Attention this is the Title Please Use Bold and Capital-Initials

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Abstract

This paper is just a sample template for the prospective authors of IISTE Over the decades, the concepts of holons and holonic systems have been adopted in many research fields, but they are scarcely attempted on labour planning. A literature gap exists, thus motivating the author to come up with a holonic model that uses exponential smoothing to forecast some quantitative variables in labour-intensive production. These varying parameters include the machine utilisation that reflects the demand and the worker absenteeism and turnover that constitute the disturbance. Collective equations are formulated to periodically compute the number of workers required. For model validation purpose, twenty-four-month data analysis is conducted on a mock-up basis.

Keywords: key words, orkforce sizing, job-shop production, holonic model

1. Introduction

In the manufacturing sector today, human capital is still essential for most factories to carry out a variety of manual operations, in spite of the rapid advancement of automation technology and robotics. Futuristic vision of "unmanned manufacturing" (Deen 1993) is forbiddingly expensive, because all its hardware components need to be computer controlled so as to freely communicate with each other; and yet, most of the outcomes are not promising (Sun & Venuvinod 2001). By and large, factories equipped with relatively simple machinery controls will require continuous attendance of human operators; for examples, textile mills, leather products, and medical appliances. With limited capital investments in production equipment, the main budget of their fixed costs lies on the workforce size (Techawiboonwong *et al.* 2006).

With regard to cost-effectiveness, labour planning always opts for the minimum amount of workers needed to deal with the daily operations, as well as the probable rate of disturbance (Lim *et al.* 2008). The workforce disturbance is often ascribed to absenteeism and turnover, which may result in considerable loss of productivity for any labour-intensive division (Easton & Goodale 2002). Buffering with redundant skilled workers (Molleman & Slomp 1999) or relief workers (Redding 2004) might be a direct solution to absenteeism; however, the rising labour cost must be justifiable due to the fact that underutilisation of labour during low demand seasons is considered a waste of resources. Absenteeism is the measure of unplanned absences from workplace due to some reasons like personal emergency, accident, illness, etc. Turnover occurs when an active worker resigns from the company of his own accord, thus leaving a vacant post until a replacement is found. If such disturbance has caused a large number of tasks become unattended and overdue, the company is then vulnerable to overtime cost, shrunk capacity and productivity, extra queuing time, lost business income, etc. In order to prevent these deteriorative effects, optimising the number of workers can be helpful. As a fundamental branch of knowledge in manufacturing business, workforce management will never fall behind the times. Therefore, it is worth an attempt to incorporate a novel methodology, such as HMS, into the state of the art of workforce sizing.

2. Holonic Manufacturing System (HMS)

"Holonic" is derived from the word "holon" introduced by a Hungarian philosopher Arthur Koestler (1967). The word holon combines the Greek *holos* meaning *whole*, with the suffix *–on* meaning a *particle* or *part*, is used to describe a basic unit of organisation in biological and social systems. Koestler found that fully self-supporting, non-interacting entities did not exist in living organisms as well as social organisations. Consequentially, every identifiable unit of organisation, such as a single cell in an animal or a family unit in a society, is composed of more basic units (e.g. plasma and nucleus, parents and siblings) while at the same time is forming a part of a larger unit of organisation (e.g. a muscle tissue or a community). The other characteristics of holons include:

- As self-reliant units, holons have a degree of independence and handle circumstances and problems on their particular levels of existence without reaching higher level holons for assistance. The self-reliant characteristic ensures that holons are stable, able to survive disturbances.
- Holons receive instruction from and, to a certain extent, be controlled by higher level holons. The subordination to higher level holons ensures the effective operation of the larger whole.
- Holons cooperate with peers in order to organise and reorganise themselves based on mutually acceptable plans. This is for solving any problem or conflict they might encounter from time to time, and ultimately, serving the goals of the larger whole.

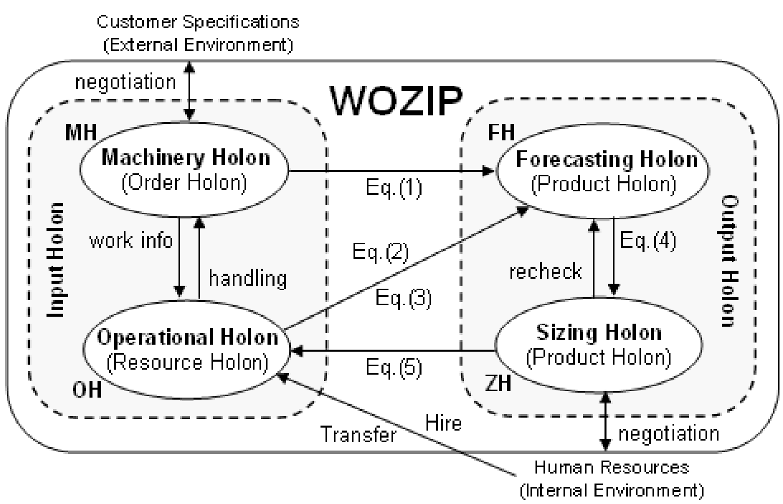

Figure 1. Architecture of WOZIP

2.1 Establishment of HMS

Towards achieving a higher level of efficiency and competitiveness in manufacturing operations, the European Community (EC), European Free Trade Association (EFTA), Australia, Canada, Japan, and the United States (US) founded an international collaborative research programme called Intelligent Manufacturing Systems (IMS) in 1993. This programme consists of six major projects, wherein the fifth one is entitled "Holonic Manufacturing Systems: system components of autonomous modules and their distributed control". It is important to emphasise that HMS does not represent a new technology, as it is merely a conceptual modelling approach to connect and make use of existing technologies with human interfaces (McFarlane 1995). HMS became one of the first fully endorsed IMS projects in 1997, and so the International HMS Consortium was formed and dedicated to replicate in manufacturing the strengths that holonic systems provide to living organisms and societies. These holonic strengths encompass stability in the face of disturbances, adaptability and flexibility in the face of change, and efficient use of available resources. Succinctly, autonomy and cooperation are known as the prime attributes of HMS (Valckenaers *et al.* 1997; Bongaerts 1998).

Table 1. Datasheet of Mock-up Test

Number of Machines, $N_M = 10$ F = forescast rate
Maximum Utilisation, $U_{max} = 0.80$ Y = actual rate
Smoothing Constant, $\alpha = 0.30$

Year	Month	Rate						No. of Workers		Remarks
		Utilisation		Disturbance		Idling				
		F	Y	F	Y	F	Y			
	Jan	0.80	0.75	0.06	0.04	0.15	0.20	**9.25**	**(9)**	
	Feb	0.79	0.70	0.05	0.07	0.17	0.23	**8.84**	**(9)**	
	Mar	0.76	0.66	0.06	0.09	0.18	0.25	**8.38**	**(8)**	lower δ_t
	Apr	0.73	0.60	0.07	0.11	0.20	0.26	**7.93**	**(8)**	
	May	0.69	0.55	0.08	0.09	0.22	0.28	**7.43**	**(7)**	
1	Jun	0.65	0.49	0.08	0.12	0.24	0.28	**6.76**	**(7)**	decreasing U_t
	Jul	0.60	0.43	0.09	0.10	0.25	0.30	**6.18**	**(6)**	
	Aug	0.55	0.39	0.10	0.08	0.27	0.30	**5.42**	**(5)**	
	Sep	0.50	0.34	0.09	0.05	0.28	0.32	**4.65**	**(5)**	increasing χ_t
	Oct	0.45	0.30	0.08	0.04	0.29	0.32	**3.76**	**(4)**	
	Nov	0.41	0.25	0.07	0.08	0.30	0.33	**2.95**	**(3)**	
	Dec	0.36	0.23	0.07	0.12	0.31	0.30	**2.31**	**(2)**	
	Jan	0.32	0.28	0.09	0.15	0.31	0.26	**2.03**	**(2)**	
	Feb	0.31	0.33	0.11	0.18	0.29	0.24	**2.25**	**(2)**	
	Mar	0.32	0.41	0.13	0.20	0.28	0.22	**2.77**	**(3)**	higher δ_t
	Apr	0.34	0.45	0.15	0.18	0.26	0.20	**3.57**	**(4)**	
	May	0.38	0.53	0.16	0.17	0.24	0.16	**4.26**	**(4)**	
2	Jun	0.42	0.62	0.16	0.12	0.22	0.14	**5.13**	**(5)**	increasing U_t
	Jul	0.48	0.69	0.15	0.16	0.19	0.12	**5.94**	**(6)**	
	Aug	0.54	0.74	0.15	0.20	0.17	0.09	**6.99**	**(7)**	
	Sep	0.60	0.82	0.17	0.17	0.15	0.06	**8.15**	**(8)**	decreasing χ_t
	Oct	0.67	0.87	0.17	0.12	0.12	0.04	**9.24**	**(9)**	
	Nov	0.73	0.90	0.15	0.12	0.10	0.03	**10.06**	**(10)**	
	Dec	0.78	0.90	0.14	0.15	0.08	0.03	**10.77**	**(11)**	

2.2 Applications of HMS

In literature, the concepts of HMS were associated with a myriad of technical measures. McFarlane (1995) stated that a holon is able to detect and diagnose problems internally or by cooperating with neighbouring holons of the same manufacturing unit. Types of holons given include processing holon, negotiation holon, scheduling holon, database holon, input/output holon, tracking holon, etc.; and in his steel mill cooling control problem, five cooling holons were used. Gou *et al.* (1998) created a holonic scheduling model using Lagrangian relaxation for a factory equipped with multiple cells. Arai *et al.* (2001) proposed a new concept "Plug & Produce" on their holonic assembly system to handle three manipulators, one belt-conveyor, and two warehouses for the purpose of meeting unexpected assembly requests. Huang *et al.* (2002) framed a holonic virtual enterprise control consisting of global coordinator and member enterprises to enhance the cost-effectiveness on production planning, resource sharing, and change management. Fletcher & Hughes (2006) discussed the technology and policy challenges to be encountered for introducing holons into factory automation. Leitão & Restivo (2007) presented the Adaptive Holonic Control Architecture (ADACOR) that is able to execute fast rescheduling in line with global optimisation during the intervals of resource breakdown. Lim & Chin (2011) devised the Holonic Workforce Allocation Model (HWM) which makes collective operator-task matching decisions based on the operator skill and task urgency parameters, in consideration of specialisation requirements as well as cross-training opportunities.

In the realm of academic management, Karapetrovic & Willborn (1999) constructed a holonic model for quality systems in higher education as to implementing ISO 9000 international standards. Their model contains a set of seven holons to carry out parallel series of tasks on documenting a service organisation. Bell *et al.* (2000) proposed a "holon planning and costing framework" based on system dynamics (SD) and soft systems thinking (SST) to assist in improving the teaching and research qualities given the cost constraints. Montilva *et al.* (2010) used the combination of holonic networks and business models to design an academic organisation devoted to professional training programmes (PTP) on software engineering.

Despite the flourishing research works listed above, the extension of HMS on the subject of labour planning is barely seen. As the gap in the literature is addressed, this paper intends to formulate a holonic model called Workforce Sizing Plan (WOZIP), which is particularly suitable for job-shop production.

3. Workforce Sizing Plan (WOZIP)

Job-shop production refers to a manufacturing environment that produces goods in small batches according to customer specifications. Usually, one or several types of products are deliverable, while the incoming orders may differ in the design, quantity, process flow, or urgency (Henrich 2005). Flexibility is allowed in terms of switching between machines, methods, and resolving problems in production. Depending on the nature of business, each of the workers hired may need to possess a certain range of skills to handle different tasks or machines, whereas the total number of workers may be adjusted in response to the varying demand. In practice, transferability of permanent workers and recruitment of temporary or contract workers will help make such adjustment feasible, thus admitting of the idea of WOZIP.

3.1 Required Data Input

The utilisation rate of machines in a period of time, U_t, can be calculated as the total processing time, t_{pro}, over the duration of periodical review, t_{rev}, and the number of machines, N_M, on the shop floor:

$$U_t = \left. \frac{\sum_i t_{pro,i}}{t_{rev} N_M} \right|_t \tag{1}$$

As mentioned earlier, absenteeism and turnover are identified as the two major problems leading to workforce disturbance. Each type of disturbance can be quantified by its frequency and intensity of occurrence. The frequency, f , ascribes to how often it occurs over a period of time (e.g. one turnover in a month), whereas the intensity, $\bar{t}$, refers to the average duration it has occupied (e.g. absent for two days). With the subscript *Abs* for absence and *Tnv* for turnover, the collective disturbance rate for a period of time, δ_t, is hence computed as:

$$\delta_t = \left. \frac{f_{Abs} \bar{t}_{Abs} + f_{Tnv} \bar{t}_{Tnv}}{N_W} \right|_t \tag{2}$$

Where, N_W represents the number of workers in total.

The other piece of information concerned is the idling time spent by worker j, $t_{Idl,j}$, which indicates the degree of underutilisation of human resources. The idling rate for a period of time, χ_t, is shown below:

$$\chi_t = \left. \frac{\sum_j t_{Idl,j}}{t_{rev} N_W} \right|_t \tag{3}$$

3.2 Forecasting and Sizing

This section relates to the data output stage. In order to labour redundancy besides negating the adverse effects of turnover and absenteeism, WOZIP is meant to estimate the number of workers for a production period based on the utilisation, disturbance, and idling rates acquired from the past period *t-1* by the Equations (1) to (3). Exponential smoothing, a common forecasting technique in operations management, is used to find the U_t, δ_t, and χ_t rates for the coming period. The general formula for exponential smoothing:

$$F_t = F_{t-1} + \alpha\,(Y_{t-1} - F_{t-1}) \tag{4}$$

Where, F and Y respectively denote the forecast value and the actual value of each variable considered, and the symbol α is the user-defined smoothing constant.

To compute the workforce size required in the coming period, the formula is composed of the number of working machines, the three parameters stated above, and the user-defined maximum utilisation, U_{mac}:

$$N_{W,\,t} = N_M\left(\frac{U_t + \delta_t}{U_{max}} - \chi_t\right) \tag{5}$$

On a monthly basis, a numerical example is given. Let the smoothing constant be 0.30, the forecast utilisation in January be 0.80, and its actual rate be 0.75. As a result, the forecast utilisation rate for February is U_{Feb} = 0.80+0.30(0.75−0.80) = 0.79. The same calculation applies to the disturbance as well as the idling rate. In the case of U_{mac} = 0.80, N_M = 10, and the other variables showing δ_t = 0.05 and χ_t = 0.17, the Equation (5) will give $N_{W,Feb}$ = 8.84, approximate to integer 9. This means, the month of February requires nine operators, by estimate, to run the ten machines on the production floor.

3.3 Holonic Architecture

"Architecture" means the art and science of building. A system or functional structure built up with holons is known as "holarchy", wherein the basic rules for the cooperation and limited autonomy of holons are expressed. Van Brussel *et al.* (1998) made a reference architecture called Product-Resource-Order-Staff Architecture (PROSA), whereby the HMS building blocks were categorised into three basic types of holons, namely product holon, resource holon, and order holon. In their respective functions, an order holon represents the customer order or demand information; a resource holon offers the handling as well as production capacity to fulfil the order received; a product holon holds the process and knowledge to assure the correct making of the product or decision. With this end in view, a holon can be a machine tool, a robot, a human worker, or a planning unit. Every holon must consist of an information processing part in association with the physical processing part of its own or its counterparts under the same holarchy. According to Rodriguez (2005), every holarchy is a moderated group, in which the supra-holon is the representative or moderator of the group as well as a part of the vivid interface in coordination with the local environment; meanwhile, each of the sub-holons has to play at least one role to secure its status in the supra-holon composition.

For the architecture of WOZIP, a holarchy consisting of machinery holon (MH), operational holon (OH), forecasting holon (FH), and sizing holon (ZH) is delineated in Figure 1. The WOZIP is itself regarded as the supra-holon, which allows and coordinates the information transfer as well as the interactive computing between the four sub-holons. In the normal process flow, MH (i.e. the order holon) will supply the work information based on customer specifications for OH (i.e. the resource holon) to prepare the workforce that will handle the machines. At the threshold of workforce sizing, both the MH and OH, which compose the input holon, will generate their respective data items via Equations (1) to (3), for the use of FH (i.e. the intermediate product holon) to conduct the exponential smoothing. The forecast outcomes of Equation (4) of FH will be channelled into ZH (i.e. the final product holon), which completes the procedure using Equation (5) — adjust the workforce size of OH. Essentially, the FH and ZH belong to the output holon. Some negotiation might take place around the beginning and the end of the process flow, between the MH and the customer side (i.e. the external environment) as well as between the ZH and the human resources division (i.e. the internal environment). As the whole process will repeat for every production period, a database has to be integrated into each of the holons for efficient information storage and retrieval.

5. Conclusion

A functional structure made up of holons is called holarchy. The holons, in coordination with the local environment, function as autonomous wholes in supra-ordination to their parts, while as dependent parts in subordination to their higher level controllers. When setting up the WOZIP, holonic attributes such as autonomy and cooperation must have been integrated into its relevant components. The computational scheme for WOZIP is novel as it makes use of several manufacturing parameters: utilisation, disturbance, and idleness. These variables were at first separately forecasted by means of exponential smoothing, and then conjointly formulated with two constant parameters, namely the number of machines and their maximum utilisation. As validated through mock-up data analysis, the practicability of WOZIP is encouraging and promising.

Suggested future works include developing a software package to facilitate the WOZIP data input and conversion processes, exploring the use of WOZIP in the other forms of labour-intensive manufacturing (e.g. flow-line production and work-cell assembly), and attaching a costing framework to determine the specific cost of each resource or to help minimise the aggregate cost of production.

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Saya

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THE INFLUENCE OF BRAIN VITALIZATION EXERCISE IN INCREASING COGNITIVE FUNCTIONS FOR ELDERLY IN LINGKAR BARAT PUBLIC HEALTH CENTER BENGKULU 2018

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Abstract
Over time elderly experience the decline in various functions of organs, one of which is a decrease in cognitive function. One of the exercises for the elderly to maintain brain fitness is brain vitalization exercise. This study aims to investigate the influence of brain vitalization exercise in increasing cognitive functions for the elderly. The design used was a quasi-experiment with pre-test and post-test with control group design. this study selected the sample through purposive sampling with a total of 18 samples for each group. In the prior of the study, the samples were observed and the observation was retaken to the samples after the intervention. The analysis used was parametric using paired T-test and independent T-test in the intervention group, and parametric analysis using the Wilcoxon and Mann Whitney tests in the control group. The results of the study comparing post-intervention and post control showed that the average MMSE score after being given brain vitalization exercise no significant difference (p = 0.007). It can be concluded that there is no effect of brain vitalization exercise between the intervention and control groups in improving cognitive function for elderly in Lingkar Barat Public Health Center of Bengkulu city.

Keywords: brain vitalization exercise, cognitive function

1. Introduction

One indicator of successful development is the increasing life expectancy of the population. With increasing population life expectancy, the number of elderly people continues to increase from year to year (Ministry of Health Strategic Plan, 2015). Older people who are still healthy and productive will be more useful for themselves, their families and their social environment.

Over time, the elderly experience a decline in various functions of the body's organs. Besides, the lack of activity and nutrient intake, pollution, and free radicals greatly affect the decline in functions of organs for elderly (Sulianti, 2009).

Regardless of the function decline physiologically, the thing that needs to be considered is Quality of Life (quality of life) for the elderly. Quality of life is the ability of a person to carry out his life both social and mental and to gain prosperity level which not only concern illness resistance.

The decline of cognitive function in mild symptoms is easy to recognize with memory loss and in severe symptoms causes senility. This condition is often considered a normal problem and naturally happens to the elderly. Indeed, the decline in cognitive abilities characterized by memory loss is one of the early symptoms of senility (Nugroho,2018)

Exercises or games which require concentration or attention, orientation (place, time, and situation) and memory can increase the work potential of the brain. The exercise should aim to increase general physical fitness through brain exercises (Brain Vitalization Exercise).

Brain vitalization exercise is an activity that stimulates intellectuals which aims to maintain brain health by exercising (Markam, 2006). The benefits of vitalization exercise in the brain is to improve the ability of alertness, concentration, memory and executive capacities for the elderly.

The results of the initial survey in Lingkar Barat Public Health Center (Puskesmas Lingkar Barat) involved 10 elderly measured for cognitive function. It was found that 7 people experienced cognitive function at a moderate level, while 3 elderly cognitive functions at a mild level (Survey in West Rim Health Center, 2018).

Based on the description above, the authors intended to study and investigate deeply through research with the title of the influence of brain vitalization exercises in improving cognitive function for the elderly group in the area Puskesmas Lingkar Barat.

2. Method

The study was a quasi-experimental research with the research design of pre-test and post-test with control group design. the state of samples before the intervention was observed and the observation was retaken to the samples after the intervention. (Nursalam, 2008).

The research site was in the working area of Lingkar Barat Public Health Center Bengkulu city and it was done in July - November 2018.

The samples were selected through purposive sampling with a sample of 18 respondents for each group and total samples of 36 respondents. The samples are respondents who meet the inclusion criteria, namely: age $\geq$ 55 years, good hearing and sight, no physical disability that interferes daily activities, and respondents are needed to do the exercise program regularly.

The instrument used in this study was in the form of a Mini-Mental State Examination (MMSE) to measure cognitive function in the pre-intervention and post-intervention stage in the elderly.

Then 6 instructors were trained to lead the gymnastics exercise for the elderly. They were also taught to measure MMSE with special instruments prepared by the researcher. brain vitalization exercises were done once a week for 6 consecutive weeks, accompanied by instructors to ensure the elderly can carry out the exercise in accordance with standard operating procedures (SOP).

3. Result

Univariate Analysis

It is used to see the mean, univariate analysis is used to see the characteristics of respondents and the average cognitive value of respondents in the control and intervention groups. The univariate analysis resulted in mean, standard deviation, minimum-maximum value, percentage, and 95% CI for the mean before and after the intervention.

Table 1
Age-based Respondents Distribution in
Lingkar Barat Public Health Center Bengkulu City 2018

Variables	Group		P Value
	Intervention	Control	
Mean	65.67	61.50	0.19
Median	65.00	61.00	
SD	8.253	3.974	
Min – Max	54 – 85	56 - 74	
95 % CI for mean	61.56 – 69.77	59.52 – 63.48	

According to table 1 it shows that the average characteristics of respondents in the intervention group were 65.67 years old, median 65 years, up to 8,253, the youngest respondents was 54 years and the oldest respondents was 85 years. From the interval estimation, it can be concluded that 95% respondents in intervention group was 61.56 - 69.77 years. Average respondents' characteristics in the control group were 61.50 years, median 61 years, up to 3,974, the youngest respondents was 56 years and the oldest respondents was 74 years. From the interval estimation it can be concluded that 95% respondents in control group was 59.52 - 63.48 years. Homogeneity test shows that there was no difference in age between intervention group and control group with p value > 0.05 at α = 0.05 (equivalent).

Table 2
Respondents Distribution based on Education Background, Sex, and Health Problem
in Lingkar Barat Public Health Center Bengkulu City 2018

Characteristics	Intervention		Control		P value
	frequencies	percentage	frequencies	percentage	
Sex					
Male	5	27.8 %	1	5.6 %	0.77
Female	13	72.2 %	17	94.4 %	
Total	18	100%	18	100 %	
Education Background					
Low	8	44.4 %	4	22.2 %	
Moderate	8	44.4 %	14	77.8 %	0.12
High	2	11.1 %	0	0	
Total	18	100 %	18	100 %	
Health Problems					
Gout	1	5.6 %	3	16.7 %	
Diabetes	2	11.1 %	0	0	
hypertension	6	33.4 %	6	33.3 %	
Gastritis	1	5.6 %	0	0	0.17
Vertigo	1	5.6 %	0	0	
Cardiac problem	0	0	3	16.7 %	
No Health Problems	7	38.9 %	6	33.3 %	
Total	18	100 %	18	100%	

According to table 2 we find data that more than half of the respondents were female, 72.2% in the intervention group and 60.0% in the control group of the 18 total respondents in each group.

Respondents in intervention group with low level background education were 44.4%, moderate education background were 44.4%, and higher education background were 11.1%. In control group, respondents with low education background were 22.2% and respondents higher education background were 77.8%.

Respondents in intervention group with gout were 5.6 %, diabetes were 11.1 %, hypertension were 33.4%, gastritis were 5.6%, vertigo were 5.6%. Respondents in control group with gout were 16.7%, hypertension were 33.3%, cardiac problem 16.7%.

Homogeneity test shows that there were no differences in sex, education background and health problems between intervention group and control group with a p value > 0.05 at α = 0.05 (equivalent).

Table 3
Elderly MMSE Average Score in Pre and Post Intervention Stage of Brain Vitalization Exercise in Lingkar Barat Public Health Center, Bengkulu City 2018

Variables	N	Mean	Median	Sd	Min – Max	95% Ci For Mean	P Value
Pre							
Intervention	18	21.06	21.50	2.461	17 - 25	19.83 – 22.28	0.024
Control	18	24.72	25.00	1.487	21 - 26	23.98 – 25.46	
Post							
Intervention	18	25.72	26.00	1.776	22 - 28	24.84 – 26.61	0.007
Control	18	26.33	26.50	0.840	24 – 27	25.92 – 26.75	

According to table 3, the results of data analysis in the intervention group showed an average MMSE score in the elderly before brain vitalization exercises was 21.06 with a median of 21.50, standard deviation 2,461. the lowest score of MMSE in before brain vitalization exercise was 17 and the highest score was 25. From the interval estimation, it can be concluded that 95% of average MSSE score in the elderly before brain vitalization exercises was between 19.83 to 22.28.

While the average MMSE score after brain vitalization exercises from the analysis of the results was 25.72, with a median of 26.00, the standard deviation of 1,776. the lowest MMSE score after being brain vitalization exercise was 22 and the highest score was 28. From the interval estimation, it can be concluded that 95% of average MMSE score in the elderly after brain vitalization exercises was between 24.84 to 26.61.

The results of data analysis in control group showed an average MMSE score in pre-elderly of 24.72 with a median of 25.00, a standard deviation of 1,467, the lowest score of MSSE in the pre-elderly was 21 and the highest score was 26. From the interval estimation, it was concluded that 95% MMSE score in pre-elderly was between 23.98 to 25.46.

While the average MMSE post score from the analysis of the results was 26.50, with a median of 26.50, a standard deviation of 0.840. The lowest score of MMSE in the post-elderly was 24 and the highest score was 27. From the interval estimation, it can be concluded that 95% of average MMSE score in post-elderly was between 25.92 to 26.75.

Bivariate Analysis

Bivariate analysis was carried out to determine the differences in the cognitive function of the elderly before and after being given brain vitalization exercises in the intervention group, the differences in cognitive function of the elderly before and after in control group, and to see the effect of brain vitalization exercises in intervention and control groups. From table 4, the data shows that the difference in the average MMSE score in the intervention group before and after being given exercise/brain vitalization training is 2.90. Statistical results showed p = 0.0001 <0.05, meaning that there were significant differences in cognitive function in the elderly before and after being given exercise/brain vitalization exercises.

Table 4
Average Discrepancy of MMSE Score between Intervention and Control Groups in Pre and Post Stage of Brain Vitalization Exercise in Lingkar Barat Public Health Center Bengkulu City 2018

Variables	N	ΔMean	P value
Intervention			
Post - Pre	18	4.667	0.0001
Control			
Post - Pre	18	1.61	0.003

According to table 4, the data shows that the discrepancy in the average MMSE score in the intervention group before and after brain vitalization exercise of 2.90. Statistical results showed p=0.0001 <0.05, meaning that there were significant differences in cognitive function in the elderly before and after brain vitalization exercises.

In the control group, the discrepancy in the average MMSE score before and after was 1.61. The statistical test results showed p = 0.003 <0.05, meaning that there were significant differences in the cognitive function of the elderly in the control group.

Table 5
The Difference of MMSE Score in Elderly between Intervention and Control Groups in Pre and Post Stage of Brain Vitalization Exercise in Lingkar Barat Public Health Center Bengkulu City 2018

Variables	N	Mean	Δ Mean	P value
Post Intervention	18	25.72	0.61	0.007
Post Control	18	26.33		

According to table 5, the asymp.ig. (2-tailed) the value was 0.007. Since the value of p> 0.05, it can be concluded that there was no significant difference in elderly MMSE scores between the intervention group and the control group. It can be concluded that there was no effect of brain vitalization exercises between the intervention and control groups in improving the cognitive function of the elderly in Lingkar Barat Public Health Center Bengkulu City.

4. Discussion

4.1. Respondents characteristics

The results on 36 respondents divided into two groups show that the elderly who did gymnastics were mostly female in the intervention group (72.2%) and control group (94.4%), age range between 54 to 85 years with average age of respondents in intervention group was 65.67 years while in control group was 61.50 years. This shows that age is not an obstacle for the elderly to stay active in physical activities.

In general, the majority of respondents had a moderate education background in the intervention group (4.4%) and the control group (77.8%). The influence of education background of the elderly can indirectly affect their cognitive function. The level of education has an influence on cognitive functions. Education affects brain capacity and impacts on the cognitive test (Farmer, 1999).

Based on health problems experienced by respondents most of the respondents in the control group (33.3%) and interventions (33.4%) had hypertension problems. The risk of hypertension increases with age, especially in men over 45 years and in women over 55 years of age (Muhammadun, 2010).

In the elderly, there is a change in the structure and function of blood vessels. The nature of the elasticity of blood vessels decreases and the stiffness in the walls of the arteries becomes smaller so that the development of blood vessels becomes disrupted (Potter & Perry 2005).

4.2. Elderly cognitive function in the working area of Lingkar Barat Public Health Center Bengkulu City

After the elderly did brain vitalization exercises once a week for 6 consecutive weeks, the results of the average MMSE score of the respondents' intervention group were 21.06 before brain vitalization exercises and 25.72 after brain vitalization exercises. While in the control group, the results of the analysis of the average MMSE score were 24.72 before the intervention and 26.33 after the intervention.

Based on these results it can be seen that the picture of the cognitive function of the elderly after doing brain vitalization exercises is greater than before brain vitalization exercises. The study obtained P value of the intervention group with a significant of 0,0001 and the control group P value was 0.003. With a P value of <0.05, it was concluded that there was a significant difference in cognitive function in the elderly before and after the intervention.

4.3. The Influence of brain vitalization exercises on the elderly in the working area of Lingkar Barat Public Helath Center Bengkulu

According to the research that concerned to determine the differences in cognitive function of the elderly in the intervention group and control group after doing brain vitalization exercise, it was obtained a significant value of 0.007. since the value of P value> 0.05, it means there was no significant difference between the intervention group and control group after brain vitalization exercise. It was concluded that there was no influence of brain vitalization exercise in improving the cognitive function of the elderly group in the working area of Lingkar Barat Public Health Center, Bengkulu City.

The researcher argues that there was no significant difference between the intervention group and the control group because Lingkar Barat Public Health Center held gymnastic activities twice a week that was followed by all the elderly. Most elderly from both intervention and control groups actively participated in this exercise which was held every Friday and Tuesday consisting of *Lansia* (elderly) gymnastics, *Germas* (healthy community movement) gymnastics, and *Diabetic* gymnastics. So that even though they do not take part in exercise brain vitalization exercise, the elderly in the control group still continue to exercise.

The physiological benefits for the elderly are to help to regulate blood sugar levels, stimulate adrenaline and nor-adrenaline, improve sleep quality and quantity. Furthermore, Kusumo Putro (2003) stated that there is an increase in the potential and resources of the brain, what is needed is physical fitness and brain fitness.

Brain vitalization exercise is a physical exercise that concerns on human brain fitness sustainability, this exercise is designed to combine the body movement, breathing, and cognitive center (memory and imagination). The series of movements in brain vitality exercise not only involve kinetic centers of certain muscles in the brain with corpus callosum but also involve the higher center parts in the brain.

The measurement of MMSE can be done every 6 weeks since the neuron tissues adaptation takes 4-6 weeks where physical exercise and cognitive function gets interconnected through the muscle contraction, and it could affect the brain through spindle muscle channel. The stimulus in Golgi tendon organ will be passed through to the nerve system center via neurons. These neurons receive the sensory information from the peripheral, visual system, vestibular system, musculo-sceletal, proprioseptic, and others where it would be then processed and integrated in all level of nerve system (Leni,2013)

5.Conclusion

The characteristics of female respondents were 72.2 % in the intervention group and 60,0% in the control group. Respondents with Low education background were 44.4% in the intervention group and 22.2% in the control group. Respondents with hypertension were 33.4% in the intervention group and 33.3% in the control group.

The difference in MMSE score between intervention and control groups indicates p-value < 0,005 which refers to a significant difference in cognitive value on the elderly before and after brain vitalization exercise.

The result analysis done to post value between intervention and control shows p value 0.007 > 0.005 which indicate the difference in MMSE score between intervention and control groups after brain vitalization exercise. It can be concluded that there is no influence of brain vitalization exercise in the increased cognitive function in the elderly in the working area of Lingkar Barat Public Health Center, Bengkulu city.

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