EVALUATION OF WORK CAPACITY OF VOCATIONAL SCHOOL STUDENTS OF DECORATOR'S SPECIALITY WITH ERGOS II WORK SIMULATOR

Daiva Mockevičienė, Ilona Dobrovolskytė
Šiauliai University, Lithuania

Abstract

The aim of the research – to evaluate the change in work capacity in students of the speciality of decorator applying vocational rehabilitation programmes. The students of the vocational training study programme of the decorator in the vocational training centre (N=10) participated in the research. In performing the present research the method of linear experiment has been chosen. The respondents were evaluated with ERGOSII Work Simulator. Individual rehabilitation programme for training work capacity was created for every respondent and performed for three month time period. After three months the re-evaluation was performed.

Key words: *decorator's speciality, work capacity, psychomotor reactions, fine motor skills, static and dynamic muscle strength.*

Relevance of the topic

People in choosing a job should be ready to appropriately physically participate in work activity, to have personal abilities to perform a certain chosen job. Therefore, it is very important to pay attention to people's physiological, psychological and social preparedness for work so that people's health is not damaged during work (Čyras, Girnius, Kaminskas, Nainys, Šukys, & Tartilas, 2003; Kaminskas, 2005; Krikščiūnas, Mingaila, Petruševičienė, Rapolienė, & Bikutė, 2009; Zaikauskienė, 2009). It has been noticed that working even under adjusted and well equipped conditions it is not possible to avoid professional illnesses or at least to decrease the scope of their spread. According to the Hygiene Institute of Lithuania, the data of the spread of professional illnesses caused by physical or ergonomic factors: 2011 – 95,02 per cent out of 402 people evaluated, 2012 – 94,15 per cent out of 393 people evaluated, in January-March 2013 – 97,22 per cent out of 108 people evaluated (Lietuvos higienos institutas (2013). It is the highest per cent of morbidity in comparison with other groups of professional illnesses.

In the system of ergonomics a human being is the most sensitive part of the system. Human work in this system is influenced not only by machinery and physical environment but also by many social and psychological factors. The parameters of physical features of a person in this system are also important (Čyras et al., 2003; Muckus, 2006; Kaminskas,

2005; Zaikauskienė, 2009). In Lithuania only the evaluation of ergonomic risk factors is performed, however, the importance of physical abilities in work activity, i.e. whether a person is physically capable to ergonomically perform a certain job, is not taken into account. The evaluation of ergonomic risk factors is based on the order of the Minister of Healthcare of the Republic of Lithuania and the Minister of Social Security and Labour of the Republic of Lithuania (LR Sveikatos apsaugos ministro ir LR Socialinės apsaugos ir darbo ministro Įsakymas "Dėl ergonominių rizikos veiksnių tyrimo metodinių nurodymų patvirtinimo", 2005) on the approval of methodical regulations of the investigation of ergonomic risk factors. In the regulations the order of the evaluation of ergonomic risk factors (ergonomic factors) is set and general preventive measures for workers' security from risk for their health and safety that is caused or may be caused by ergonomic factors are indicated. In the supplements of the order the methodologies of evaluation that cover the classification of ergonomic risk factors and methodology of measuring are presented. It is the methodology that is referred to in Lithuania in order to identify ergonomic risk factors, however, this methodology does not help to reveal the level of human work (physical) capacity and it is not measured. Namely ERGOSII Work Simulator is created to evaluate functional and physical human abilities and compares them to work requirements (Baker, 2012). The evaluation of human physical abilities before choosing a job is a very important factor that may have positive influence on the decreasing of professional illnesses because of physical and ergonomic factors.

Aim is to evaluate the change in work capacity in students of the speciality of decorator applying vocational rehabilitation programmes.

Object - Change in work capacity.

Research methods

1. Testing and evaluation by standard tests:
   - Evaluation of static and dynamic strength
   - Evaluation of the speed of psychomotor reactions
   - Evaluation of the strength of fine motor skills
2. Linear experiment.
3. Analysis of statistical mathematical data (SPSS 19.0; Microsoft Excel 2007)

Sample of the research

The students of the vocational training study programme of the decorator (builder) in the vocational training centre (N=10) participated in the research. The sample group consisted of 9 boys and 1 girl. The average age of the respondents – 19,6 years.

Organization and methods of the research

In performing the present research the ***method of linear experiment*** has been chosen. The specifics of this kind of experiment is that only one experimental group of the respondents or several groups but identical from the viewpoint of the factor of experimental impact participate in the research. Linear experiment permits to measure changes in a certain time, gives more possibilities to investigate changes than other researches. The verification of the research hypothesis refers to the comparison of two states of the object in a different time, i.e. "from" and "until" (Kardelis, 2002; Tidikis, 2003). Following the specifics of this method the organization of the research is divided into three stages:

Stage 1 – creation of the sample group and its evaluation with ERGOSII Work Simulator. The respondents (N=10) were evaluated with ERGOSII Work Simulator. This instrument is used to measure physical work capacity and its level defining whether the respondent meets physical requirements necessary for work. Computer programme helps to identify it according to the analysis of work and general work (physical) features of the respondent. The system is fully related to work (physical) activity (Baker, 2012).

During the evaluation the general block of 22 tests has been chosen, that was identical for all the respondents. The set of tests consisted of: evaluation of static and dynamic strength (6 tests); evaluation of the speed of psychomotor reactions (4 tests); evaluation of the strength of fine motor skills (12 tests).

Stage 2 – creation and realization of individual vocational rehabilitation programme for training work (physical) capacity. In creating vocational rehabilitation programme for the development of work capacity the following main principles of rehabilitation have been referred to: gradation, individuality, accessibility, versatility, consciousness, activeness (Dadelienė, 2006; Krikščiūnas, 2009).

The aims of the created programme for the development of work (physical) capacity:

- To apply physical exercises meant to increase static and dynamic muscle strength and endurance.
- To develop observation, attentiveness, coordinated actions and positive responsive reactions with physical exercises, working in a team and individually.
- To develop coordinated work of both hands using various manipulations with hands.
- To teach ergonomics: correct sitting, standing, lying; choice of correct posture for work, safe ways of lifting and carrying weights.
- To teach to perform exercises consciously and correctly.
- To encourage applying the combinations of ergonomic movements in everyday work activity.
- To encourage following safety requirements when performing physical exercises.
- To help to perceive the importance of physical fitness for general self-feeling and overall health of the organism.

The programme of vocational rehabilitation for training of work capacity (physical abilities) has been created referring to the following literature: Baublienė (2000), Skurvydas, & Gedvilas (2000), Potieliūnienė, Sližauskienė, & Bendoraitienė (2007). The classes of training work physical activities lasted for 3 months, 2 academic hours twice a week.

Stage 3 – re-evaluation of work (physical) capacity with ERGOSII Work Simulator.

At the end of the research the re-evaluation of work capacity has been performed according to the same tests: evaluation of static and dynamic strength (6 tests); evaluation of the speed of psychomotor reactions (4 tests); evaluation of the strength of fine motor skills (12 tests).

Results of the research

In order to reveal the changes in decorators' work capacity the means of the tests of static and dynamic strength, the speed of psychomotor reactions and the strength of fine motor skills performed by the respondents have been compared. The means of strength and speed of performing tests have been compared to the obtained results before and after rehabilitation. The respondents' results of the strength and speed have also been compared to the set criterion of the requirements for the decorators' profession, standard deviation (SD) and statistical significance according to Wilcoxon rank criterion have been taken into account.

Table 1. Changes in static and dynamic strength among decorators (N=25)

Tests	Before rehabilitatio, kg, (SD)	Criterion, kg	After rehabilitation kg, (SD)	Positive change	Negative change	p
1-T (dynamic lifting bench height)	14,9 (1,9)	11,3	14,9 (3,0)	N=7	N=3	Statistically insignificant change
3-T (static lifting ankle height)	20,6 (7,4)	7,6	25,4 (12,3)	N=5	N=5	
4-T (static lifting bench height)	23,4 (6,5)	7,6	23,0 (7,8)	N=5	N=5	
5-T (static pushing cart height)	12,8 (2,6)	6,0	13,0 (5,6)	N=4	N=6	
6-T (static pulling cart height)	11,5 (2,8)	5,0	9,8 (4,4)	N=4	N=6	

Note. [1] SD – standard deviation

In Table 1 the changes of the decorators' static and dynamic strength have been presented. Having analyzed the presented data it has been noticed that the strength results of the tests of static lifting ankle height (3-T), static pushing cart height (5-T) (25,4 kg; 13,0 kg) have increased, i.e. the respondents' static and dynamic strength performing these tests after rehabilitation (3-T; 5-T) was bigger than before rehabilitation. The strength of static lifting ankle height (3-T) has changed the most, i.e. increased from 20,6 kg to 25,4 kg. The mean of the respondents' strength in static lifting bench height (4-T) has decreased by 0,4 kg, the mean of the respondents' strength in static pulling cart height (6-T) has decreased by 1,7 kg. The standard deviation (SD) of all tests has revealed that before rehabilitation the respondents' strength distinguished less than after rehabilitation. It is shown by the increase of standard deviation. It is possible to make a precondition that the results of the changes of the respondents' static and dynamic strength are very individual. Wilcoxon rank criterion shows that the changes of static and dynamic strength were statistically insignificant ($p>0,05$). However, analyzing the results of the means performing all the tests it has been revealed that static and dynamic strength has increased, except 4-T and 6-T after rehabilitation and corresponds to and is bigger than physical requirements for actions necessary for work.

Table 2. Changes in the speed of psychomotor reactions and dynamic carrying among decorators (N=25)

Tests	Before rehabilitation %, (SD)	Criterion[2] MTM %	After rehabilitation %, (SD)	Positive change	Negative change	p
2-T (dynamic carrying (weight 5 kg; distance – 6 m)	136,7 (29,1)	81,0	144,9 (27,1)	N=6	N=4	Statistically insignificant change **(p>0,05)**
7-T (reaction to the stimulus reaching forward)	69,6 (19,3)	81,0	72,4 (12,8)	N=4	N=6	
8-T (reaction to the stimulus bending/stooping)	68,1 (17,7)	81,0	79,8 (18,4)	N=9	N=1	p=0,008
9-T (handling dexterity, left hand)	63,4 (12,1)	81,0	73,3 (16,0)	N=10	-	p=0,005
10-T (handling dexterity, right hand)	66,3 (11,1)	81,0	77,6 (14,2)	N=9	N=1	p=0,009

Note. [1]SD – standard deviation

[2]Criterion – the level of the evaluation of the speed of the reaction: below competitive – MTM - 0 % < 80 %; competitive – MTM - 81%< 100 %; above competitive – MTM - 100 % < (MTM – movement time measurement standards)

In Table 2 the changes in the strength during the tests of the speed of psychomotor reactions among decorators and dynamic carrying before and after rehabilitation have been presented. The means of the speed of psychomotor reactions and dynamic carrying have been compared to the set competitive level (competitive – MTM – 81 per cent – 100 per cent). Having analyzed the obtained data it has been noticed that the results of all the tests of the speed of psychomotor reactions have increased after rehabilitation, i.e. the change is positive. The mean of the respondents' results of the test (2-T) in dynamic carrying (weight 5 kg; distance – 6 m) before and after rehabilitation corresponds to the level above competitive MTM – 100 per cent <, i.e. the highest result of evaluation. The mean of the results of the test of the reaction to the stimulus reaching forward (7-T) has increased by 2,8 per cent, the mean of the results of the test of the reaction to the stimulus bending/stooping (8-T) has increased by 11,7 per cent, and the results of the tests of handling dexterity of left hand (9-T) and right hand (10-T) have increased respectively by 9,9 per cent and 11,3 per cent. The results of all these tests have increased, however, the means of the speed of the respondents' reactions before rehabilitation and after rehabilitation correspond to the level below competitive MTM – 0 < 80 per cent. To evaluate the difference in strength among the respondents Wilcoxon rank criterion has been applied. This criterion reveals that the strength of performing tests of the reaction to the stimulus bending/stooping (8-T – z= -2,67, p=0,008, r=1,19), handling dexterity of left hand (9-T – z= -2,81, p=0,005, r=1,13) and right hand (10-T – z= - 2,60, p=0,009, r=1,21) after rehabilitation has changed statistically significantly. After rehabilitation the strength of performing the tests 8-T and 10-T in 9 respondents has changed positively, in 1 respondent – negatively, the strength of performing the test 9-T in all the respondents (N=10) has changed positively. With regard to the standard deviation it has been noticed that before and after rehabilitation the respondents' results in performing these tests were different, especially the results of the test of dynamic carrying (SD=27,1).

Table 3. Changes in pronation and supination of left and right forearms among decorators (N=25)

Tests	Before rehabilitation kg, (SD)	Criterion	After rehabilitation kg, (SD)	Positive change	Negative change	p
11-T (grip left hand)	14,3 (3,2)	10,3	11,2 (3,6)	-	N=10	z=-2,803 p=0,005
12-T (grip right hand)	10,3 (2,7)	10,3	9,6 (2,3)	N=3	N=7	Statistically insignificant change (p>0,05)
13-T (pinch left hand)	8,4 (1,6)	2,7	8,1 (1,4)	N=4	N=6	
14-T (pinch right hand)	8,0 (1,9)	2,7	8,6 (1,5)	N=5	N=3, N=2- did not perform	
15-T (flexion left wrist)	10,2 (8,6)	10,2	14,6 (5,9)	N=6	N=4	
16-T (flexion right wrist)	11,5 (8,3)	10,2	12,0 (6,5)	N=4	N=6	
17-T (extension left wrist)	2,3 (2,5)	5,1	3,6 (2,5)	N=5	N=2, N=3 did not perform	
18-T (extension right wrist)	4,1 (2,9)	5,1	8,2 (5,4)	N=4	N=2, N=4 did not perform	
19-T (pronation left forearm (cm/kg))	45,6 (17,1)	23,0	47,7 (23,1)	N=7	N=3	
20-T (pronation right forearm (cm/kg))	48,0 (28,3)	23,0	58,4 (29,1)	N=7	N=3	
21-T (supination left forearm (cm/kg))	46,5 (10,9)	24,5	48,3 (18,6)	N=7	N=3	
22-T (supination right forearm (cm/kg))	50,2 (18,7)	24,5	59,5 (18,4)	N=8	N=2	z= -1,99 P=0,047

Note: [1] *SD – standard deviation*

Having analyzed the changes in the strength of fine motor skills among decorators (builders) presented in Table 3 it has been noticed that the mean of the results of the strength of the grip of left hand (11-T) and right hand (12-T), and the mean of the results of the strength of the pinch of left hand (13-T) after rehabilitation has decreased. To evaluate the difference in strength among the respondents Wilcoxon rank criterion has been applied. This criterion reveals that the results of the strength of performing the test of the grip of left hand (11-T) after rehabilitation has changed statistically significantly z= -2,80, p=0,005, r=1,13. After rehabilitation the strength of the grip of left hand in all the respondents (N=10) has changed negatively. The results of the strength of the test of supination of right forearm (22-T) after rehabilitation have changed statistically significantly z= -1,99, p=0,047, r=1,58. The strength of supination of right forearm in 8 respondents has changed positively, while in 2 respondents the strength has changed negatively. The changes in the results of other performed tests of the strength of fine motor skills were statistically insignificant (p>0,05). Although the change was statistically insignificant, however, it is very important to note the results of performing other tests before and after rehabilitation. The mean of the results of the strength of the grip of right hand (12-T) has decreased to 9,6 kg., i.e. has become lower than the set criterion. It has been noticed that after rehabilitation in 7 respondents the strength of performing the test 12-T has changed negatively, and only in 3 respondents it has changed positively. The strength of extension of left wrist (17-T) did not correspond to the set criterion before and after rehabilitation, although the strength of performing the test has increased. The strength of extension of left wrist (17-T) has increased by 1,3 kg and differed from the set criterion by 1,5 kg. It has been noticed that after rehabilitation in 5 respondents the strength of extension of left wrist has changed negatively, while only in 2 respondents it has changed positively, in 3 respondents the result has not been recorded, i.e. the respondents performed the test incorrectly or did not perform the test at all. This result may influence the general mean of the group. With regard to the standard deviation it has been noticed that after rehabilitation the respondents' strength in performing the tests (12-T; 13-T; 14-T) was similar. The results of all other tests of the strength of fine motor skills were very individual.

Conclusions

1. After rehabilitation the static and dynamic strength among decorators (builders) has increased, except static lifting bench height and static pushing cart height when the strength has decreased.
2. The speed of psychomotor reactions and the results of dynamic carrying have increased, i.e. the change is positive. The reaction to the stimulus bending/stooping, handling dexterity of left and right hands have changed statistically significantly (p<0,05).
3. The results of the strength of fine motor skills among decorators (builders) have increased, i.e. out of 12 performed tests in 9 tests the results of the strength have improved. The strength of the grip of left hand and supination of right forearm have changed statistically significantly (p<0,05).
4. Static and dynamic strength and the strength of fine motor skills before and after rehabilitation met the set physical requirements, except the strength of the grip of right hand and extension of left wrist. The results in dynamic carrying before and after rehabilitation correspond to the level above competitive MTM – 100 per cent <, i.e. the highest result of physical requirements. The speed of psychomotor reactions after rehabilitation as well as before rehabilitation corresponded to the level below competitive MTM – 0<80 per cent, although the results have improved and the difference from the set competitive level has decreased. Referring to standard deviation the changes in performing tests in all evaluated areas are different, i.e. the changes in the respondents' physical capacity were individual.

References

1. Baker, Ch. (2012). *Evidence – based work capacity evaluation advisory commentary.* Department of industrial relations.
2. Baublienė, R. (2000). *Saugūs mankštos pratimai.* Vilnius.
3. Boadella, J. M., Sluiter, K. J., & nFrins-Dresen, M. H. W. (2003). Reliability of upper extremity tests measured by the Ergos™ work simulator: a pilot study. *Journal of occupational Rehabilitation, 13 (4),* 219–232.
4. Čyras, P., Girnius, V., Kaminskas, K. A., Nainys, V., Šukys, R., & Tartilas, J. (2003). *Profesinė sauga ir sveikata. Ergonomikos principai*. Vilnius: Vilniaus Gedimino technikos universitetas.
5. Dadelienė, R. (2006). *Sporto medicinos pagrindai.* Lietuvos sporto informacijos centras.
6. Kardelis, K. (2002). *Mokslinių tyrimų metodologija ir metodai*. Kaunas.
7. Kaminskas, K. A. (2005). *Ergonomika.* Vilnius.
8. Krikščiūnas, A. (2009). *Reabilitacijos pagrindai.* Kaunas: Vitae Litera.
9. Kriščiūnas, A., Mingaila, S., Petruševičienė, D., Rapolienė, J., & Bikutė, I. (2009). Ergoterapijos paradigma reabilitacijos srityje ir jos profesinis reglamentavimas. *Reabilitacijos mokslai: slauga, kineziterapija, ergoterapija, 1 (1)*, 10–15.
10. Lietuvos higienos institutas (2013). *Profesinių ligų statistika Lietuvoje 2009–2013 metais.* Retrived from <http://www.hi.lt/content/prof_lig_stat.html>.
11. LR Sveikatos apsaugos ministro ir LR Socialinės apsaugos ir darbo ministro 2005 m. liepos 15 d. Įsakymas Nr. V-592/a1-210 „Dėl ergonominių rizikos veiksnių tyrimo metodinių nurodymų patvirtinimo“. Retrived from <http://www3.lrs.lt/pls/inter3/dokpaieska.showdoc_l?p_id=260443>.
12. Muckus, K. (2006). *Biomechanikos pagrindai.* Kaunas: LKKA.
13. Potieliūnienė, S., Sližauskienė, N., & Bendoraitienė, V. (2007). *Mankštinkimės savarankiškai: mokomoji metodinė priemonė.* Vilnius: Lietuvos sporto informacijos centras.
14. Skurvydas, A., & Gedvilas. V. (2000). *Fizinių ypatybių lavinimo teorija ir metodika.* Kaunas: LKKL.
15. Tidikas, R. (2003). *Socialinių mokslų tyrimų metodologija.* Vilnius.
16. Zaikauskienė, R. (2009). *Ergonomikos pagrindai*. Panevėžio kolegija.

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Summary

Daiva Mockevičienė, Ilona Dobrovolskytė
Šiauliai University, Lithuania

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The aim of the research – to evaluate the change in work capacity in students of the speciality of decorator applying vocational rehabilitation programmes. The students of the vocational training study programme of the decorator (builder) in the vocational training centre (N=10) participated in the research. In performing the present research the method of linear experiment has been chosen. The respondents were evaluated with ERGOSII Work Simulator. This instrument is used to measure physical

work capacity and its level defining whether the respondent meets physical requirements necessary for work. Computer programme helps to identify it according to the analysis of work and general work (physical) features of the respondent. During the evaluation the general block of 22 tests has been chosen, that was identical for all the respondents. The set of tests consisted of: evaluation of static and dynamic strength (6 tests); evaluation of the speed of psychomotor reactions (4 tests); evaluation of the strength of fine motor skills (12 tests). Individual rehabilitation programme for training work capacity was created for every respondent and performed for three month time period. After three months the re-evaluation was performed.

After rehabilitation the static and dynamic strength among decorators has increased, except static lifting bench height and static pushing cart height when the strength has decreased. The speed of psychomotor reactions and the results of dynamic carrying have increased, i.e. the change is positive. The results of the strength of fine motor skills among decorators have increased, i.e. out of 12 performed tests in 9 tests the results of the strength have improved. The strength of the grip of left hand and supination of right forearm have changed statistically significantly ($p<0,05$). Static and dynamic strength and the strength of fine motor skills before and after rehabilitation met the set physical requirements, except the strength of the grip of right hand and extension of left wrist. The results in dynamic carrying before and after rehabilitation correspond to the level above competitive MTM – 100 per cent <, i.e. the highest result of physical requirements. The speed of psychomotor reactions after rehabilitation as well as before rehabilitation corresponded to the level below competitive MTM – 0<80 per cent, although the results have improved and the difference from the set competitive level has decreased.