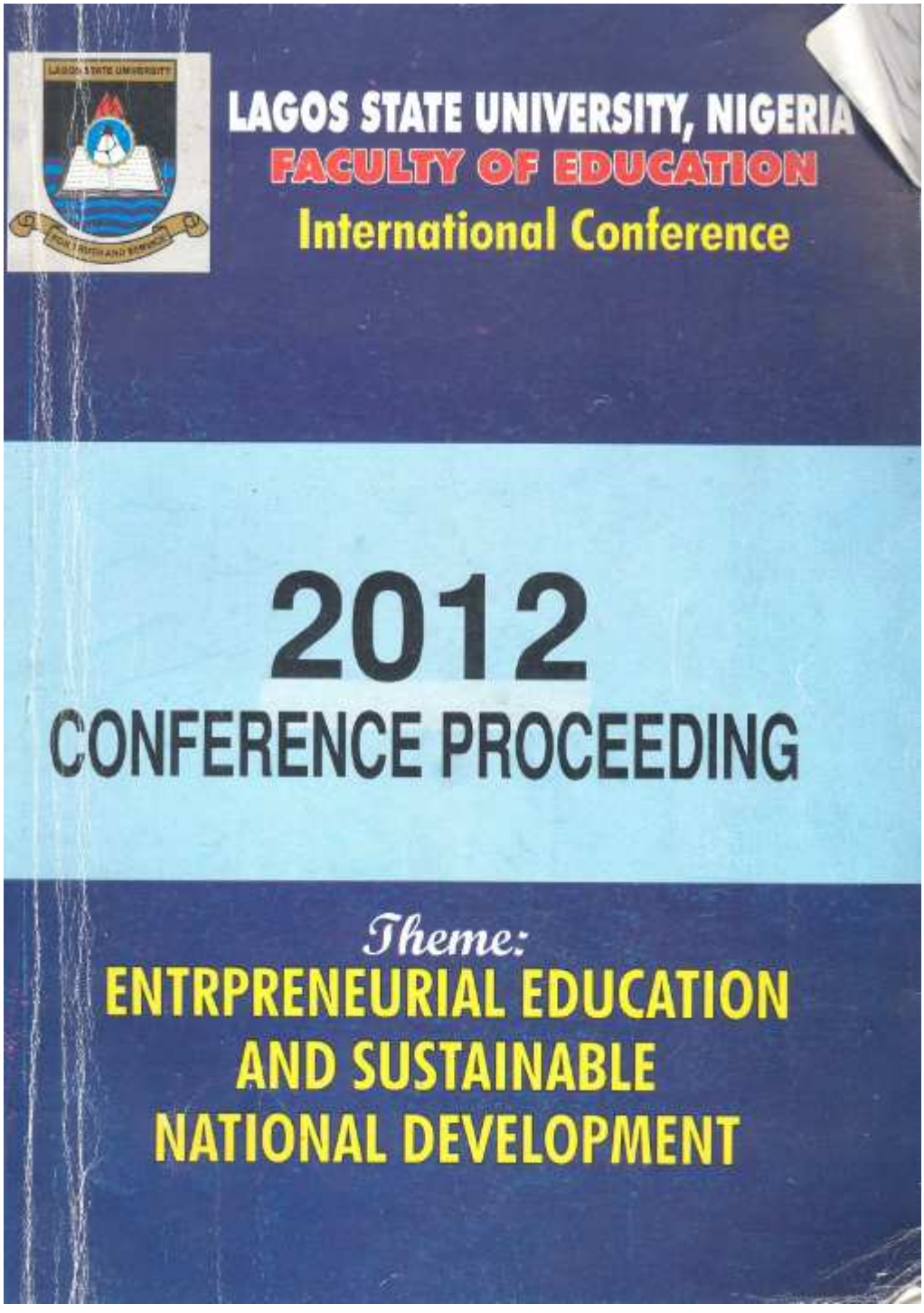

LAGOS STATE UNIVERSITY, NIGERIA
FACULTY OF EDUCATION
International Conference
2012
CONFERENCE PROCEEDING
Theme:
ENTRPRENEURIAL EDUCATION
AND SUSTAINABLE
NATIONAL DEVELOPMENT

VALIDATION AND RELIABILITY TEST OF A CUSTOMIZED BACK AND LEG-LIFT DYNAMOMETRE: IMPLICATION FOR ENTREPRENEURSHIPIN SPORTS

TONY DANSU [PH.D]

Department of Physical and Health Education

Lagos State University, Ojo LAGOS

ABSTRACT

Poor access to instrument for direct measurement and evaluation of certain physical fitness and physiological parameters is a challenge in the field of physical education and sports science in Nigeria. The Purpose of this study therefore was to validate and test for reliability of a customised back and leg-lift dynamometer. Thirty-three [33] undergraduate students of Department of Physical and Health Education students participated in the study. An orthodox back and leg-lift dynamometer, with model number of A5402 which was a product of TAKEI Company, Japan, and a customised back and leg-lift dynamometer was used for data collection; and variables measured were strength of back and legs muscles. Data collected were analysed using mean and Pearson's product moment correlation coefficient Findings showed that the customised back and leg-lift dinamometre of this study is valid and reliable for data collection in researches that involve strength of legs and back muscles. This has entrepreneurial implications as this customised instrument can be produced in commercial quantity for sales to researchers and research institutes.

Introduction

Poor access to instrument for direct measurement and evaluation of certain physical fitness and physiological parameters is a challenge in the field of physical education and sports science in Nigeria. Many of the measuring instruments used are for indirect measurement, designed to estimate values, and they are not without limitations. Sports Fitness Advisor [2012] mentions that there are several methods used to determine an athlete's fitness parameters, but the most accurate and reliable is through the direct testing. Sports Fitness Advisor [2012] also states that there are several field tests that can also be used for estimation, and they vary in their reliability, though some offer an acceptable alternative for most amateur athletes. In line with this, McArdle, Katch and Katch [2000] posit that the most accurate way to determine lactate threshold is via a graded exercise test in a laboratory setting. During the test the velocity or resistance on a treadmill, cycle ergometer or rowing ergometer is increased at regular intervals (i.e. every 1 min, 3min or 4min) and blood samples are taken at each increment. Very often VO2 max, maximum heart rate and other physiological kinetics are accurately measured during the same test [Maud & Foster 1995], andthis is far valued over measurements that estimate.

A dynamometer is an apparatus that measures mechanical force, speed, or power. In a typical dynamometer test cell testing an engine, motor or transmission is coupled to the dynamometer via couplings and a drive shaft. When the device under test is running, the dynamometer can exert a braking force on it [Dyne System, 2010]. In sports science, Back and Leg-Lift Dynamometre is an instrument that is used to measure the strength of muscles of the back and legs [Dansu, 2011], with reliability value of 0.85 [Hattori, Ono, Shimaoka, Hiruta, Kamijima & Takeuchi, 1998].

Muscle strength is an essential factor in sports performance. It is the ability of a muscle group to develop maximal contractile force against a resistance in a single contraction [Heyward, 2002]. According to Menard [1994], strength training is used as a tool to improve performance in most sports skills including weight lifting, archery, basketball,football, swimming, volleyball, and track and field athletics. Ayeni [2001] opines that strength is important because nearly all

movements are performed against some resistance, and sportsmen perform more movements against much greater resistance than usual. Therefore, regular assessment of thisimportant physical fitness index, among others is as important as training and/or preparation for competitions.

Experience shows that back and leg-lift dynamometer is scarce among research instruments for sports science in Nigeria. This problem calls for proactive approach such as customisation of an existing model of Back and Leg-Lift Dynamometre, its ,validation and reliability test. Success of this research is targeted at producing multiple of the customised instrument for the purpose of commercialisation at affordable price. This is essential for easy access to good instruments that are affordable to carry out quality research in this area of sports science. A valid and reliable instrument is essential for any activity, be it in the clinical, educational or research field [Fraguas & Henriques, 2007]. Validation describes the procedures used to analyze products so that the data generated will comply with the requirements of regulatory bodies [Chan et al, 2004], and instrument reliability is a way of ensuring that any instrument used for measuring experimental variables gives the same results every time [Shuttleworth, 2009].

The purpose of this study was to seek answer to the following research questions:

Participants

The participants of this study were thirty-three [33] part-time undergraduate students of physical and Health Education of Lagos State University, Ojo Lagos Nigeria, who volunteered to take part in the study. These Participants included 21 [63.6%] males and 12 [36.4%] females. The mean-age of the female participants was 23.65+ 6.14 within the range of 19 — 36 years and for the male was 26.0 + 4.33 within the range of 21 — 38 years. The females have the mean-stature of 159.76 + 6.50 within the range of 150 — 173cm, and it was 168.22 + 6.34 within the range of 163 — 180cm for the males. For the weight, the mean for the female participants was 60.46 + 9.33 within the range of 51 — 88kg, while it was 58.37 + 7.42 within the range of 56.56 — 79.50kg for the male participants.

Instrumentation

The instruments used for data collection in this study were orthodox back and leg-lift dynamometer, and a customised one.The orthodox back and leg-lift dynamometer,with model number of A5402 which was a product of TAKEI Company, Japan was used todetermine back and leg muscular strengths of participants for the first observation [01]. Back and Leg Lift Dynamometre has 0.85 reliability

i. What is the validity value of the customised back and leg-lift dynamometer for determining legs' muscular strength?

ii. What is the reliability value of the customised back and leg-lift dynamometer for determining legs' muscular strength?

iii. What is the validity value of the customised back and leg-lift dynamometer for determining the back's muscular strength?

iv. What is the reliability value of the customised back and leg-lift dynamometer for determining back's muscular strength?

METHODS AND PROCEDURE RESEARCH DESIGN

The Correlational Research Design was employed in this study:

Where

P = Participants of the study

01 = Observation on orthodox Back and Leg-lift dynamometre

02 = Observation on customised Back and Leg-lift dynamometre

value for measuring muscular strength [Hattori, Ono, Shimaoka, Hiruta, Kamijima & Takeuchi [1998]. The locally customised back and leg-lift dynamometer produced from a Diamond

Product weighing scale made in Taiwan was used to determine back and leg muscular strength for thesecond observation [02].The customised instrument is in line with the orthodox in terms of size and parts. The parts include, the Body (face), Dial, Pointer, Footstand (base), Grip and Chain; and to assemble the unit, the handle/chain is attached to swivel on top of face by using adjustable chain link [See Appendix 1 for images].

Procedure for Data Collection

All measurements were carried out in the performance laboratory of the Department of Physical and Health Education, Lagos State University.

For leg muscular strength test, the participant held the back and leg lift dynamometre with both hands (paluis prone positioned) so that the bar rests at the juncture of the thighs and trunk. The participant then took his/her position on the platform of the dynamometer so that the pull will be directly upward. Bending the knee slightly,he/she held this position while the chain length is adjusted. At the command "GO," the participant exerted maximum force upward by extending his legs, at the same time keeping the arms and back straight; the head erect and chest high. Score was recorded in kilogram [kg], and the better of two trials was taken.

For testing back muscular strength, using the dynamometer, the participant stand upright on the base of the dynamometer with feet shoulder-width apart, arms straight, and fingers extended downward as far as possible on the fronts of the thighs. The bar is then attached to the chain so that it is 1 to 2 inches below your fingertips. Then bend forward slightly and grasp the bar. The participant bent forward slightly at the hips while keeping the legs straight. His/her head is held upright and looking straight ahead. He/she lifts steadily, keeping legs straight and feet flat on the base of the dynamometer. At the completion of the test, the back is almost straight. In the cases of perfectly straight back, the test was repeated with the bar slightly lower. Score was recorded in kilogram [kg], and the better of two trials was taken.

Data for validity test were obtained from both the orthodox and customised dynamometer same day; while a repeated test [Test-retest] was carried out seven days after using the customised dynamometer to determine the reliability value. **Data Analysis**

Mean and scattergram were used to describe the data collected in this study, while validity and reliability values were determined using Pearson's Product Moment Correlation Coefficient at 0.05 level of probability. Data analysis was carried out using statistical package of TexaSoft, WINKS SDA Software [6th Ed, 2007].

Results

Table 1: Summary of Pearson's Correlation Analysis on validity of dynamometer for leg muscular strength

Leg Strength	No	X [kg]	sd [±1	df	r	r2
Orthodox	33	115.03	18.06			
31						
0.96						
0.92						
18.66						
**0.001						
Customized	33	113.80	18.12			

** = significant at 0.01

An analysis using Pearson's correlation coefficient in table 1 indicates a statistically significant linearrelationship between muscular strength of leg using orthodox dynamometre and muscular strength of leg using the customised dynamometer [$r(31)=0.96$, $p < 0.001$]. This result indicates a significantly valid value for the customised dynamometer in testing muscular strength of the leg. This result is further described in figure 1.

Figure 1: Scatter Plot on validity of dynamometer for leg strength

Table 2

Summary of Pearson's Correlation Analysis on reliability of dynamometer for leg muscular strength

Leg Strength	No	k [kg]	sd [±]	df	r	r2	T	P
Customised	2	33	113.80	18.13				
31								
0.96								
0.92								
19.16								
**0.001								
Customised	2	33	115.85	18.79				

** = significant at 0.01

An analysis using Pearson's correlation coefficient in table 2 indicates a statistically significant linear relationship between muscular strength of leg using the customised dynamometer in a test-retest reliability test [$r(31)=0.96$, $p < 0.001$]. This result indicates a significant reliability value for the customized dyanometer in testing muscular strength of the leg. This result is further described in figure 2.

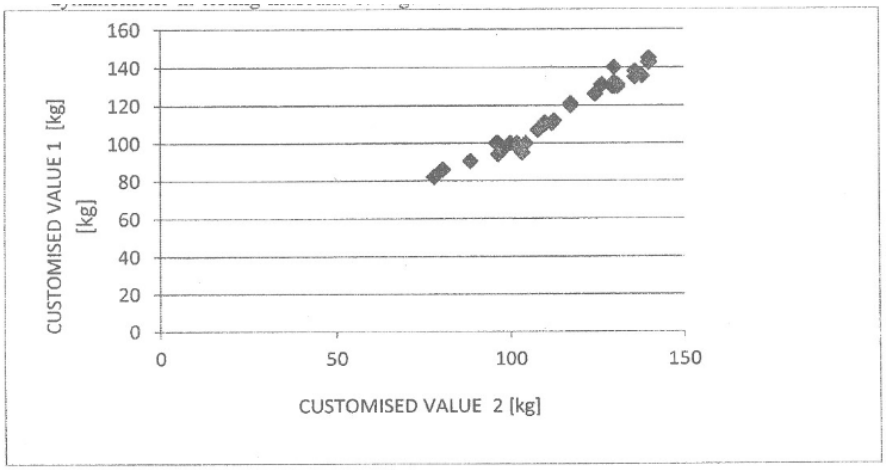


Figure 2: scatter plot on reliability of dynamometer for leg strength

Table 3: Summary of Pearson's Correlation Analysis on validity of dynamometer for back muscular strength

Leg Strength	No	X [kg)	sd [±1	df	r	r2
Orthodox	33	62.13	7.11			
31						
0.79						
0.64 7.42						
**0.00l						
Customised	33	62.90	7.06			

** = significant at 0.01

An analysis using Pearson's correlation coefficient in table 3 indicates a statistically significant linear relationship between muscular strength of the back using orthodox dynamometre and muscular strength of the back using the customised dynamometre [r(31)-0.79, $p < 0.0011$. This result indicates a significantly valid value for the customised dynamometer in testing muscular strength of the leg. This result is further described in figure 3.

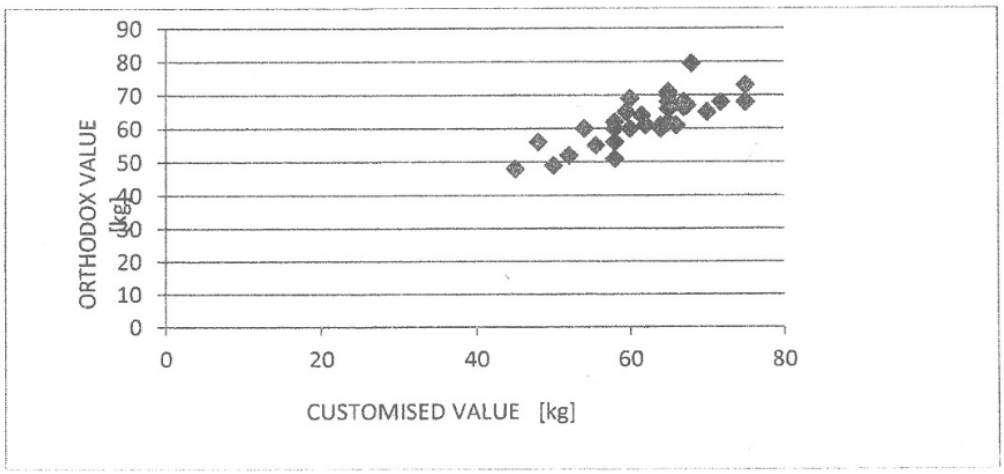


Figure 3: Scatter Plot on validity of dynamometer for back muscular strength

Table 4: Summary of Pearson's Correlation Analysis on reliability of dynamometer for back muscular strength

Leg Strength	No	5c- [kg]	sd [±]	df	r	r2
Customised	2	33	62.90	7.06		
31						
0.78						
0.62						
7.13						
**0.00l						
Customised	2	33	61.33	6.11		

** = significant at 0.01

An analysis using Pearson's correlation coefficient in table 4 indicates a statistically significant linear relationship between muscular strength of the back using the customised dynamometer in a test-retest reliability test [r(31)-0.78, $p < 0.001$]. This result indicates a significant reliability value for the customised dynamometer in testing muscular strength of the back. This result is further described in figure 4.

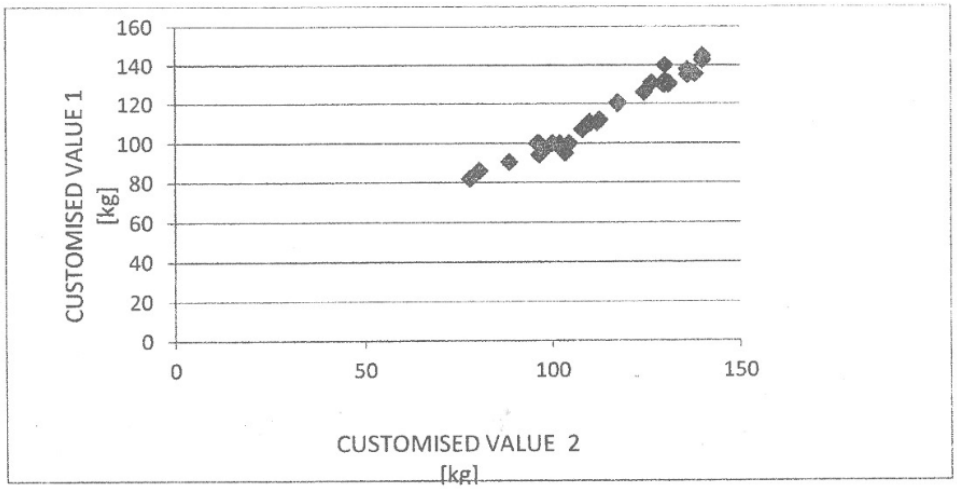


Figure 4: Scatter Plot on reliability of dynamometer

DISCUSSION

Findings of this study show that the customised back and leg-lift dynamometer has strong validity and reliability values for testing strength in the back and leg muscles [see tables 1-4 and figures 1-4]. These results could be expected considering the fact that there , are similarities between the materials used for the production of the customised instrument, and its orthodox counterpart [see images in appendix]. According to Worthen et al [1993], measurement experts (and many educators) believe that every measurement device should possess certain qualities. Perhaps the two most common technical concepts in measurement are reliability and validity. Any kind of assessment, whethertraditional or "authentic," must be developed in a way that gives the assessor accurate information about the performance of the individual.

Emphasising the importance of research instrument, however, Wiki Answers.com [2012] state that scientific instruments may be usefully regarded as the capital goods of the research industry. That is to say, the conduct of scientific research generally requires some antecedent investment in specific equipment for purposes of enhancing the ability to observe and measure specific categories of natural phenomena. This calls for efforts to make research instrument available to researchers and students who are in training at affordable prices.

Stressing the need for customising research instrument, The National Academies [2006] observes that research instruments have revolutionized how we look at the world, refining and extending the range of our senses. From the beginnings of the enlightenment, development of the modem scientific method, with its emphasis on testable hypotheses, required the ability to make ever more accurate measurements. Instruments for research continue to grow more and more sophisticated, and there is need for every research-based institution to move along with the trend.

Conclusion, Implication and Recommendations It is concluded in this study that the customised back and leg-lift dinamometre of this study is valid and reliable for data collection in researches that involve strength of legs and back muscles. This has entrepreneurial implications as this customised instrument can be produced in commercial quantity for sales to researchers and research institutes. Based on this, it isfor the back muscular strengthrecommended that the customised back and leg-lift dynamometer validated in this study should be produced in commercial quantity and made available for interested marketers for sales at affordable price to researchers, sports research institutions, colleges, universities, sports and fitness clubs, and every individual and body that find it useful. It is also recommended that efforts should be made by experts in the field of Physical Education to customise many of the scarce research instruments, training and teaching equipment as availability, and affordability of such will make researches and other activities in Physical Education more interesting.

REFERENCES

Ayeni, S. 0. [2001]. Comparative effect of a twelve-week taekwondo and calisthenics training programme on selected university of Ibadan male students. Unpublished Doctoral Thesis. Ibadan: University of Ibadan.

Chan, C.C., Lee, Y. C., Lam, H., Chan, T. & Zhang, X. [2004]. Analytical Method Validation and Instrument Performance Verification. London: John Wiley & Sons

Dansu, A. [2011]. Physical fitness indices as correlates of sports injuries among studentsof football academies in Nigeria. Unpublished Doctoral Thesis, Lagos: Lagos State University.

Dyne Systems [2010]. What isdynamometer?http://www.dynesystems.com 01/06/2012

Fraguas, R., Henriques, S.G. [2007]. The validation of an instrument to diagnose depression: Beyond the yes/no question. J Postgrad Med, 53,85-6

Hattori, Y., Ono, Y., Shimaoka, M., Hiruta, S., Kamijima, M. & Takeuchi, Y. [1998].

Test-retest reliability of isometric and isoinertial testing in symmetric and asymmetric lifting. Ergonomics, 41[7], 1050-1059.

Heyward, V. H. [2002]. Advanced fitness assessment and exercise prescription [4th Ed]. Mexico: University of New Mexico Pub.

Maud, P.J. & Foster, C. [1995] Physiological Assessment Of Human Fitness. Champaign: Human Kinetics

McArdle, W.D., Katch, F.1., & Katch, V.L. [2000]. Essentials of Exercise Physiology[2nd Ed.]. Philadelphia: Lippincott Williams & Wilkins

Menard, D. [1994] The ageing sportsman, in M. Harries, C. William, W. D. Stanish & L. J. Michele (Eds) Oxford Textbook of Sports medicine [605-608]. New York: Oxford University Press.

Shuttleworth, M. [2009]. Instrument reliability. www.experiment-resources.com

Sports Fitness Advisor [2012]. How to Determine Lactate / Anaerobic Threshold [online]. Available: http://www.sportfitness-advisor.com 06/07/2012.

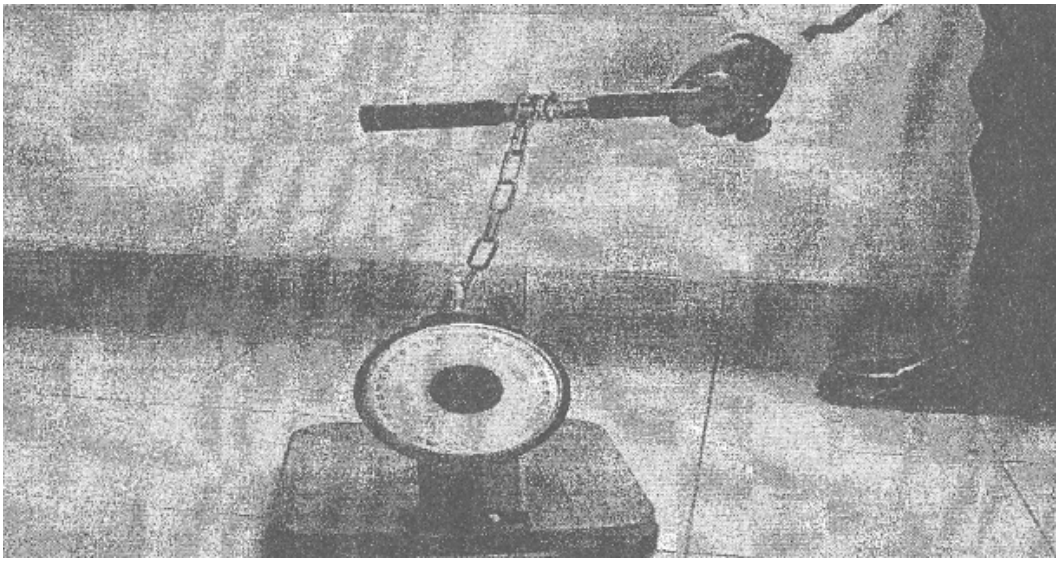
The National Academies [2006]. Advance research instruments and facilities. http://www.nap.edu/openbook.07/07/2012

Wiki Answer.com [2012]. What are Importance of scientific instruments?http://wiki.answers.com 12/07/2012

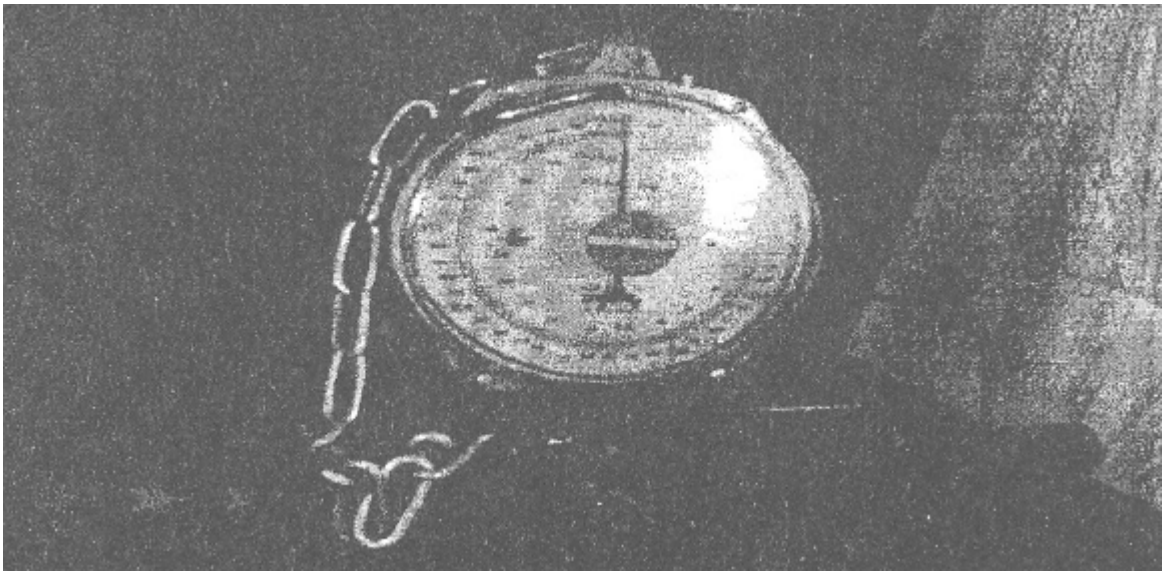
WINKS Statistical Data Analysis Package [2007].TexaSoft, WINKS SDA Software [6th Ed]. Texas: Cedar Hill.

Worthen, B. R., Borg, W. R., & White, K. R. [1993]. Measurement and evaluation in the school. New York: Longman.

APPENDIX



An orthodox back- and leg-lift dynometer of Takei Co., Japan



An customized back- and leg-lift dynometer