention, eye-hand coordination are some cognitive and physical features that have been permanently in the attention of researchers.

People have very developed abilities to track and catch moving objects changing their position (Kovari et al, 2020). In eye-hand coordination, the area of the frontal and parietal lobe cortex is used more intensely, and they play an important role in planning eye movements but also for hand movements and the relationships produced between hand-eye movements. Most of the activities done during the day use a certain degree of eye coordination, which is why this coordination needs to be as trained as possible. In general, visual information is used to correct the behavior that is not appropriate for a situation, and this is why this psychomotor ability is so important.

Eye-hand coordination represents the body's ability to coordinate the upper limb in various daily activities (writing) and in some sports activities (catching the ball, throwing at the target) (Przednowek et al, 2019; Paul et al, 2011, Natarajan & Malliga, 2011, Kovari et al, 2020). The eye-hand coordination is working like a single unit that controls the eye and the hand at the same time with the complex of cognitive abilities (Crawford et al, 2004; Bueno et al, 2002).

The purpose of this study is to find an alternative to the assessment of psychomotor skills (especially eye-hand coordination) in the online environment during the pandemic.

For the elaboration of the study, we established the following hypotheses:

H1: There are gender differences in eye-hand coordination

H2: Instruments used in the online environment cause changes in assessment eye-hand coordination.

Material and method

Subjects – 80 students (40 M + 40 F), age 15-16 years old, students at Sport Highschool “Szasz Adalbert" from Targu Mures, Romania. The study was conducted during the 2020-2021 school year.

Subjects participated voluntarily in this study and had to submit online, by completing a table, the results of specific tests.

The tests were conducted on the site www.humanbenchmark.com. The eight tests aimed at eye-hand coordination are presented in Figure 1. The testing was carried out with the dominant hand. The students performed each test three times in 2 trials (initial and final testing) and the best results of each test were noted.

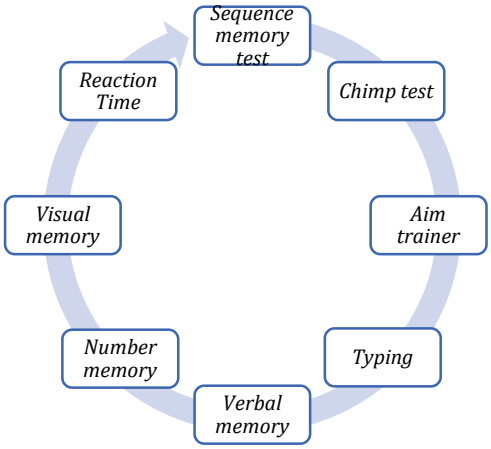

Figure 1 - the 8 tests performed for eye – hand coordination

Sequence memory test (STT)The student must memorize the sequence in which the buttons are lit, and he will press them in the order in which they were. An extra lit button is added to each level until the student no longer remembers the correct order. The average of this test is level 7, according to the website on which the tests were performed.

Chimp test (CT) - this is a test of working memory. In this test, students start with 4 numbers on the screen and must remember the order and place of each number. After passing a level, it is increasing the number that appears on the screen increases. The average on this test is eight numbers, according to the website.

Aim trainer test (ATT) – is a test that addresses reflexes and eye-hand coordination. The test consists in aiming at a number of 30 targets with the help of the mouse by fixing and making a click on it. After 30 targets the score and the average time for the target will be displayed on the screen. The results of this test will be higher than the reaction test because you have to react first and then move the mouse to the target. The average of this test is 600 milliseconds, according to the website.

Typing test (TT) - this test measures typing speed and is expressed in words per minute (WPM). The players have a text that needs to be written as soon as possible. The average word written, according to the website, is 20 words per minute.

Verbal memory test (VeMT) This test measures how many words you can keep in short-term memory at once. Every player has three strikes until the game is over, and the player must remember as many words as he can. The number of words increases constantly. The game is over if the player loose for three times.

Number memory test (NMT) In this test, the student must remember as many numbers as possible in the order in which they appear on the screen. They had three attempts in each round and after that, they lost the game.

Visual memory test (VMT) The test consists of memorizing the number of tiles that will flash white. This must be made before tiles are reset. The levels get progressively more difficult. If the player misses three tiles on a level, he loses one life. He has three lives.

Reaction Time test (RTT) is a simple tool to measure your reaction time. The student must wait for the color to change from red to green, at which point he must press the mouse as quickly as possible in order to have the best possible reaction time. The average of this test is 273 milliseconds, according to the data on the site.

Data were collected for each test in both the initial assessment and the final assessment, being recorded separately for girls and boys. For each data set, the mean and standard deviation (SD) were calculated. For statistical differences, an independent sample t-test was applied for normally distributed data.

All statistical analyses were conducted using SPSS v24 for Windows (IBM, New York, NY, USA).

Results

In Table I is the descriptive statistic for boys and girls at all 8 tests, for the both trials.

Table I Descriptve statistic for boys and girls

		Girls			boys		
Test	Trial	N	Mean	Std. Deviation	N	Mean	Std. Deviation
RTT	I	40	378.00	112.89	40	354.13	94.21
	F	40	349.38	134.08	40	336.75	101.32
SMT	I	40	7.40	2.15	40	8.50	2.20
	F	40	8.58	2.81	40	9.30	1.96
CT	I	40	8.65	1.83	40	8.95	2.70
	F	40	9.43	2.56	40	10.23	3.51
ATT	I	40	758.95	178.31	40	788.78	144.89
	F	40	731.15	172.31	40	745.05	136.56
TT	I	40	14.93	5.03	40	15.88	6.88
	F	40	15.93	5.35	40	16.78	6.16
VeMT	I	40	18.50	11.66	40	16.48	10.21
	F	40	21.45	12.58	40	17.48	10.48
NMT	I	40	8.38	3.18	40	9.63	2.81
	F	40	9.43	3.28	40	10.85	3.18
VMT	I	40	8.80	1.77	40	9.38	2.35
	F	40	9.55	2.18	40	9.93	1.98

To test hypothesis H1, we applied the T-test on independent samples both to the initial and to the final testing. Table IIa shows the difference between groups (male and female) in the initial testing on the eight tests, and Table IIb shows the T-test on independent samples at initial testing.

Tabel IIa The difference between groups (male and female) in the initial testing on the 8 test

Group Statistics					
	gender	N	Mean	SD	Std. ErrorMean
RTT	M	40	354.13	94.210	14.896
	f	40	378.00	112.888	17.849
SMT	m	40	8.50	2.196	.347
	f	40	7.40	2.146	.339
CT	m	40	8.95	2.698	.427
	f	40	8.65	1.833	.290
ATT	m	40	788.78	144.88	22.909
	f	40	758.95	178.313	28.194
TT	m	40	15.88	6.877	1.087
	f	40	14.93	5.025	.795
VeMT	m	40	16.48	10.211	1.614
	f	40	18.50	11.664	1.844
NMT	m	40	9.63	2.807	.444
	f	40	8.38	3.184	.503
VMT	m	40	9.38	2.350	.372
	f	40	8.80	1.772	.280

Tabel IIb T-test for independent sample at initial testing

		t-test for Equality of Means		
		t	df	Sig. (2-tailed)
RTT	Equal variances assumed	-1.02	78	.308
	Equal variances not assumed	-1.02	75.58	.308
SMT	Equal variances assumed	2.26	78	.026*
	Equal variances not assumed	2.26	77.95	.026*
CT	Equal variances assumed	.582	78	.562
	Equal variances not assumed	.582	68.68	.563
ATT	Equal variances assumed	.821	78	.414
	Equal variances not assumed	.821	74.86	.414
TT	Equal variances assumed	.705	78	.483
	Equal variances not assumed	.705	71.40	.483
VeMT	Equal variances assumed	-.826	78	.411
	Equal variances not assumed	-.826	76.65	.411
NMT	Equal variances assumed	1.86	78	.050*
	Equal variances not assumed	1.86	76.79	.050*
VMT	Equal variances assumed	1.23	78	.220
	Equal variances not assumed	1.23	72.50	.221

* significant at the p< 0.05 level (2-tailed).

After analyzing the data we found that for initial testing we have statistical significance just for two tests:

SMT, t=.026, and NMT t= .050 between boys and girls.

Sequential memory test (SMT), boys obtained better results than the girls with a mean = 8.50 and SD = 2.196 is bigger with t= 2.26 for significance p=0.26 .

For the Number memory test (NMT) boys obtained better results (mean = 9.63, SD = 2.807) with t = 1.862 for significance p = .050

Table IIIa shows the difference between groups (male and female) in the final testing on the eight tests, and Table IIIb shows the T-test on independent samples at final testing.

Tabel IIIa - the difference between groups (male and female) in the final testing on the eight tests

Group Statistics					
	gender	N	Mean	SD	Std. ErrorMean
RTT	m	40	354.13	94.210	14.896
	f	40	378.00	112.888	17.849
MST	m	40	8.50	2.196	.347
	f	40	7.40	2.146	.339
CT	m	40	8.95	2.698	.427
	f	40	8.65	1.833	.290
ATT	m	40	788.78	144.888	22.909

TT	f	40	758.95	178.313	28.194
	m	40	15.88	6.877	1.087
VeMT	f	40	14.93	5.025	.795
	m	40	16.48	10.211	1.614
NMT	f	40	18.50	11.664	1.844
	m	40	9.63	2.807	.444
VMT	f	40	8.38	3.184	.503
	m	40	9.38	2.350	.372
	f	40	8.80	1.772	.280

Tabel IIIb T-test for independent sample at final testing

		t-test for Equality of Means		
		t	df	Sig. (2-tailed)
RTT	Equal variances assumed	-.475	78	.636
	Equal variances not assumed	-.475	72.59	.636
SMT	Equal variances assumed	1.33	78	.185
	Equal variances not assumed	1.33	69.76	.185
CT	Equal variances assumed	1.164	78	.248
	Equal variances not assumed	1.164	71.335	.248
ATT	Equal variances assumed	.400	78	.690
	Equal variances not assumed	.400	74.13	.690
TT	Equal variances assumed	.659	78	.512
	Equal variances not assumed	.659	76.49	.512
VeMT	Equal variances assumed	-1.53	78	.129
	Equal variances not assumed	-1.53	75.53	.129
NMT	Equal variances assumed	1.97	78	.052
	Equal variances not assumed	1.97	77.92	.052
VMT	Equal variances assumed	.805	78	.423
	Equal variances not assumed	.805	77.26	.423

For testing hypothesis H2, we applied paired sample T-test for all eight tests. The results are presented in Table IV.

Tabel IV T test for paired sample

	Paired sample		t	df	Sig. (2-tailed)
	Mean	Std. Deviation			
RTT I - RTT F	23.000	70.677	**2.911**	79	**.005***
SMT I - SMT F	-.987	1.717	**-5.143**	79	**.000***
CT I – CT F	-1.025	2.355	**-3.894**	79	**.000***
ATT I – ATT F	35.762	84.068	**3.805**	79	**.000***
TT I – TT F	-.950	2.695	**-3.153**	79	**.002***
VeMT I – VeMT F	-1.975	6.930	**-2.549**	79	**.013***
NMT I – NMT F	-1.137	1.901	**-5.352**	79	**.000***
VMT I – VMT F	-.650	1.654	**-3.514**	79	**.001***

*Correlation is significant at the p< 0.05 level (2-tailed).

After analyzing the data, we noticed that there is a statistical significance for all eight tests between the initial and final testing.

In Table V are the data analyses for paired sample tests from boys. We found statistically significant differences between initial and final testing for the Sequence memory test, Chimp test, Number memory test, and Visual memory test.

Table V Paired sample test for boys

	Paired Differences		t	df	Sig. (2-tailed)
	Mean	Std. Deviation			
RTT I - RTT F	17.38	60.25	1.824	39	.076
SMT I - SMT F	-.800	1.34	-3.766	39	.001**
CT I – CT F	-1.28	2.83	-2.851	39	.007**
ATT I – ATT F	43.73	75.52	3.662	39	.001**
TT I – TT F	-.900	2.47	-2.306	39	.027*
VeMT I – VeMT F	-1.00	4.76	-1.328	39	.192
NMT I – NMT F	-1.23	1.91	-4.046	39	.000**
VMT I – VMT F	-.550	1.80	-1.936	39	.060

*Correlation is significant at the p< 0.05 level (2-tailed)

** Correlation is significant at the p< 0.01 level (2-tailed).

I= initial assesment

F = final assesment

In Table VI are the data analyses for paired sample tests from girls. We found statistically significant differences between initial and final testing for the Reaction Time test, Sequence memory test, Chimp test, Typing test, Verbal memory test, Number memory test, and Visual memory test.

Table VI Paired sample test for girls

	Paired Differences		t	df	Sig. (2-tailed)
	Mean	Std. Deviation			
RTT I - RTT F	28.63	80.14	2.26	39	.030*
SMT I - SMT F	-1.18	2.02	-3.67	39	.001**
CT I – CT F	-.78	1.76	-2.78	39	.008**
ATT I – ATT F	27.80	92.10	1.90	39	.064
TT I – TT F	-1.00	2.94	-2.16	39	.037*
VeMT I – VeMT F	-2.95	8.52	-2.18	39	.035*
NMT I – NMT F	-1.05	1.90	-3.48	39	.001**
VMT I – VMT F	-.75	1.51	-3.13	39	.003**

*Correlation is significant at the p< 0.05 level (2-tailed)

** Correlation is significant at the p< 0.01 level (2-tailed).

I= initial assesment

F = final assesment

In this case, we can say that hypothesis 2 is confirmed. The use of various tools and resources for online education led to the improvement of results for hand-eye coordination.

Discussions

The purpose of this study was to find an alternative way to make the assessment in physical education during the pandemic. Because psychomotor abilities are included in the school curriculum and coordination level is one component, we used these eight tests from www. Human Benchmark.com for the assessment of eye-hand coordination online.

In the article '*The Correlation between Psychological Characteristics and Psychomotor Abilities of Junior Handball Players*" (2022) the authors emphasize the importance of developing psychomotor skills such as hand-eye coordination, dynamic balance, general dynamic coordination, and spatial-temporal orientation (Muntianu et al., 2022).

After comparing the groups (girls and boys) we can say that the boys obtained better results than the girls in just two tests, Secvential memory test (SMT) and the Number memory test (NMT). Similar results were obtained by other authors (Nikam & Gadkari, 2015; Shelton & Praveen, 2010; Der &Deary 2006, Badau et al. 2018). In some tests (typing and aim trainer test) the average of our subjects was below the average of the results on the site, but through the exercise, it was improved.

At the reaction time test (RTT) our results are different from the average of the site, mean for girls was 378 milliseconds at initial testing and 349 milliseconds at final testing, and for the boys, the mean of result at initial testing was 354.125 milliseconds and 336.750 milliseconds for final testing. Comparing results with the average of the test online (273 milliseconds) we found that our results are higher than average on the site. An explanation of these results can be the response error of the different devices used by participants: phone, laptop, desktop used with a mouse and without a mouse, and different processors (Schatz et al., 2015). By regular training, the reaction time can be improved (Shenol et al, 2020), and that explains better results obtained by our participants in the final assessment of tests.

In different areas such as sports, academics, and other tasks of daily life, reaction time is a relevant variable (*Metin et al., 2016*).

Between initial and final testing, our participants have improved their results. That is the result of different instruments used for online learning.

There are researches that demonstrate that in the context of the pandemic, students have become more autonomous in terms of using devices and understanding online learning guidelines (Popa et al. 2020, Radu et al, 2021).

The boys improved their results at SMT, CT, ATT, and NMT - results significance for $p<.01$, and TT – result significance for $p<.05$.

The girls improved their results at SMT, CT, NMT, VMT – results significance for $p<.01$, and RTT, TT, VeMT –result significance for $p<.05$

Computer-based assessment of reaction time offers benefits over paper-and-pencil measures in the form of millisecond timing accuracy, reliable and randomized presentation of stimuli over multiple trials and repeated administrations, and unobtrusive measurement of cognitive skills and reaction times during all aspects of the assessment process (Schatz & Browndyke 2002). Computer games are used in physical education and sport in order to improve some skills and optimize the evaluation process (Kudryavtsev et al, 2016; Badau et al 2018; Balakrishnan et al., 2014).

Our finding refers of improving the psychomotor abilities especially eye-hand coordination are the same like in other studies (Szabo et. al, 2020; Zupan et al., 2006; Scanlon et al., 2007; Bosch et al, 2018; Foerster et al, 2011; Safstrom et al, 2014; Vakil et al. 2017).

Conclusions

Eye-hand coordination is vital for the performance of most everyday activities.

The study conducted provides us with important information about the assessment of psychomotor abilities (especially eye–hand coordination) in an online environment.

In order to test hypothesis H1 that there are gender differences in terms of hand-eye coordination, the obtained results deny this. Only two tests out of 8 showed that there are significant differences between boys and girls. In this case, we can say that the hypothesis is not confirmed.

Regarding the second hypothesis H2, if there are improvements in hand-eye coordination between the two moments of the test, we can say that yes, there are, and this is confirmed in the result of both girls and boys. So the hypothesis is confirmed.

We consider that these tests could be used for an easy and attractive physical education assessment.
The study has some limitations. Due to the fact that during this period, the education took place exclusively online, this may influence the final result of the tests (improving the results). The subjects participated in the study voluntarily and used their own devices to carry out the tasks required by the tests, which were influenced by Internet speed, and the variety of devices. In the future, we recommend similar conditions for accessing online tests.

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