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Guide for upper body free-weight training

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THESIS
ABSTRACT

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Gym training and fitness has become a trend in past few years. This phenomenon can be seen at the gyms. Women has interested in free-weight training among gym and aerobic machines. However, some customers do not have knowledge of free-weight training movements and techniques. Therefore, the area might not feel welcoming and familiar.

The purpose of the thesis is to make a free weight guide for a fitness center. Therefore, it will be a free service for customers to deepen their knowledge of gym training.

The aim is to make a guide for ladies to lower the threshold for free weight training with knowledge. Training has great health benefits and it can make the daily chores easier. For author, the aim is to develop professionally during this project. Knowledge from anatomy, physiology, biomechanics, free-weight training, strength training and developing a product will be deepen. The project will also lead to working life as professional knowledge will be applied to the product. Critical thinking and research based theory will be required. Process is expected to improve independent working, self-motivating and use of time.

Theoretical framework will discuss ladies and the recommendation for their training, safety, effective free-weight training and basic knowledge of gym training. To meet these research tasks, author will carefully study subjects and based on them, make a guide for free weight training.

Thesis will be done as product development process. It will be published by Kajaani University of Applied Sciences during the Winter 2017.

Keywords: resistance training, productized thesis, free-weight, gym training, ladies, product development

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PREFACE

"The last three or four reps is what makes the muscle grow. This area of pain divides the champions from someone else who is not champion. That´s what most people lack, having the guts to go on and just say they´ll go through the pain no matter what happens."

Arnold Schwarzenegger

CONTENTS

1 INTRODUCTION

The thesis project started from the interest to gym training and product development. After contacting gyms, Liikuntakeskus Terve! (Fitness centre Terve!) finally answered positively to the request of a thesis project. The thesis project idea was received with open minds. After brain storming the topic, upper body training guide and free weights got selected. Already existing free weight training area and various lower body group exercise classes left market niche for upper body training and free weights.

The product is expected to work as a tool for the company as they hoped to get more gym area visits in their fitness centre. Commissioning party felt that free weight training and the interest toward it has grown within past three years. However, part of customer does not have knowledge and skills to use free-weights as a training equipment. Knowledge of training methods is therefore expected to give a motivational push to training. Commissioning party felt that the young adults had more knowledge and got help from friends and social media. Therefore, the target group was selected to be 30-40 years old ladies. This group presents major part of the customers of Terve! The product works a guide to free-weight training movements and gym training principles. However, other people beside the target group can benefit from the product. The final product can be seen as a free version of personal training service; adding knowledge of training without expenses.

This process required adapting professional knowledge and skills to the project. Theory part required research based knowledge processing and critical thinking. The thesis product was done in co-operation with the fitness centre. The theory covers knowledge of how a lady should train in different phases of life and why, recommendation for resistance training, the muscle anatomy, physiology, biomechanics, resistance training principles, free weight training pros and cons, safety and productization. Strength training has health benefits and those are emphasized in the thesis.

Obesity and in fitness trend created general background to the topic. In Finland 46% of women and 65% of men are at least over weighted (BMI 25kg/m2 or more) and 20% of them are obese (BMI 30kg/m2 or more). In bigger picture, the obesity rate with Finns are

little above median when compared to other European countries. However, the growth of body mass index and waist circumference has slowed down or even stopped. Finland is one of the first countries reporting this kind of news. (Männistö, Laatikainen, Harald, Borodulin, Jousilahti, Kanerva, Peltonen, Vartiainen, 2015.) BMI, or body mass index, can be calculated by dividing weight (kg) with the square of height (m)2. Normal body mass index is defined to be between 18,5-25. (Mustajoki, 2015.)

On the same time fitness trend has shown it power on social media posts, marketing and grocery store selections. New fitness and dietary supplement stores, gyms and fitness centres has been opened. Therefore, information concerning training and eating habits, and training possibilities are growing and showing healthy example to people. This trend has an impact to youth as well. Finnish youth uses less alcohol and more time to wellbeing and health. (Känni ei enää nuoria kiinnosta, 2017.) Even though the youth has taken a step to better wellbeing and health, part of older people lacks information of training. This product will be a tool for Terve! gym to instruct people toward safety and effective free-weight training.

The aim of the product was making a guide for ladies to lower the threshold for free weight training. This way, the customers could have more out of their training and find free-weight training more familiar. In optimal situation, this can benefit both the health and fitness of customers and the gym business. Deeper understanding of gym, free weight and resistance training as well as anatomy, physiology and biomechanics, safety, trajectories, marketing, productization, long period processes and actual productization of professional knowhow was aimed by the author.

2 THEORETICAL FRAMEWORK

Theoretical part of the thesis got research and studied for the productization process. The guide was to be health promoting, knowledge increasing and highlighting healthy way of training. Theory got research, studied and processed, and thereafter transformed into simpler and understandable form for the guide.

2.1 Previous studies

At the Kajaani University of Applied Sciences, there has been published two gym training video guides recently, both with Balance fitness center as their commissioning party. Lausti and Lehtinen (2015) made a guide for free weight training for beginners as their thesis. Vatanen and Alakärppä (2013) made a product that guides how to use gym equipment and how to do exercises. Thesis product was also targeted for beginners and it was based on health recommendations and latest research. Both of these previous thesis was made as a development processes. Lausti and Lehtinen (2015) concentrated to free weights as well. Vatanen and Alakärppä had gym machine guide as their product. As an outcome of the Lausti and Lehtinen (2015), they wrote that a proper training plan is a key to successful training. These theses were made to different gym and the movements were selected for the whole body. For the thesis in question, perspective was more specified to free weights and upper body.

2.2 Guide

Actual guidelines for making gym guide was difficult to found, therefore instructions from social and health industry and general instructions for guides were adapted to the project. Riitta Hyvärinen (2005;121:1769–73) writes about good patient instructions; a clear, logical progression, use of headlines, sentences wrote with standard language, adequate appearance and use of arguments, especially telling what the customer will gain is highlighted. A clear guide gives the information in simple and understandable form. Special terms should be explained if those are necessary to use. Use of short and simple sentences, that include only

one thing, makes the guide more user friendly. It is also better to use active than passive form in the text to make it clear who is doing. Use of colors, pictures, clear and simple layout and different size of font make the guide more understandable and easier to read. (TUKES, n.d.) As a conclusion, the guide should be clear, simple and logical. Use of headlines and different fonts makes it more user friendly.

2.3 Recommendations

Recommendations in the guide must be health promoting and safety to follow. Therefore, different recommendations were studied. For 18-64 years old adults to include at least 150 minutes of moderate – intensity or 75 minutes of vigorous –intensity aerobic physical activity in a week. Weekly amount can also be implemented by combining vigorous- and moderate –intensity aerobic physical activity. Aerobic activity could be done in parts. One part should last at least 10 minutes. This physical activity can include leisure time, transportation, occupational or household chores, games, sports in context of daily life. (UKK, 2017; WHO, 2017.) These physical activity recommendations aims to improve bone health, muscular and cardiorespiratory fitness. It can reduce the risk of depression and non-communicable diseases (NCDs). (WHO, 2017.)

Adults are recommended to perform muscle strengthening activities at least twice a week. These activities should engage big muscle groups. During muscle strengthening activities 8 to 10 movements with 8-12 repetitions should be done with big muscle groups. (UKK, 2017.) However, the recommendations for additional physical activity benefits differ. Among WHO the amount should be 300 minutes of moderate intensity aerobic activity or 150 minutes of vigorous intensity. (WHO, 2017.) Whereas UKK recommends 150 minutes of moderate intensity or 75 minutes of vigorous intensity physical activity.

On a strength gaining and muscle building perspective two times a week type of muscle strengthening activity is enough for a beginner. Later, this activity level is enough for muscle maintenance. For advanced trainer 3 times is minimum for developing the performance. 4 to

5 times is recommended for shaping the body. When seeking a progression for certain body part the training amount should be 2 to 5 times a week for this part while the other parts of the body remains at maintenance level with 1 to 2 training sessions per week. (Aalto et al. 2014, 66.)

An intensive strength training session increase building, anabolic, hormonal action in body temporarily. However, this last up to 45-60 minutes before turning into breaking, katabolic, stage. For optimal result the training sessions should not be kept too long. The intensity of the training, energy levels and focus will also remain during shorter training sessions. (Aalto, Seppänen, Lindberg & Rinta, 2014, 66.)

2.4 Differences between sexes

For some female trainers, an idea of muscles growing too fast has rouse. Working as a personal trainer this question was asked many times. Therefore, the differences between sexes and hormonal responses was researched.

Even though there are physiological differences between sexes, the training fundamentals and practical implementations are almost alike. A skeletal muscle reacts and adapts similarly to progressive training load in time with both sexes. The main difference in muscles is between the quantity rather than quality. (Kauranen, 2014.)

Maximal force production is approximately 30% lower with females than males. The biggest difference in force production are at upper limbs and shoulder and the lowest differences can be found from pelvic area and lower limbs. (Niemi 2014, 493-494.) Female trainer has approximately 50-60% of maximal upper body strength and 60-70% of maximal lower body strength compared to male (Hulmi 64, 2017).

Even though the absolute maximal force has great differences between females and males, the difference is almost diminished when the muscle force is proportioned to body weight, lean body mass or to skeletal muscle cross-section area (Niemi 2014, 493-494). The biggest difference seems to be in muscle size (Hulmi 64,2017). However, females have lower force production and relaxation time. There are differences in hormonal concentration and in muscle types. Average male produces 2,5 - 11 mg of testosterone in their testicles daily and the concentration in blood is 20nmol x 1 (-1). Females has also testosterone in their body but the level is under 1 mg per day and around 2 nmol x 1 (-1) in blood concentration. However, there can be found big differences between female from 1 to 6 nmol x 1(-1). Testosterone is central anabolic hormone and affects to muscle force development and recovery. On the other hand, females have bigger concentration of human growth hormone, other central anabolic hormone, in their body at resting stage. (Niemi 2014, 493-494.) Female trainers seem to have slower maximal force production, but they can work longer series with proportional big loads. Therefore, female trainer should train hard close to own limits of capacity to maximize the development. Fast force production should also be trained. (Hulmi, 2017, 64-65.)

2.5 Pregnancy

30-40 years old ladies give birth of 50% of all babies in Finland (Jämsen, 2015) and therefore, training during pregnancy is also introduced. During pregnancy, physical activity increases physical condition, help women to cope with physical stress caused by the pregnancy, increase mental wellbeing, make the recovery from the delivery faster. Physical activity can help pregnant women to control weight gaining and decrease the risk of diabetes mellitus, back pains, leg swelling and varicose veins. (UKK, 2017.)

Hormonal changes during pregnancy effect tendons by softening them (Valasti & Takala 2011, 40-42). Pregnancy changes the centre of gravity and the position of spinal cord. (Hulmi 2017, 65). One should pay attention to the overall posture and especially to the back posture. In the later phases of pregnancy some supportive muscles get looser so it is also good to work consciously with the muscle control while training. The abdominals are in

great stretch during the end of the pregnancy, therefore one shouldn´t vigorously train them. Valsalva maneuverer, where the breath is held during a movement in order to gain more power, is not recommended during the end of the pregnancy because it rises the blood pressure. Otherwise, moderate training has many benefits. (Hulmi 2017, 65.) Heart rate should not rise over 150 BPM for long periods. Strength training can be done during pregnancy but the intensity should be decreased. Maximal and power training is not recommended. Free weights can be changed to machine training for smaller risk of injury or to aerobic training. Martial arts type of training should be avoided when pregnant. (Kauranen 2014.)

If a woman has not engaged to physical activity before pregnancy, it is recommended to start calmly and add the training sessions slowly. The physical activity should be divided to at least 3 days in week and the sessions should be at least 10 minutes long. The total amount should be 150 minutes a week. If woman has been active before the pregnancy the physical activity can be continued like before. However, it is good to talk to a doctor about the training and listen to own body and condition. (UKK, 2017.)

According to study published by journal of Physical Activity & Health, women can engage in aerobic physical activity and resistance training 3 days a week for 30 minutes during pregnancy. The strength training could also lower the prevalence of hypertensive disorder and gestational diabetes mellitus; however, the body mass index is still bigger factor with both disorders. (White, Pivarnik & Pfeiffer, 2014.)

2.6 Changes in muscle mass during middle age

The product is aimed for ladies from 30-40. Aging changes body and theory concerning the changes got studied and used in the product to increase knowledge. The speed of changes can be intervened with resistance training.

At thirty`s muscle mass peak. After that the lean body mass start to decreases (Sundell 2015). After fifties the lean body mass decreases at the speed of 1% per year. Power decrease 1% per year after 40´s without training. (Hulmi 2017,14.) The decrease of power and muscle mass speed up after 70´s. These bodily changes caused by ageing can lead to muscle mass lack. This change in aging body is called sarcopenia. Genes seems to define a part of the bodily changes. If person has good muscle strength during middle age, it can predict impressive performance and overall wellbeing for the next 25 years. (Hulmi 2017,14.) If the situation in the middle age is not that good, one can interfere these bodily changes with healthy lifestyle, training and eating well (Komulainen & Vuori, 2015). Even though sarcopenia is not current feature at 30-40 years old ladies it is good to make physical activity part of lifestyle in advance. Resistance training is the most important way to prevent and cure sarcopenia (Komulainen & Vuori, 2015)

2.7 Benefits of strength training

Strength training has multiple benefits. It helps to maintain bone mass and prevents osteoporosis. It strengthens tendons and joints thus, decreasing injury risk. Strength training decrease blood pressure, lowers body fat and improves cholesterol and therefore decrease risk for multiple illnesses. Strength training boost metabolism and is in key element to increase muscle mass. (ACSM, 2013; Garber, Blissmer, Deschenes, Franklin, Lamonte, Lee, Nieman & Swain, 2011.) Daily calorie consumption increases, because muscle mass requires more energy than fat tissue. Strength training burns calories and helps to control weight gaining (MacDonald, 2010, 63- 77.)

Strength training has also multiple mental benefits. Reduction of anxiety symptoms has been related to strength training among healthy adults. Moderate intensity strength training seems to have greater benefits for anxiety. Depression symptoms has decreased among depressed adults. Older adults have had improvements in cognition. Depressed older adults have benefit strength training by improving the quality of sleep. Strength training has improved

self-esteem. Strength training has significant clinically improvements in chronic fatigue. (O'Connor, Herring & Caravalho 2010.)

2.8 How do muscles work

Muscle tissue is one of the four tissue types in human body among connective, epithelial and nervous tissues. There are 3 different type of muscle tissue; voluntarily striated skeletal muscle tissue, autonomic striated cardiac and autonomic smooth muscle tissue. From 640 muscles in human body, 430 are skeletal muscles and the rest works mainly autonomically. (Kauranen, 2014.) Muscles work in pairs; another one contracts while the other relaxes (MacDonald 2010, 64-84). Meaning that both pairs cannot contract at the same time.

Muscle tissue has many function in human body: movements and posture maintenance require muscle function, orifice function is controlled by muscles, inner organs are shielded and supported by muscles, blood flow is produced and regulated by muscles, thermoregulation and peristaltic (meaning wavelike movements in tubular construction) are controlled by muscles. (Leppäluoto, Kettunen & Rintamäki 2016, 93.) Brain keeps the muscles in service alertness all the time by sending small partial neural impulses (MacDonald 2010,64). This maintain the muscle´s health and ability to serve. This is called muscle tonus. Muscle tissue has characteristic ability to transform chemical energy from food to power thus generating movements. Myosin and actin filaments cause the movements. These two filaments slide over each other thus causing shortening of a muscle and contraction in a muscle. Action potential starts the contraction and it requires ATP (adenosine triphosphate) formulated energy. The relaxation of a muscle requires also ATP energy. (Leppäluoto et al., 2016,93.) Contracting muscle actually pulls a tendon connected to it. The tendons are not that stretchy tissue. Therefore, the tendon transfers the pulling force to a bone (or skin in face) which causes the movement of a limb for example.

2.9 Skeletal muscles

During embryogenesis, some of our muscle cells fuses in together. These kinds of cells have many, even hundreds, of nucleus placed peripherally under the cell membrane. The size is massive: 0,01-0,1 mm wide and 1-400 mm long in an adult. (Kauranen 2014, 60-61.) These cells are called skeletal muscle fibres.

Muscle fibres consist of myofibrils which consist of two type of myofilaments, actin and myosin. Actin and myosin filaments with attachment bands, gives the striated appearance to the muscle. This can be seen with microscope. These fibres are covered with sarcolemma. A bundle of muscle fibres is covered with perimysium and it is called muscle fascicle. a Bundle of muscle fascicles are then covered with epimysium and on top of this is fascia which attach to tendon and by that to a bone. There are also blood vessels and nerves in a muscle. (Leppäluoto et al., 2016, 94-95.)

A skeletal muscle functions are conducted by nerves. A muscle always need a command from nerve to the movement to occur. An axon of an alpha motoneuron is attached to every muscle fibre. This bond is called neuromuscular conjunction. The muscle contraction is triggered by the release of neurotransmitter acetylcholine (in neuromuscular conjunction). An alpha neuron has many axons. One alpha neuron and all the muscle fibres that are connected to it by neuromuscular conjunction forms a motor unit. It works with all or nothing method. Said in other words, either the whole unit works simultaneously with maximal force or then none of its parts. The force a muscle produce thus depends on the amount of the required motor units. (Leppäluoto et al., 2016 ,99.)

Skeletal muscles are attached to bones by tendon and usually cross at least one joint. By contracting, a muscle actually pulls the tendons which pull the bones closer to each other. Thus, producing a movement. (MacDonald 2010, 68.)

2.10 Muscle cell types

1873 French doctor Louis-Antoine Ranvier divided muscle cells into two groups by their morphological and physiological features: fast white cells that seemed to react quickly and slow red cells that reacted slower. 1929 new-Zealand neurology Derek Ernest Denny-Brown noticed that every muscle has both of these cells, however the division between the cells changed in different muscles. 1972 muscle cells were divided by American doctors Michael Brooke and Kenneth Kaiser by the histochemical features of the muscle cells. Classes are I, IIa and IIb. American doctor James Peter divide muscle cells by their metabolic qualities at the same year. This classification includes types SO (slow twitch, oxidative), FOG (fast twitch, oxidative-glycolytic) and FG (fast twitch, glycolytic). Brook´s & Keiser´s and Peter`s classifications are still in use nowadays. (Kauranen 2014, 77-79.)

In these classifications, the division seems to be in 3 categories. The first (I) category is slow red ones. They contract slowly, and the power generation is low. These cells, however, have great stamina because of the mitochondria and myoglobin amounts. The red color comes from mitochondria. Long lasting and moderate work load. These cells have thick capillary nets. These cells have oxidative enzymes and they mainly work under aerobic stage. Tonic, posture maintaining muscles consist mostly from these muscle cells. Inner and medial muscles, functionally extensors, rotators or adductors usually consist of slow muscle cells. (Kauranen 2014, 78-79.)

Second category is fast white muscle cells (II). These cells work mainly under anaerobic circumstances by using glycolytic reactions as an energy source. However, type IIa has some ability to function under oxidative circumstances with mediocre stamina. Type IIb or actually, as it is known nowadays type IIx (because of the myosin MHC-IIx that was earlier expected to be MHC-IIb) however has ability to function only in anaerobic circumstances. They contract fast and generate great amount of power but they do not last long times. Fasic muscle; motoric and posture chancing muscles consist of these. Many times, these muscles are flexors and lateral muscles. they tend to cross over two tendons. (Kauranen 2014,78-80) Muscle may enclose multiple type of muscle cells. One motoneuron, however, recruits only one type of muscle cells. (Leppäluoto et al., 2016,102.)

Human has these cells in every muscle. The division changes between muscles and individuals, but sex does not influence on it. Genes seems to be the deal breaker even though usually the division is quite balanced. Endurance specific athletes may have 90% type I cells whereas person with greater type II muscle cell composition has succeed in explosive power specific disciplines. Meaning that whoever can train the muscle cells to the top, but genes may define who can make it to the elite athletes. This genetic division is nearly impossible to change quantitatively, however the size of the muscle cells can be impacted with training. (Kauranen 2014, 83.)

2.11 Type of muscle contraction

Muscle can produce force with either dynamic or static form. During dynamic contraction muscle length changes. when the length of a muscle shortens because of muscle work it is called concentric and when it lengthens it is called eccentric. Static muscle work is also called isometric. In isometric muscle work the length of a muscle does not change even though the tension changes. (Leppäluoto, et al. 2016, 99-100.)

2.12 Functional roles

Muscle work is rarely isolated to single muscle. Actually, muscles have many functional roles. Muscles can work as agonist or antagonist, neutralizer, fixator or as a synergist. Muscle usually work in agonist-antagonist pairs. Agonist is the main working muscle, whereas antagonist is the opposing muscle for the agonist. Antagonist stretches when agonist contracts. Agonist and antagonist does not work at same time. (Mcdonald 2010,67.) Neutralizer limits unmeaningful muscle co-operation. Fixator stabilize limb or body during the agonist´s work. Synergist supports the work of the agonist muscle. (Kauranen 2014, 218-

219.) Free weight training, where the trajectories are in three-dimensional space, recruits more muscles than isolating movements in machines. Therefore, free weight training is closer to daily activities and chores.

2.13 Muscle fatigue

Muscle can be fatigued by two ways. The muscle fatigue means acute descending in maximal or optimal nerve-muscle system´s force production caused by physical loading. The fatigue can be seen for example in decreased capacity to produce maximal power in maximal power performances or maintain the stamina in endurance sports. The force production (firing rate) and relaxation time decreases. (Kauranen 2014, 202-205.) In dynamic work, eccentric contraction seems to cause more muscle fatigue than concentric work load.

During the repolarization of an action potential potassium-ions diffuses out from a cell to extracellular fluid. In the end of action potential these potassium ions are pumped back to intracellular fluid by natrium-potassium pumps. In maximal force production, the potassium level rises explosively high in the extracellular concentration. Therefore, an action potential cannot be formed again if the repolarization time is too short between the action potentials. (Leppävaara 2016, 101.)

During anaerobic physical exercise, body can be fatigued by the lactic acids, the waste products of the cellular metabolism. The pH level is decreased by lactic acids. This is expected to cause the fatigue in muscles or disturbing physiological reactions. (Leppävaara, 2016, 101; Kauranen, 2014, 214-215)

Strength training affects muscle cells by growing single cells size rather than increasing the amount of muscle cells. Muscles strengthen also by increasing the number of mitochondria's in a single muscle cell. Chemical reactions that are needed for fuel to the muscle contractions occurs in mitochondria's. Strength training improve blood flow in muscles thus

more oxygen is available for the working muscle. Training makes the muscles more sensitive to the commands from central nervous system by enforcing the neural connections. All in all, trained muscles are more prepared to be on duty. They possess bigger energy stores that are easier to access. (Macdonald 2010, 64-84.)

2.14 Recovery

Recovery occurs in rest. During recovery muscles and fascial membrane is fixed, energy stores are filled and metabolic waste is removed from the muscles. The aim of recovery is to normalize the muscles to the stage they were before the physical stress. Thus, the muscle power will be reloaded and ready to use again. (Kauranen 214-215.)

2.14.1 Muscle cell recovery

Muscle can only strengthen by getting broken. Muscle fibres get small microscopic fragments during intensive muscle contractions. Body fixes the muscle and makes them little bit stronger. By repeating this procedure muscles get stronger in time. Therefore, recovery is important after intensive training. Training should also be progressive to maintain the development. (MacDonald 2010, 70-71.)

2.14.2 Stress reaction

During strength training the muscle activation and the physiological changes related to it are measured as well as the metabolic changes. Mechanical load, meaning the forces that are targeted to the body and the forces body produce, potassium ion concentration in special parts of the muscle and lactic acids are measured. Through these and many other physiological responses muscle cells can measure the results of earlier positive adaptations (overcompensation) and needs of new adaptations in muscles. (Hulmi 2017, 18.) This mechanical and metabolic stress causes general stress reaction in body leading to changes in hormonal balance. General stress reaction affects to endocrine system, which adds hormones in circulation. Thereafter, metabolism will become anabolic or katabolic. Anabolic hormones (testosterone, growth hormone (GH), growth factors, insulin, catecholamine) will accelerate the metabolism and lead to protein synthesis and muscle hypertrophy. Contrary to anabolic, katabolic hormones (cortisol, thyroid hormone, glucagon, myostatin) causes muscle cell breaking and causes atrophy. (Kauranen 408-410.)

2.14.3 Protein synthesis

Muscle gains on a cell level are based to protein synthesis. During protein synthesis, new proteins to muscle cells are built from amino acids. Protein synthesis is occurring in the body all the time. Protein synthesis accelerates after eating protein consisting food and after training. During hard or intensive workout muscle cells got small fragments. These fragments are fixed during rest, actually 24-48 hours after hard work out the synthesis is active. On a counterbalancing action, katabolic or braking stage occurs as well. It is vital action in body and helps to regenerate the muscles. Katabolic stage during training session is one triggering factor for anabolic stage. (Hulmi, 2017, 18-19.) Generally, high intensive training causes anabolic hormone rise in the blood whereas long, low intensive training lead to katabolic hormone increasement (Kauranen, 2014, 410).

2.14.4 Metabolic recovery

The main points in metabolic recovery is to refill the energy stores, get rid of metabolic wastes and return the pH level to normal. Metabolic recovery occurs faster than muscle cell or fascial membrane recovery. (Aalto et al. 2014, 114-117). Cooling down after training helps to remove the metabolic waste (lactic acids) faster. Otherwise metabolic recovery can be supported by drinking water and eating well around the training.

2.14.5 Energy storage recovery

Recovery can be divided into short and long recovery phase. muscles can recover during next minutes and hours (short recovery phase). In fact, during the next minute after the performance power stages are at the lowest. The recovery occurs fastest 1 to 4 minutes right the performance. (Kauranen 2014, 214-215.) The length and intensity of the physical performance effects to the recovery. Isometric power, dynamic power and relaxation time can be totally recovered in 15 minutes from short performance. After hard work out, it can take few days for a body to recover and fully fill the energy stores (long recovery phase). (Kauranen 2014,214-215.)

Training uses energy, but depending on the training intensity the source can be different. Muscles uses carbohydrates and fats to generate adenosine triphosphate (ATP). ATP is the only kind of energy that cell can use. ATP molecules has ability to recover nearly to the fullest in 1 to 3 minutes whereas creatine phosphate (CP) molecules takes half minute to recover 50%, 2 minutes to recover 85% and approximately 10-15 minutes to recover 100%. (Kauranen 2014, 214-215.)

3.12.6 Nervous system recovery

Every training session requires use of nervous system. However, the recovery process is not that easy to follow compared to muscle ache or hunger. There is no trustworthy subjective, sensation based way to follow the recovery (Aalto, et al., 2014, 114).

Short, under 60 minutes long, low-intensive training sessions done under aerobic threshold are healing nervous system functioning. This kind of training increase the number of neurotransmitters in the nervous system. After hard work out or at the next day, a 30-45 minutes long, light training session is recommended. (Aalto et al., 2014 114-116.)

Hard and intensive power, speed or endurance training sessions are stressful for nervous system. This is necessary when the training is meant to be developing and progressive. However, excessively performed this can lead to overtraining. It takes 3-5days for nervous system to recover from hard under 60 minutes work out. Therefore, one should do average of 2 hard training session in a week, meaning maximal strength, maximal power, speed power or explosive power. A beginner little less. During other training days, one could work out with metabolism, basic endurance or technique. (Aalto et al., 2014, 114)

Nervous system is loaded by physical and social factors as well. Therefore, stressful situation in life can cause extra stress for nervous system. Recovery can be also improved with enough sleep, average of 7-9 hours depending on person.

2.15 Progression

Training need to be progressive to be improving and challenging. Human body will recover and over compensate from the stress and load it is exposed to (Hulmi, 2016). Said in other words, in a long run, similar type of training does not cause new stimuli for the body and the training will stay at the same level.

2.15.1 Adaptive muscles

Muscles are adaptive to the use. Adaptions are partly made as a response to different kind of signals and sensors measurements (Hulmi 2017,18). If muscles are not used, it would be waste

of energy for body to maintain them. Thus, body starts to diminish them and save in the energy expenditure (Macdonald 2010, 70-71). For example, two weeks of bed rest with minimal food consumption can diminish quadriceps even up to 20% (Hulmi 2017,18). However, maintaining muscle mass is quite easy. Even one to two strength training sessions is enough for maintenance (Aalto et al. 2014, 75). When muscles are used with heavier loads or more intensively than where they are used to, in adequate circumstances body will overcompensate during recovery. (Hulmi 2017, 50). Meaning that body will strengthen the muscles little more than they were before to survive from this kind of physical stress in future. However, gaining muscle mass is not easy. Body has many functions limiting excess muscle mass growth, for example myostatin and other proteins (Hulmi 2017, 18).

2.15.2 Interference

There might be some interference with the strength results and progression when simultaneously training strength and aerobic physical activity. This phenomenon is explained in the guide to increase the knowledge of appropriate amount of training. Training strength and endurance at the same time may cause negative effect on strength gaining because of abrogate training responses. However, with right kind of alternating this effect can be avoided. If person is seeking primarily strength gains, endurance training is not necessarily needed. However, anaerobic sprints or short bicycle or skiing exercises can promote aerobic capacity simultaneously with strength training. (Taipale, 2015.)

2.15.3 Individual factors

On a research, strength training studies from years 1996 to 2011 made at Jyväskylä University were analysed. The research showed that people have different kind of responses for strength training. The results showed that mediocre had good response for muscle size growth and strength development. However, for some people the responses were low. 7% of the population that trained had low response for training when considering the comparison group.

30% of the study group didn`t have response at all for muscle growth. For small part of the results were even negative with muscle size and strength. The study showed also that sex or age does not matter for the results. More than that the genes seem to be the deal breaker. (Ahtinen, Walker, Peltonen, Holviala, Sillanpää, Karavirta, Sallinen, Mikkola, Valkeinen, Mero, Hulmi & Häkkinen, 2016). Individual factors affect the training results, and this is explained in the product. For some people knowledge of the effect may help to understand their own strengths and weaknesses in different style of training

3 FREE WEIGHT TRAINING

American heritage Dictionary of English language defines free weight as "A weight, such as a barbell or dumbbell, that is not attached to another structural device and is raised and lowered by use of the hands and arms in weight lifting" (free weight, n.d.).

Free weight training offers a great tool for versatile functional or structural training. Movements can be done with full range of motion (ROM) and with free trajectories. Movements can be anything between isolated movements, such as bicep curls, to whole body engaging movements, like snatch. Free weights are not supported and the movements can be performed in three-dimensional space. Free weight training is beneficial when thinking everyday life. It demands and improves balance and body control.

With machines, the target muscle is usually more isolated than when performing same movement with free-weights where assistant muscles are also involved (Snideman, 2005). When more muscles are involved the metabolism and calorie consumption accelerates also. Therefore, free weights can offer more efficient training than isolating machines.

Machines offers usually possibility to train in two-dimensional space because they are supported or structured to work in limited trajectories. Therefore, the movements are more isolated. On the other hand, one can use other equipment or devices if seeking extra support for isolating free weight movements. Scott bench for example help to isolate bicep curl to biceps brachii. In bigger picture, the machines that are supported might have lower risk of injury compared to free weights. Free weight training allows natural trajectories and full range of motion. Training partial range of motion (ROM) can allow higher load than full ROM. Training with smaller weight and full range of motion however seems to cause greater delayed onset muscle soreness DOMS. (Baroni, Pompermayer, Cini, Peruzzolo, Radaelli, Brusco & Pinto, 2016.)

From hormonal perspective to muscle growth, free weight training might be more beneficial. A study published on the Journal of Strength and Conditioning Research showed that acute hormonal response of growth hormone and cortisol concentration were bigger in blood after training squat with free weights than leg press with machine (Shaner, Vingren, Hatfield,

Budnar, Duplanty & Hill, 2014). The affect to hormonal function seems to be bigger with pervasive than with isolating movements (vapaat-painot, n.d.) Hormonal function has connection to muscle gains and therefore the muscle growth can be faster with free weigh training. This phenomenon is also recognized among muscle gains seeking bodybuilders. Free-weight training and pneumatic resistance training results in strength, velocity and power were studied after 8 weeks of training with 18 resistance trained men. (Frost, Bronson, Cronin & Newton, 2016) The result showed that free weight trainers had increased significantly 1RM, maximum force, velocity and power with both free-weights and pneumatic resistance. However, the pneumatic resistance trainers only improved their peak force and power, even though the training were done with same load with both groups. However, the training equipment is not the only function leading to the most effective training. Pros and cons of free weight training are depending on same thing, the technique. When the technique is perfect one can train muscles with the optimal trajectory for the body, however if the technique is incorrect the trajectories can lead to incorrect training or injuries.

4 TERMINOLOGY

4.1 Central concepts

Central concepts to the topic are productized thesis, productized thesis process, free weight, resistance training, ladies and productization.

Among KAMK Productized thesis defines the product generally and describes how the proficiency is productized. Productizing description is adaptable to the thesis and to the work of actual product. Productized thesis process means that new product or service will be developed and brought to the markets. During the development process data is collected to fit the needs of customers. Productizing process should be adjusted to fit the meaning of the product and target group, framing, the requirements of a thesis work, implementation and demands of the service. (KAMK, n.d..)

Resistance training

Resistance training is a type of physical activity where muscle or muscle group works against external resistance thus improving muscular fitness. (ACSM, 2013)

Free weight

American heritage Dictionary of English language defines free weights as "A weight, such as a barbell or dumbbell, that is not attached to another structural device and is raised and lowered by use of the hands and arms in weight lifting" (free weight, n.d.).

Ladies

In the thesis, a term lady is selected to describe women approximately aged 30-40 years old. This is the target group of the thesis product. This group is expected to have some knowledge and experience of strength training. However, the product can beneficial for people outside of the target group.

Productization do not have one general definition. Conceptualisation and systematisation of service can be talked when making some acts of productization. Productization can be talked also when standardizing a service to a product like good. (Jaakkola, Orava, & Varjonen, 2009)

Productization can be classical, agile or iterative. In classical productization the process is linear, check-list type of progressing Productization may be project management alike. Nonrecurring productization leads then to marketing and production. In agile productization the idea is to bring the product to the markets as fast as possible. Additional development and productization will be then done with first customers. Iterative productization mean sequel kind of productization. The service will be made to be continuously developing unity. There won´t be ready product, because updates and changes will be done when necessary (Foundry, n.d.).

4.2 Key elements and terms of the training session

These elements can make it easier to understand the factors of a training session. Together they build it up, like pieces of a puzzle build up a bigger picture.

A Set

A set describes x amount of repetitions per exercise. For example, 1 set of bench press could be 8-10 repetitions. Set can be repeated after a small resting pause. 2 to 3 sets seem to cause greater strength gains than just 1 set (Krieger, 2010). The results fitted both beginners and for advanced trainers.

A Repetition

Repetitions are the amount of performances of an exercise. For example, 12-15 hammer curls. The amount of repetitions is defined by the training style. Maximal force style allows body to perform only few repetitions whereas endurance strength style aims to 15 or above.

Load

How to choose a right load for the training? The ideal situation is that one perform the x amount of repetition but don´t have power for single more. The weight should be under control all the time. Therefore, the load and work is focused to the target areas. If the load is too big, surrounding muscles may participate too much to the work and injury risk decreases. If the load is too small there will not be enough resistance for the working muscle/ muscle group. Thus, small microscopic fragments that makes the muscle grow, will not occur. Because eccentric contraction causes more fragments to the muscle than concentric. The eccentric phase should also last longer. (MacDonald, 2010, 74-75)

Rest interval

After a set is done small recovery pause is kept to reload energy lack in muscles. Resting time depends on the training style. In maximal force training the energy stores should be well recovered before next set. This kind of training aims to load the mechanical work. Contrary to this, on a metabolic loading style, using smaller weights and higher amount of repetitions submaximal, the resting time is kept smaller. This aim to strain the metabolic system with high lactic acid concentration in muscles.

Trajectories

When it comes to trajectories in resistance training partial range of motion (ROM) can allow higher load than full ROM. However greater muscle soreness when compared after 72 hours

has been gained from full range of motion. (Baroni, et al., 2016) With longer range of motion, the strength gains are also greater (McMahon, Morse, Burden, Winwood & Onambélé, 2014). impact of range of motion during ecologically valid resistance training protocols on muscle size, subcutaneous fat and strength. Therefore, the ROM is not worthy to compromise with heavier external loading.

Velocity of the movement

How long a performance should last? The duration includes eccentric, isometric and concentric time of the performance. In a systematic review and meta-analysis made 2015, the hypertrophic outcomes were homologous to repetitions duration from 0.5 to 8 seconds. From a hypertrophy perspective, slower than 10 second duration seems to be inferior. (Schoenfeld, Peterson, Ogborn, Contreras, & Sonmez 2015)

Optimal performance

A performance should be done so that the movement is felt in the target muscle/muscle group during the movement. This requires conscious focusing to the movement. Swinging the weights unnecessarily leads to use of other body parts. The weight should be rather changed to smaller one if the movement is not possible to do with the weight in question. The eccentric part of the movement should be highlighted. Eccentric part trained with high intensities results in total and eccentric strength gains, muscle mass increase and muscle cross-sectional growth. (Roig, O'Brien, Kirk, Murray, McKinnon, Shadgan & Reid 2008.)

Length of training session

An intensive strength training session increase building, anabolic, hormonal action in body temporarily. However, this last up to 45-60 minutes before turning into breaking, katabolic, stage. For optimal result the training sessions should not be kept too long. The intensity of the training, energy levels and focus will also remain during shorter training sessions. (Aalto et al. 2014, 66) Variety physiological response to training is influenced by mode and intensity

of the loading, length of training session and individual characters of muscles (Hulmi 2016, 18).

Breathing

Breathing should be taken into conscious consideration during training. Muscles need oxygen to work properly. Therefore, unintended breath holding might cut series or power production. Breathing out during pushing/ lifting and breath in during reverting is the main formula. However, during abdominal training the rhythm is inverse. (Macdonald, 2010, 76.)

5 TARGET GROUP

The target group of the thesis development process got selected by the fitness center. Their two main customer groups are women aged 20-30 and 30-40. The commissioning party felt that the older age group would need more instruction with upper body and free weight training. According to commissioning party the younger group knows their way better on the free weight training are. One purpose behind the product is to have more gym area visits. By giving guidance for the older group, more people know how to work out with free weights.

Challenges caused by the group concerns the different level of previous knowledge, physical condition and the skill levels. However, the guide was made so that it would serve as many customers as possible with clear and simple yet informing material. The guide can always be a good informing revision for advanced trainers.

The age group was ideal to give guidance in contrast to elderly people or to child groups, which require more precaution with movements. However, muscles performance peak is at the age of 20-30, thereafter it starts slowly decreasing (Pohjolainen, n.d.). To slow this process and keep up physical functionality it is important to use and strengthen muscles.

6 RESEARCH QUESTIONS AND PRACTICAL PROBLEM

The research questions for the thesis were:

What are the pros and cons of free-weights?

What are the recommendations for female trainer?

How to train muscles?

How to recover from workout?

Selecting the suitable movements for upper body training was the main practical problem.

7 METHODOLOGY

7.1 Product development process

The production development process includes the manuscript process, the production of the process, filming, people involved with the process and marketing.

Kajaani University of Applied sciences offers a possibility to make a productized thesis. The idea of productized thesis is to create new product and launch it to the markets as a product able to compete. The production process requires information gathering and processing to meet the customers' expectations. It is important to consider the meaning of the product and the target group, demands and broadness of the product and execution. (Tuotteistaminen, 2017.) Said in other words, thesis production is mostly concentrating in turning the learning and professionality into a useful product.

7.2 Manuscript plan

Productiztion is conducted with manuscript plan. Two production processes were combined in the thesis project. The first plan is divided into following phases: idea and initial survey, planning the productization, describing the product (content), prizing, planning the PR, launching and finally follow up with additional development (Tuotteistaminen, 2005). The second plan was divided into 5 phases. Firstly, recognizing the problem and considering if a product would offer a solution for it. This phase requires surveying the necessity. Secondly, the processing of the idea. Creative problem solving, information from different aspects and information from idea banks leads to the selection of the solutions and production. The product should be capable to solve the problem or meet the necessity. Thirdly, drafting the product. This phase includes gathering the knowledge of the subject, customers, product, and the production processes and quality factors. By analyzing the information, the implementing principles and options can be then realized and selected. Therefore, a manuscript can be made. Fourthly, developing the product. The product is developed by the

manuscript. This phase can include testing and assessing the initial product. Some parts may rise a thought that requires further development. The outcome of this phase is model product. Fifthly the product needs to be finalized. Details are finished, the product is being fixed and developed to the final model. This phase includes planning the marketing and directions for use. (Jämsä & Manninen, 2000.) The outcome of this phase was a product, ready to use. The actual theses product is free for the fitness center and for the customers. Therefore, some phases have been left with less attention.

7.3 Production

Firstly, idea of making a thesis product concerning a gym related theme got fixed and thereafter, a suitable commissioning party got selected. Secondly the need of free weight training visit and lack of knowledge was addresses, and solution addressed. Thirdly the product was framed to be a guide for free weight training and the theory searching begun. The product was initially planned. Fourthly, after the theory part was accepted by the thesis supervisor the actual product was made and evaluated by the commissioning party and friends. Fifthly, finalizing were made according to feedback and the final product was delivered to the commissioning party.
A printed version of the guide is available at the fitness center, a poster of the movements is on the wall at the free weight area and the product will also be on the fitness center´s website as an electric version.

The product was decided to be launch with a small customer feedback raffle. Small prize is raffled among the customers that take part to the feedback. This way customers are invited to look at the product and familiarized it. Marketing the product is involved with the raffle at the gym. Otherwise the fitness center can market the product on their social media.

7.3.1 Production of the product

In the beginning of the guide free-weight training is introduced, the pros and cons are discussed, and the training style is compared to machine training. Ladies and training is discussed in the next part with following themes: the recommendations, age and changes in body, the differences between lady and gentleman trainers and pregnancy. Training with free weights is subtheme to gym training. Therefore, gym training principles are introduced followed by warm up, cooling down and stretching principles. The warm up, cool down and stretching pictures and programs was not included to keep the product in frames. Recovery process is explained in muscle, energy and nervous system levels. In the end of the guide there are programs for different styles of training. For advanced and inquisitive trainers, there is one repetition maximus chart in the end.

The text in the guide is wrote in Finnish because most of the customers at the fitness center are Finns. The research questions were set so, that the answer, meaning theory, would be an expanded version of the product. The text in the product therefore emphasizes the theory but is written in more user-friendly tone.

7.3.2 Filming

The upper body movement were selected to be basic training movements. The movement got selected to back, chest, biceps, triceps and shoulders and additionally for abs. Movements were studied from Exorlive – exercise software and book Kaikki kuntosaliharjoittelusta. Pictures were analyzed and some movements were filmed again. The product was filmed at Liikuntakeskus Terve during spring 2017 by Sara Waenerberg. Jasmin Sampakoski and the author were modeling. Some movements were filmed again because the pictures did not meet the requires or was not clear enough. Pictures were edited with Layout for Instagram - application. This application was free of charge and simple to use. The pictures were edited during summer 2017.

8 DISCUSSION

The research questions were selected to guide and frame the project. The expanded answers to these questions was then used as a theory part of the thesis. From the theory, the actual product was built. The product was made to be understandable and user-friendly. Therefore, the important parts of the theory are presented in simpler and shorter manner in the guide. The guide explains terms, indicate the idea of sets and rest intervals, guide the right kind of weights for the sets, address the right kind of technique and trajectories, inform of eccentric and concentric phases, workout time and indicate the differences between different kind of training styles. There is pictures and explanations for different kind of movements in the guide.

Author worked as a personal trainer during the thesis process and used the required knowledge to the thesis and the practical information from the working life to the thesis process. In the guide, author also answered to the questions most frequently asked in the working life. These questions were mostly concerning the sets, weights, rest pauses and trajectories. The idea or fear of female trainers getting too big muscles rouse many times. Therefore author explained the differences between male and female trainers and hormonal differences affecting the muscle growth.

The pros and cons of free-weight training was the first question of the thesis project. Part of pros comes from the training style whereas part of pros is related to resistance training. Free weights offer full range of motion and free trajectories. Full range of motion seems to cause greater delayed onset muscle soreness (Baroni, B.M., et al., 2016). Because free weight training requires use of assisting muscles, calorie consumption and metabolism accelerates (Snideman, 2005). Hormonal respond to free weight training seems to be also greater compared to machine training.

The training style, however is not the only variable affecting the training responses. The genes seem to have their own affect to resistance training (Ahtinen, et al. 2016). Overlapping endurance training seems to affect the resistance training results. However, right kind of alternating can help to avoid this problem. Anaerobic sprints, short bicycle and skiing exercises can promote aerobic capacity when trained simultaneously with strength. (Taipale, 2015).

Resistance training can be done with multiple different ways, free weights are one of those. Resistance training has various health promoting benefits. Osteoporosis can be prevented, and bone mass maintained with training. Training helps to decrease blood pressure, lowers body fat and improves cholesterol and therefore decrease risk for multiple illnesses. Strength training boost metabolism and is in key element to increase muscle mass. (ACSM, 2013; Garber et al. 2011). Among physically pros there are mental benefits also. Training can improve self-esteem, reduce anxiety and decrease symptoms of depression (O'Connor, et al. 2010).

Second research question concentrated to training recommendations. Recommendations for a female trainer were gathered from WHO and UKK-institution. The recommendations were the same: 2 strength and balance improving training sessions in a week is recommended. Additionally, 2 hours and 30 minutes of moderate or 1 hour and 15 minutes of vigorous intensity in a week for 18 to 64 years old people. The time can be gathered from shorter sets that are at least 10 minutes long.

Third question was: How to train muscles? Muscle anatomy, physiology and biomechanics got studied when answering this question. Muscles works in pairs; another one relaxes when another contract. (MacDonald 2010, 64-84) Muscles has many function in human body. Most important parts of muscle functioning during training in the thesis perspective are: participation in movement production, posture maintenance, blood flow regulation and thermoregulation. Muscles work by transforming chemical energy from food to power. (Leppäluoto, et al., 2016, 93)

Skeletal muscles are controlled by nerves and therefore they are volitionally used (Leppäluoto et al., 2016 ,99). There are three type of muscle contractions: isometric, concentric and eccentric (Leppäluoto, et al., 2016, 99-100). Trainer should carefully perform eccentric movements especially when seeking muscle mass increase. On a resistance training perspective, muscles can be trainer by concentrating to metabolic changes or to mechanical loads. (Hulmi, 2017). Mechanical or metabolic stress causes general stress reaction in body which affects endocrine system and hormones. Hormones thereafter affect to muscle hypertrophy, protein synthesis. (Kauranen, 2014, 408-410) Training need to be progressive to be improving. Muscles are adaptive and therefore the type of stimuli is good to change after 6-8 weeks.

The recovery is divided into more detailed sections in the product to remind that recovery is overall process in body. As discussed, muscle cells and fascial got small fragments during training. These are fixed with new cells built from amino acids during recovery (Macdonald 2010, 70-71). This process can occur as overcompensation. Meaning that body over fix the damage. In long run this lead to training results. Metabolic recovery is faster process than cell recovery. Energy stores are filled, metabolic wastes are removed from the muscles and pH is returned to normal level. (Aalto et al. 2014, 114-117) Nervous system is under a stress during hard, intensive workout. Nervous system recovery is not as easily traceable than muscle (muscle ache) or energy recovery (hunger). Above this, psychical and social factors can cause stress to nervous system. Enough sleep and short under 60 min, low-intense sessions done under aerobic level can improve nervous system to recovery. (Aalto et al., 2014, 114-116)

During the thesis process author had problems with the communication to the fitness centre. Therefore, the initial idea of the development process got changed. In the beginning of the process, there was idea of videos played on screen and sponsor clothes worn on the videos marketing some products of the subcontractor of the fitness center. The product changed and the outcome was decided to be simpler, the guide.

9 CONCLUSION

9.1 Aim & Purpose

The purpose of the thesis was to make a scientifically reliable free weight guide for a fitness center. It is a free service for customers to deepen their knowledge of free weight and gym training. The aim was to make an upper body, free weight training guide for ladies to lower the threshold for free weight training and to make the training more familiar. More gym area visits are expected for the fitness center, especially to the free weight training area. The change in the number of gym are visits is not studied or address in the thesis because of time limit and framing of the project. The amount will be seen in the fitness center in future.

For author, the aim was to develop professionally during this project. The process developed author`s professional skills and competences. Physical activity, coaching and health promoting competences were reflected by specializing in free-weight training, gym training, physiology, anatomy, biomechanics and ladies as a target group. Innovation competences were developed with problem solving, customer based thinking, project working and by adapting information and researches to the thesis project. This were mostly seen when author planned and implemented the actual product. Work community competences were improved with communication and working in changing situations. Leading the project, project management skills, self-motivation and independent working improved. From ethical competences, professional ethical principles played a big role during the writing and development process and heterogenous customer group was took into consideration. Taking responsibility and dealing with the consequences developed. Learning competences were mostly developed. Professional skills, learning abilities and habits were developed. Critical thinking was used during the whole process. (KAMK, n.d.)

9.2 Reliability

The guide was to be scientifically reliable. The reliability was maintained by using scientific researches, books, multiple sources and studies with critical thinking. The professional knowledge from the studies, author´s own experience of gym training and working experience as personal trainer set a base for the thesis process which was then build up with more specific information. The background helped keeping the interest and criticism towards the information flow. The actual product was evaluated at many points; at planning phase, after filming, during the edition and after the product was done.

9.2 Ethical issues

The thesis process was started on time but the framing and the final idea of the thesis didn´t fall in place that easily. There were multiple things occurring at the same time with the thesis process which decreased the motivation in some phases, including moving to different city. The thesis process and product were handed over later than planned in the beginning. Fortunately, the commissioning party was understanding.

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