EDUCATIONAL WELLBEING DRIVEN BY DESPECIALIZED CONTEXTUAL DESIGN

by

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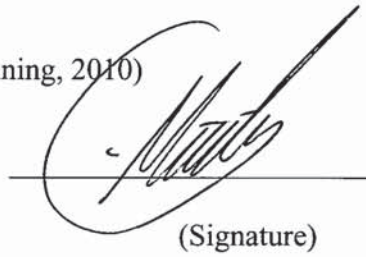

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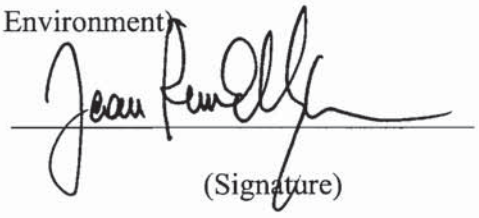

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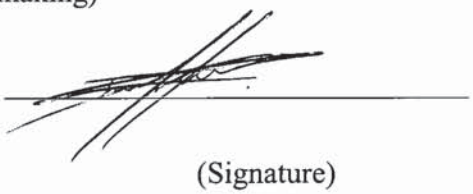

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ABSTRACT

Many university students work in poorly designed facilities, and these environments negatively affect them, by causing physical discomfort and posing a threat to their wellbeing. Additionally, studies show that the physical environment can affect students' wellbeing, satisfaction, and productivity. This research explores the effect of desks in educational facilities on students' wellbeing. It proposes to address the characteristics of desks that would enhance physical wellbeing among students through a despecialized approach.

The research investigates the current state of desks within the three campuses of Notre Dame University- Louaize (NDU). The methodology includes questionnaires regarding students' comfort in classes, and observations of students in classrooms within different durations and course activities. Moreover, anthropometric measurements were taken from the students. The desks and chairs that are commonly used in the university were taken as a sample of the study, and their dimensions were measured to allow a comparison of the students' ergonomic needs with the design features of these desks and chairs.

The research concluded that anthropometric measures should be determined through more detailed studies so that desks can be designed to provide better ergonomic conditions for university students. Guidelines are provided to designers and manufacturers that would provide the protection of the physical and mental health of the users according to ergonomic norms.

1- INTRODUCTION

1.1- BACKGROUND

A significant part of Children's, teenagers', and college students' daily life is devoted (five to ten hours per day) at educational facilities (Cardon, De Clercq, De Bourdeaudhuij, and Breithecker, 2004), where most of this time is spent in class in a sedentary position—sitting for long hours (Tunay and Melemez, 2008). Students generally sit in a forward position, during writing, reading, and painting, whereas a backward position is commonly adopted while resting or listening to the teacher (Savanur, Ghost, and Dhar, 2004). Besides the static posture, poor body positions may trigger discomfort and musculoskeletal complaints, and consequently could affect the students' wellbeing, affecting concentration and motivation.

Furniture-induced postural problems have become to be common. Studies have shown that unfavorable effects on human comfortability are triggered by being restrained to an inappropriate posture as caused by poorly designed furniture for an extended period (Das and Chakrabarti, 2004). Those postural behaviors are maintained by children and teenagers for the rest of their lives (Cardon et al., 2004). Human postures are considered as a major concern since the eighteenth century (Zacharkow, 1988). In the beginning, ergonomics (the systematic analysis of work efficiency relating users to their environment) was deliberated as a military concern. It was extensively applied in the industrial, agricultural, and service sectors since the 1960s (Zacharkow, 1988). Nowadays, ergonomics forms an essential factor in the design of furniture within educational facilities, where classroom seating must meet functionality (Springer, 2010). Even when students sit still, their bodies are constantly moving. Sitting involves

large and small motions. Maintaining balance and slight position changes involve micro motions. Larger macro motions involve moving the arms and legs. Both motions are essential for the physical wellbeing (Jerry, 2012).

The diversity of students' body dimensions or anthropometrics, a systematic study of humans' body proportions, renders the design of appropriate educational facilities furniture a complex matter (Woodham, 2016), where it is not enough to provide a panoply of chairs, desks and tables and let students randomly choose. It is essential to ensure that chairs and desks are properly scaled to fit the size of the individual student. A chair should fit the person who sits on it, and a desk should fit his or her height (Woodham, 2016). Numerous design standards and guidelines have been recommended for classroom furniture in the past (Woodham, 2016). An early approach towards the development of a universal standard of 'ergonomic-centered' classroom furniture was based on the necessity to deliver good sitting postures while in the classroom and includes the ISO5970[1] (International Organization for Standardization, 1979). Researchers have continued to compare their data to the ISO 5970 anthropometric database regardless of the fact that is quite outdated (Jung, 2005, p 12).

Seats and tables, which are referred to as the educational furniture, play a pertinent role in the preservation of a good sitting posture (Corlett, 2006; Murphy, Buckle, and Stubbs, 2004; Saarni, Nygard, and Kaukiainen, 2007). Consequently, anthropometric sizes of students are an imperative aspect that should be considered upon designing university furniture (Ehsanollah, Zahra, and Seyed, 2011; Panagiotopoulou, Christoulas, Papanckolaou, and Mandroukas, 2004). However, there is an absence of conventionality between anthropometric sizes of students and dimensions of furniture

[1] This International Standard specifies the basic functional sizes for seating and tables in educational institutions. It does not include any special requirements that apply to "special schools" or to adjustable furniture. This International Standard does not include requirements for materials, design, construction or quality.

used, where a significant mismatch between the anthropometric measurements of the students and the measurements of the furniture still exists (Ehsanollah et al., 2011; Panagiotopoulou et al., 2004).

Wrongly designed educational seats and tables that do not respect the body proportions of students lead to poor postures, which initiate some physical pain and physiological disorders among students (Chaudhary, Sharma, and Grover, 2004). Moreover, a study concluded that ergonomic mismatch is thought to perform an imperative role upon the development of discomfort and that both mismatch and discomfort levels vary due to many factors such as gender, age, and nationality, potentially resulting from different physical demands, and furniture dimensions (Brewer, Davis, Dunning, and Succop, 2009). Therefore, providing considerable ergonomic furniture is of high importance to improve comfort among users (Cardon et al., 2004).

In addressing ergonomics within furniture design, two industrial designers, Philippe Carreau and Hubert Pelletier proposed the despecialization of objects (Tucci, 2006). The main principal of despecialization of objects addresses the ignored and underrating of objects (poor human-object relationships) caused by post-industrial overabundance. Despecialization is the process by which there is a reverting in an object's function moving it to a more generic state so that it no longer answers a specific need, but instead gratifies a broader range of needs (Carreau, 2004). The two designers believe that a mission to search for ways in which design might work to reframe the terms of people's relationship with objects is a necessity (Carreau,2004). The reason this theory is used in this study is not the main core of despecialization, but its integration of anthropometrics and ergonomics where however one reverts to utilize the object, it remains ergonomic and respects the anthropometric measurements, leading to healthier posture and physical comfort.

Health, performance, motor skills like energy and strength, leisure, and physical activity and other aspects of students' life are fundamentally affected by the act of sitting done by students when done improperly considering it a major part of their lives (American Occupational Therapy Association, 2002). A standard to outline the appropriate furniture characteristics to be used by university students is absent. This situation arises due to the illiteracy to anthropometrics by governmental authorities and the population (American Occupational Therapy Association, 2002). The body of knowledge on educational facilities design is growing with further literature on the correlation between the design and user satisfaction. In light of this new focus, there are countless resources available that speak to students' physical environment. However, very little exists showing the relationship between the physical environment and students' physical wellbeing.

1.2- RESEARCH PURPOSE

Being a student can be looked at as a person's occupation, so the classroom becomes the work place and can be assessed for ergonomics. A decrease in student performance and motivation, and an increased risk of injury are not favorable. Regarding physical factors, Saarni et al. (2007) stated that the furniture in educational facilities raised concern as the cases of neck-shoulder pain and low-back pain increased among students. Saarni et al. (2007, p16) explained that 'a possible factor behind the increase could be sitting for extended periods in stooped, static or otherwise awkward postures at educational facilities'. Moreover, starting from ergonomic design perspective of the product (desk) and using ergonomics knowledge, measurement method and model method are adapted to analyze harmonious relations between people in the sedentary

state and the various parts of the desk. Consequently, further studies on educational furniture is required.

The issue of educational facilities' furniture in not foreign for the Lebanese environment. Being a Master student, and spending three consecutive hours at classroom desks raised a serious problem. A student cannot concentrate if he or she is uncomfortable. This is not only the students' concern, but also the faculty members who are aware of the problem students are facing. This made the study of desks at the Notre Dame University- Louaize (NDU) highly pertinent. No similar studies were done in Lebanon, and no record was found that refers to the ergonomic standards and educational furniture in Lebanon.

This research is an exploratory research that will highlight the concept of anthropometrics and ergonomics in the context of educational furniture in Lebanon. This research will not address all aspects of the classroom environment, and will focus only on educational furniture (the desks). It will tackle the importance of ergonomics and anthropometric data in guiding the researcher to find the possible solution for the Lebanese educational facilities that may be through despecialization, which meets the needs and physical wellbeing of students. The research will explore how educational furniture can affect students and their wellbeing. The effect of educational furniture on students' concentration and motivation will not be addressed, as this requires tackling the psychological wellbeing of the students demonstrated in the realm of learning and achievement.. The result of this study is not intended for global generalization but rather to gather a collection of data and interpretations of the interactions between students and university furniture and use that information to develop new types of furnishings for the classroom that meet with the Lebanese students' physical wellbeing.

The findings of this study add knowledge about ergonomically educational furniture in Lebanon and an additional aspect of a significantly new theory, the despecialization,

1.3- RESEARCH QUESTION

Many students struggle with sitting for long periods of time to receive instruction from an instructor and this is affecting their physical wellbeing (Gestwicki, 1999). Understanding the physical characteristics of the classroom environment that affect students' health and wellbeing is the key requirement underpinning the beneficial design of educational facilities (Knibbs, 2013).

The research question is:

What are the characteristics of educational furniture that affect students' wellbeing and performance specifically in the context of universities in Lebanon and how can they be enhanced?

The research addresses desks within the classrooms setting at Notre Dame University-Louaize (NDU) in Lebanon. In order to answer the research question, several objectives are defined to:

- Describe and analyze a research on the contextual influences of the learning environment aspects on the university students' wellbeing by interpreting it and linking it to the Lebanese context.
- Identify the effect of furniture on students' physical wellbeing by detecting the cause of discomfort among the university students in Lebanon.

- Understand and analyse the theoretical framework adopted by the two industrial designers of the despecialization of objects and its components within the classrooms.
- Establish a relation between despecialization of objects and the classrooms, to explore the possibility of this approach in addressing the concern.
- Analyse the effects of educational furniture by tackling the ergonomics and anthropometric measurements of the students to understand the ideal measurements for the Lebanese students of NDU.

By describing and analyzing the learning environment, the researcher was able to tie the aspects of this environment that affect the wellbeing of the students, to their factors, such as ergonomics. When tackling the ergonomics in the Literature Review, the need of the anthropometric measurements of the students was found to be crucial in order to reach the ideal measurements of the Lebanese students. This was achievable when a data set of measurements of the students' anthropometrics and the dimensions of the used desks were collected as a method in the case study. Not only the data sets, but also questionnaires helped in the detection of discomfort among the NDU students. Here comes the role of the theoretical framework parented, where despecialization treats the users as individuals, and provides their needs using a generic form of design. As this theory was used in an office setting, and because many studies tie office spaces to classrooms under the name of workplace, then despecialization may be used in a classroom setting, applying the measurements of the Lebanese students.

1.4- RESEARCH STRUCTURE

In the literature review, a reliable general knowledge about the topic was built, this helped to refine the ideas and build a strong research case. The research was divided into four major subjects. The first is about the relationship between furniture, educational environment, and the physical wellbeing of students. The second chapter explains the idea of despecialization and its importance and relation to this study. The third and fourth dimensions involve an analysis of anthropometric parameters, and the study of ergonomics. On the ground of this literature, a methodology was developed in chapter three in order to benefit from other countries' experience to the Lebanese case. The following step is about testing the importance of the information factor in an experimental approach. The researcher presente an informative message to the respondents explaining the reason of this research, and the respondents answered an organized survey that questioned their comfortability and satisfaction toward the furniture they are currently using in the university. Moreover, anthropometric measurements were measured from the students of the faculty. The desk and chair that are commonly used in the university was taken as a sample of the study, and their dimensions were measured to allow a comparison of the students' ergonomic needs with the design features of these desks and chairs. Chapter four presents the results of the study that was done in the university. And finally, chapter fivepresents the conclusion driven out of the critical reading and researches done so far, exploring the possibility of despecialization as an approach for the problems that were revealed by the data analysis combined with the Literature Review.

2- LITERATURE REVIEW

2.1- INTRODUCTION

This chapter provides an overview on furniture and the educational environment, furniture and students' wellbeing, the meaning of despecialization of objects and its relation to the study, an analysis of anthropometric parameters, and a study of ergonomics.

2.2- FURNITURE AND EDUCATIONAL ENVIRONMENT

Milne (2006) described the physical learning environment as any private space, such as a car, residence, or other personal space, small group or social work spaces, such as libraries and lounge areas in educational facilities or elsewhere; and transitional spaces, such as buses or lobbies and other temporary learning environments. The lecture room set is the considered learning environment in this study.

It is worth noting that this was the case in the Lebanese educational setting. As stated by Anis Freiha in one of his popular novels 'Ismaa Ya Rida', learning spaces were introduced in the late twentieth century under oak trees (sindiyan) in the villages during the summer, and then pupils moved to small rooms located in the local church or mosque. They used a piece of carved wood (tabliyyeh) as a supporter or desk to place their books and be able to write (Freiha, 1985). In the first half of the twentieth century, inventor-designers in Europe were busy redesigning the educatonal desk, witnessed by an entire battery of approved patents. Between 1900 and 1950, the ministries in Belgium granted 68 patents for educational furniture (Herman et al., 2011). Meanwhile,

the Lebanese pupils were gathering old tables and chairs from their neighborhoods to provide their learning spaces with some decent and more comfortable furniture (Al Rassi, 1983). Beginning with the first public educational facilities, educational design has been limited to a passive nature (Burke et al., 2008). Efforts to experiment with the design of objects used in the classroom were undertaken by Modernists such as Kramer in the 1920s, continuing with Prouve, Lindau, and Lindekrantz, and more recently with Berthier (Burke et al., 2008). These experimentations led to new designs. However, all remained within already existing types of current educational furniture (Figure 2.1 and Figure 2.2).

Figure 2.1: Plywood School Chairs in Frisco Kramer Style. Adapted from Vintage School Chairs by Vintage Furniture & Design Studio. Retrieved from http://www.fuseinteriors.ie/blog/vintage-school-chairs

Regardless of the fact that the negotiation of the physical environment and ergonomic principles in the workplace have been a material of discussion (Miles and Perrewe, 2011; Robertson and Maynard, 2005; Vischer, 2007; Wallace, 2009), less attention has been given to the physical learning environment in the educational setting. Miller (2009) documented the prominence of learning spaces and comfortable surroundings and indicated that comfort is governed by optimal temperature, lighting, and furniture. Miller stated that for 'students, comfort and flexibility positively contribute to their

learning experience' (2009, p 3). Referring to learning environment characteristics, McVey (2001, p 1045) concluded that the learning environment is needed to 'consist of all those physical-sensory elements such as lighting, color, sound, space, furniture, and so on, that characterize the place in which a student is expected to learn' and so stated Higgins et al. (2005). These elements should optimally be pleased. Other studies have elaborated a connection between physical space and focuses on the influence of learning environments wellbeing (Higgins et al., 2005). The learning space has been referred to as a place where 'space and pedagogy are unquestionably intertwined' (Hunley & Schaller, 2009, p 34).

Figure 2.2: School Desk by Jean Prouve. Adapted from School desk | Wright by Architonic. Retrieved from http://www.architonic.com/dcsht/school-desk-wright/4107044

Functional furniture is one standard associated with student comfort and wellbeing. The consequences of inadequate furniture are discomfort, tiredness, and inefficiency and can result in problems of eyestrain, muscle soreness, and injuries from repeated motions (Kennedy, 2012). These kind of pains and discomfort are results of poor designed seat pans, backrests, seat and table height (Kennedy, 2010). Furniture is

required to be comfortable, lightweight, flexible, adjustable, and ergonomically advantaged (Herman Miller Inc., 2009; Hunley and Schaller, 2009; Kennedy, 2010; Timm, 2007; Wroblaski, 2011). As with temperature acclimation, comfort in furniture should reflect and interpret students' individual characteristics, such as age, gender, weight, height, differing body proportions, ethnicity, and individual differences (Bennett et al, 2006; Kennedy, 2012). Considering that much of their time is spent in a sedentary position, substantial attention should be given to students to their seating behaviour and habits (sitting on a chair, leaning on the desk, moving the furniture, rocking in a chair, using supplies, kneeling on chairs, and using the table and desk surface). Their physical health, motor and intuitive skills, and ability to learn can be largely affected by improper seating. (Rudolf and Griffiths, 2009).

Furniture is referred to as both tool and environment. It is an environment by defining any interior displayed setting and a tool by its usage within its explicit function (Cornell, 2002). It is designed, deliberated, and built with a purpose in mind as the case of every artifact. The same case is reported for learning environments that have a clear purpose, and which have been changing by time. Toffler (1970,1980) stated that our lives, work, and behavior were experiencing tremendous change. Accordingly, the understanding of change and development became a common sense. For example, successful leaders are aware of their urge towards learning organizations. Successful educators realize they need to prepare a different strain of citizen. In a sense, work needs to drift towards being more like educational facilities, where learning is an expected part of the job. On the contrary, educational facilities need to become more like work, antedating the kinds of skills and knowledge students will require for a happy and successful life. Work activity, or pedagogy in the case of education, has

changed drastically. Since furniture is a tool with a specific function, it too must change (Cornell, 2002).

2.2.1- Pedagogical Shift

Teaching methods are changing over time due to increased understanding of perception (Gardner, 1983; Reber, 1993), attitudes concerning the nature of knowledge (Davenport and Prusak, 1998; Gardner, 1999), the role of context in learning and behavior (Brown and Duguid, 1997; Suchman, 1987), the prominence of social learning (Ormrod, 1998; Wenger, 1999 cited in Cornell, 2002), and the role of technology in changing and enabling the teaching methods (Chism, 2006) to name few. The fundamental goal of education is to inspire all students to achieve success and fulfillment, and reach their full potential by developing the competencies of engaged thinkers and ethical citizens with an entrepreneurial spirit. This lead to a transformation from traditional to student-centered pedagogy (Cornell, 2002). New methods require new tools and environments. And with every contributing factor stated before, the learning environment was shifting to accommodate with the new method (Wulsin, 2013). It is of great importance to note how there exists a direct effect of classroom furniture on every and each contributing feature detailed before, and that furniture that serve in rapid reorganization of the classroom environment, and flexible furniture are suggestions offered by the authors, for example, tables that accommodate two students working side by side when free-floating can be combined with other tables to create small-group work spaces and large conference tables (Wulsin, 2013). Consequently, after exploring the physical characteristics of a learning environment, furniture is a major factor that affects students' wellbeing.

2.2.2- User-Centered Design

A new category emphasizing the urge to consider the needs and wishes of the intended audience was made by the human factors profession in the 1940s, and in Europe the ergonomics community goes back even further in history. Popularity was gained by user-centered design in the past years. The core of the idea is that design must be constantly driven by the needs of the end-user. When it comes to educational furniture, designers need to be concerned with two kinds of users: instructors and learners. Instructors include teachers, professors, and trainers, and learners include children, teens, and adults (Cornell, 2002).

The main focus of most furniture design is the functional need (Wenger, 1999). It emphasizes aiding users to attain their needs, whether it is relaxation, entertainment, education, or work. In a user-centered approach, and out of many dimensions to consider, functionality is just one of them (Cornell, 2002). Other design objective includes comfort, safety, and health (Cornell, 2002). The design should maintain wellbeing and quality of life. Another dimension is usability. The intended purpose of the given designed furniture and its manoeuvre should be obvious to all users and not complicated. The intention is to prevent accidents and optimize use. Not to forget that the design should have psychological appeal. The user should feel motivated to use the design repeatedly.

2.2.3- Implications of User-Centered Design on Furniture

There are two terms that should be differentiated; human-centered design, and user-centered design. It is supposed that human-centered design is the process of creating

things deeply based on general natural characteristics and peculiarities of human psychology and perception (Hyysalo and Johnson, 2015). Any object of design can be made human-centered on the ground of psychology, physiology, sociology and other sciences analyzing human life and interaction with the environment. It means that human-centered product will be functional according to psychological traits and features typical for big groups of users (Hyysalo and Johnson, 2015).

User-centered design is more focused and concise version of human-centered design with deeper analysis of target audience. It is concentrated on not only human characteristics and perception in general but also specific traits and features of target users to make problem-solving potential of the designed product as high as possible in perspective of its users. This is the stage when details about the target user of design object start playing their role: defining target audience, designer takes into account age, gender and social status, potential education level and professional background, influential social factors and typical environments of product usage and so on. On this basis, designer makes deeper research on preferences and peculiarities, special aspects of interactions, specifying general human-centered ideas with important details of target audience's preferences, emotional and physical perception traits as well as levels of technology awareness and tons of other factors (Hyysalo and Johnson, 2015).

The six dimensions that are of great importance to furniture user-centered design are: comfort, safety, health, usability, psychological appeal, and functionality. As cited by Odunaiya (2014), McVey (1996) provides an excellent overview of how these magnitudes come together. In the following, however, the focus will be on furniture.

Comfort, Safety, and Health: The intent of addressing comfort, safety, and health needs is to promote wellbeing. The aim is that the students should be able together with

their instructors to work in a safe, efficient and comfortable way. Even when they sit, they should still be able to move, without the distress of affecting on their safety or to be under pain (Zunjic et al, 2015).

Usability: Clarity, ease of use, access, and control are all part of usability. A product may be highly functional and ergonomically designed. Usability can be achieved in several ways. The best way is to track industry standards or common practice. If no such model exists, the design should be automatically obvious. However, furniture controls cannot be standardized. The operation and location of levers, buttons, and knobs vary within as well as between producers (Cornell, 2002).

Psychological Appeal: Learning is a social process. Networking and relationships are key to learning. Thus, more than ever, the environment must be appealing, drawing people in. When people feel comfortable and appreciated they will come, stay, and return. The fit and finish of furnishings also convey a message. Dull, official, and otherwise ugly furnishings do not motivate people to stay. Nicely chosen furnishings convey a message of trust and respect that is mutual between owner and visitor (Cornell and Martin, 1999). The space predisposes people to certain kinds of behavior. Brooks (2012) suggested that the space directly effects on learning among students. A fixed, eyes forward arrangement says the environment is one for listening, not interaction. Putting furniture on casters indicates that the room is reconfigurable. Chairs that are adjustable convey a concern for the users and their comfort. Tables arranged in clusters, facing one another, suggest collaboration (Cornell and Martin, 1999).

Functionality: The user-centered design criterion that gets the most consideration is functionality. Furniture should help the instructor and student achieve their goals using

the approaches and tools of their choice. Furniture should ease learning, not just be a place to sit (Ormrod, 1998).

Regardless of any of its other characteristics, a piece of furniture should be functionally fit for purpose (Lawson, 2013). There are of course faults and annoyances in furniture performance that people are prepared to put up with because it may be useful in other aspects, but overall, designers should have discovered and edited out these mistakes at the development stage, rather than discovering them in the final product when it is too late (Lawson, 2013)

The user-centered approach suggests that design is multidimensional. While functional requirements are usually the most pressing and challenging, all issues must be incorporated into the design (Cornell, 2002).

Upon categorizing furniture and objects in the classroom, chairs and desks and tables are listed under a limited number of categories. Focusing and relying mainly on utilizing the previously mentioned objects to solve problems and applying them to offer design solutions have been a major point of criticism used against designers (Colguhoun, 1969, sited by Brooker, 2011). Tradition, habit, and imitation limit the process of designing objects based on the presumed needs of a society. There is an approach adopted by designers translated by the assumption that what worked before should work again and predominantly in relation to the classroom and its furniture, they find it troubling to divert from the nostalgic meaning and memories instilled in the traditional furniture. Although, upon the alteration in the user needs and developmental changes the creation of new meaning is what should be introduced at all time during design. Colguhoun (1969) refuted the assumption that a fixed and immutable relationship exists between form and meaning, in that both the use and interpretations

on the part of the individual user vary. This strict hold on traditional design has been responsible for the relatively small changes in educational furniture over the years.

Much attention on the needs of the end-users was centered by successful designers through utilizing a user-centered design approach to create new meaning and forms (Cornell, 2002). However, a misinterpretation is recorded in the practice of a user-based design approach, with designers often directing their focus on the ease of functionality of the piece (Cornell, 2002). The aim of adopting the user-based design process is not in the produced tangible product, but rather about the successful allowance of "creative positive, rich and meaningful user experiences" that result from the interactions with the products (McDonagh, Denton, and Chapman 2009, p 433).

Taking into consideration all the conditions and situations they might have or face, learners need to be treated as individual. To accommodate this, the learning environment needs to be a place of their choice not an obligation. For its part, furniture needs to be more comfortable, adjustable, intuitive, reconfigurable, technology-capable, compressible, and attractive. When its design incorporates ergonomics, usability, and functionality, furniture will help teachers and students achieve their learning objectives. Making furniture user-centered will enhance the overall experience. If properly designed and placed, furniture is more than a place to sit; it can be a strategic asset by providing all means of comfort for users, highlighting on the fact that this piece of furniture can be used in different areas inside the educational premises reflecting a modern classy sophisticated image for the university itself in front of new freshmen students, visitors, and to whom might be interested in evaluating this facility.

2.3- EDUCATIONAL FURNITURE AND STUDENTS' WELLBEING

The built environment can have significant consequence on the wellbeing of users (Scott-Webber, 2004). Irrespective of its function, the influence of a building on its users could either be positive or negative. Where its design and associated facilities effectively support the building function and provide suitable working condition, it positively affects the users. Considering the importance of the workplace, further research is needed on the effects of the indoor environment on productivity and satisfaction. It therefore seems that the design of the workplace is barely regarded as a strategy for productivity enhancement (Rashid et al., 2017). As Roelofsen (2002, p35) stated 'improvements in workplace reduce complaints and absenteeism and raise productivity'. Smith et al. (2011) highlighted the need to design workplaces that positively influence their users, stating that there are many factors that affect the influence, such as lighting, thermal environment, air quality, furniture and sound level. Moreover, buildings can have negative influence by constraining user behaviour (Monahan, 2000) or through their potential to cause stress and eventually affect human health (Evans and McCoy, 1998).

One of the conditions to support productivity is to ensure that the work spaces and equipment that people use conform to the anthropometric and biomechanical characteristics of the users. Anthropometric data are used in ergonomics to specify the physical dimensions of work spaces, equipment, furniture, and clothing (Tunay, 2008). Appropriate use of anthropometry in design may improve the wellbeing, health, comfort, and safety of a product's users (Barroso et al., 2005). The use of poorly designed furniture, especially school and university desks and tables, that fails to account for the anthropometric characteristics of its users has a negative influence on human health (Watson et al., 2002). Also, students suffer from backaches and a

considerable amount of research was conducted on this matter (Burton et al., 1996; Watson et al., 2002; Murphy et al., 2004). The student's sitting posture is predisposed by the activities performed in the classroom, but also by the anthropometric measures and the measurements and design features of the classroom furniture they use (Yeats, 1997; Panagiotopoulou et al., 2004).

Because students spend more time at the educational facilities than any other place, it can therefore be definite that students learning environment can be stated as their workplaces, and therefore can influence their behaviour, comfort, health and productivity. In a curriculum of three years for example, a student may spend 160 days per year (academic year), for four hours a day. This is bound to impact on their academic output or achievement and satisfaction with academic life. Studies have shown that the workplace environment influences users (Bluyssen et al., 2011; Felsten, 2009; Huang et al., 2004; Roelofsen, 2002). Taking into consideration that this suggestion is true, the specific aspects of buildings through which the influence is exerted were stated by Muhammad et al. (2013), and furniture came on the top of the list.

Wellbeing is a complex construct that concerns ideal experience and functioning. Research on wellbeing has been derived from two general perspectives. The first perspective is the hedonic approach, which focuses on happiness and defines wellbeing in terms of pleasure accomplishment and pain avoidance, it equates wellbeing with pleasure and happiness (Kahneman et al. 1999; Ryan and Deci 2001). The second perspective is the eudaimonic approach, which focuses on meaning and self-realization and defines wellbeing in terms of the point to which a person is fully functioning, and conceptualizes wellbeing in terms of the cultivation of personal strengths and contribution to the greater good (Aristotle, trans. 2000). As stated by McMahan (2011),

acting in accordance with one's inner nature and deeply held values (Waterman 1993), the realization of one's true potential (Ryff and Keyes 1995), and the experience of purpose or meaning in life (Ryff 1989) are all related to the eudaimonic approach. These two views have given rise to different research emphases and a body of knowledge that is in some areas different and in others complementary (Ryan and Deci, 2001). Despite significant attention to conceptualizing and evaluating wellbeing in academic and in policy circles, wellbeing remains a narrowly defined, if not undefined, term in education, complicating efforts to plan for and monitor it effectively (Ereaut and Whiting, 2008; Fraillon, 2004; Konu and Rimpela, 2002). Often, assessment of youth wellbeing in the educational context involve quantifiable metrics such as grades, test scores, and attendance records. However, following the introduction of the Global School Health Initiative (World Health Organization, 1998), there has been increased attention in the education sector to conceptualizing student wellbeing in broader terms. Examples of emerging policy and programming relate student wellbeing to constructs such as physical and mental health, risk reduction and resilience, and have also focused on conditions, contexts and climates that facilitate healthy education such as safety, building environment, and relationships for example (Allensworth and Kolbe, 1987; ASCD, 2011; Barnekow et al., 2006; Board, 2008; Buddeberg-Fischer, Klaghofer, Reed, and Buddeberg, 2000).

Knowing that the concept of wellbeing is difficult to define, the term is centred on people and their priorities and perspectives (White, 2010). Wellbeing is an all-inclusive view of the health of individuals and groups of people that goes beyond a biomedical perspective, where it doesn't only focuses on purely biological factors, but includes multiple dimensions such as physical, spiritual, emotional, social, intellectual, and environmental influences. It is generally used to refer to a subjective experience

rather than a state that can be measured objectively (Oxford, 2017). Current psychiatric study and practice highlight measurement of operationalized variables, quantification, and difficult theory testing (Nakaya et al., 2002). The fact that mental states can be subjectively practiced and that thoughts can denote to things and events outside the mind suggests that such objectifying methods alone may not provide a complete approach to wellbeing (Bull, 1998 cited in Nakaya et al., 2002). The wellbeing of an individual can be expressed in terms of certain aspects of the physical environment such as furniture thermal factors, lighting aspects and so on. The lack of environmental quality constitutes a risk to individual's wellbeing (Moser, 2009). Human-friendly environments support people so that they achieve their goals, and so, their potential to positively impact on their subjective wellbeing (Horelli, 2006). A building may have an influence on the quality of life of users through their physical condition and the environment surrounding it (Ng et al., 2005). Hence, efforts intended to ensure that academic buildings meet the purpose for which they are provided should focus the needs and priorities of students.

One of the measurements of wellbeing concerns how people are satisfied with their access to services, facilities, their views on the physical environment and how they perceive their social location (White, 2010). One of the features that are of high importance to the wellbeing and overall achievement of students during their study life is Quality of College Life (QCL). The term refers to the overall feeling of gratification students experience in college (Yu and Lee, 2008). Studies found that satisfaction with university's facilities services, among others, have a positive influence on quality of college life of students. Findings also indicate that quality of college life is influenced by services that students interact with more often. Academic buildings being one of the

facilities frequently used by students would influence the quality of life of students (Yu and Lee, 2008; Sirgy et al., 2007; Ng, 2005).

Sirgy et al. (2007) developed a conceptual model for Quality of College Life (QCL) of students. According to the model, the QCL of students is predisposed by gratification with academic aspects and social aspects of students' college experience, which they are influenced by satisfaction with facilities and services provided. Certain aspects that would lead to satisfaction with various types of facilities such as academic building need to be recognized so that the model identifies that satisfaction with facilities that have impact on students' quality of life. Improving upon such aspects of academic building will result in more fulfilment and later positive influence on quality of college life. This suggests that it is necessary to prioritise on enhancing students' academic buildings emphasizing on the aspects of internal environmental conditions.

Many aspects of indoor environment such as furniture, thermal factors, lighting aspects, moisture, noise, particulates and so on are stressors whose contact can cause both short-term and long-term effect that influences the user activities. (Bluyssen et al., 2011). Muhammad et al. (2013) indicate that it is important to identify the factors influencing students' wellbeing in academic buildings based on aspect of indoor environment. Based on a detailed reading and analysis of their study as well as related literature, six categories emerged: comfort; health and safety; access and quality of facilities; space provision and adequacy; participation and inclusiveness; interaction. As mentioned by Muhammad et al. (2013), furniture is among the most emphasized aspects of internal environmental conditions that are mentioned in four out of the six categories. It is one of the aspects emphasized by respondents regarding comfort. Muhammad et al. (2013) describes suitable furniture as one of the facilities that make students to enjoy their

study. This is because learning or study is an activity that involves sitting for many hours on a daily basis.

The core objective of educational furniture is to facilitate the learning process by providing a comfortable and stress-free workstation. The general interpretation among researchers is that sitting in fixed-type tables and chairs manifest to the development of constrained postures (Grimes and Legg, 2004). Several studies have explored the postural problems related to educational furniture and its design (Parcells et al., 1999; Milanese and Grimmer, 2004; Murphy et al., 2004; Gouvali and Boudolos, 2006), and concluded that there is a relation between the given furniture and the postural problems students faced. Traditional chairs and tables obliged the students to sit in awkward positions (Hanninen and Koskelo, 2003). According to Gouvali et al. (2006), students are subject to a risk from poorly designed and ill-fitting furniture, especially after considering the extended periods of sitting. Grimes and Legg (2004) stated that with expectations and emphasis on greater educational achievements, the duration of sitting is most likely to increase. Muhammad et al. (2013) stated that suitable furniture is one of the facilities' aspects that make students enjoy their study. As to combining and correlating the health-related consequences of bad posture and poor seating coupled with long periods of immobility, the development of lower back pain is definitely a consequence (Grimes and Legg, 2004). Hence, discomfort resulting from furniture can potentially reduce the time spent concentrating in class and affects students' physical wellbeing (Muhammad et al., 2013).

The desk is very important to students' wellbeing because that is what they sit on to study. Desks of certain specification make students uncomfortable. Obviously, due to differences in body size and height, students may need slightly different furniture specification. The best way to address the issue is by ensuring that appropriate

ergonomic standards are applied with regard to furniture for educational buildings. There may be few cases of students with 'special' body features such as very tall or very fat. Such students may not be comfortable with furniture designed using standard specification. That's where students need to be treated as individuals and the anthropometric parameters' role interferes in such study and becomes one major factor.

2.4- DESPECIALIZATION OF OBJECTS

The despecialization theory was parented by the two industrial designers, Carreau and Pelletier. Despecialization is the process of reverting an object's function to a more generic so it satisfies a broader spectrum of needs. The two designers search for ways in which design might reframe the terms of our relationship with objects (2004). Within the context of the domestic interior environment, Carreau and Pelletier explain that the problem is caused by the presence of too many objects and that too many of them are specialized. In interior environments, various needs generally translate into a need for numerous objects; each created to accommodate a specific function yet being ergonomic (Tucci, 2006).

Ergonomics refer the accommodation of various human dimensions and shapes into the design of objects so that the object may be used comfortably and safely (Braunstein, 2000). Because human proportions and shapes were integrated in the generative design, the concept of despecialization is taken in this study as a corner stone for the design of university desk.

As mentioned before (2.2.3- Implications of User Centered Design on Furniture p 11), people have always developed a relationship with the objects they possess; a physical, psychological, emotional and spiritual connection with objects (Prown, 2002). 'Objects

of consumption are always culturally meaningful and have been used at all times to reproduce social identities culturally' (Slator, 1997, p 5). The fundamental premise of material culture is that objects have meaning, even utilitarian objects (Hebdige, 1979, Prown, 2002). People physically interact with all objects, whether statically or dynamically. When someone sits on a chair, they change their body position to conform to the chair, and in return the chair supports the weight of the body. As soon as the person can operate the chair to best fit their physical needs, the physical relationship becomes dynamic. This could be as simple as turning the chair around, or even standing on it to reach something up high. The physical aspect of the relationship is purely utilitarian, but the physical relationship can quickly develop into a psychological and emotional dependence.

The human-object interaction and relationship is not a new idea. The Arts and Crafts movement, established as a reaction to the effects of nineteenth century industrialization and the Victorian aesthetic, reshaped modern sensibilities about design and underscored the importance of well-crafted objects, spaces, and buildings (Bhaskaran, 2005). In addition, practitioners of Arts and Craft movement–John Ruskin and William Morris–sought to reform society through good design and, in so doing, suggested shifts in human-object relationships and in subtle ways, indicated a deepening consciousness of the designers in realizing that the products they designed impacted the quality of life for both maker and user.

Reflecting on the Arts and Crafts movement, it is clear that the clean lines and the respect for materiality directly influenced later design aesthetics, but more importantly, the movement brought forth the self-conscious designer, one who realized that their ideals and products affected society and individual (Bhaskaran, 2005), and in return

affected on Carreau and Pelletier perspective and the way they see how a piece of furniture should be designed (Tucci, 2006).

'*Faced with supersaturation, designers often inappropriately try to perfect things through specialization, by giving objects greater distinctive, expressive, and aesthetic qualities. As a result, paradoxically this exacerbates the banalizing and anesthetizing process. We believe that we must search for ways in which design might reframe the terms of our relationship with objects*' (Carreau, 2004, p 16).

Carreau and Pelletier (2004) explain that the problem is caused by the presence of too many objects and that too many of them are specialized. In interior environments, various needs generally translate into a need for numerous objects; each created to accommodate a specific function. Baudrillard's (1968, p 88) view supports their claim: 'The current trend, moreover, is by no means to rectify this inconsistency but, rather, to meet successive needs by introducing new objects'. The result is that each object added to the sum of objects may be adequate to its own function but work against the whole; it even happens that a new object will be adequate to its functions while at the same time working against it.

Carreau and Pelletier (2004) suggest that this hyper-specialization; that is the over limited scope and functionality given to everyday tools; often causes an unnecessary fragmentation of functions and that people must find ways to simplify, decreasing the number of used and discarded objects, generating new socially and ecologically responsible ways of living. They propose that in order to simplify, people must live with less without having to lose the functions provided served by numerous specialized objects (Carreau, 2004). They argue that the despecialization of objects would enable people to live with less while not compromising functionality. To sum up, Carreau and

Pelletier propose to rethink the design of furniture, décor items, and gadgets to change human-object relationships to curb over-consumption and, in return, affect positive change to the environment.

Interior objects fulfill very basic functions requiring simple means. For example, the function to provide seating simply requires a supportive surface for someone to lean on. The floor accomplishes this function, let alone an object such as a box or a chair. Also, other objects, besides interior ones, that address more complicated tasks such as electronics, vehicles and even hand tools may benefit from a less explicit and more generic approach to functionality (Tucci, 2006).

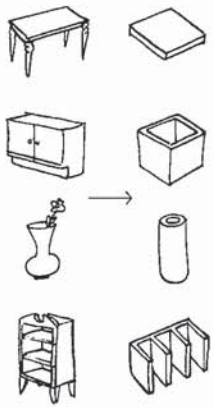


Figure 2.3: Existing furniture broken down to Fundamental forms (Carreau, 2004)

Figure 2.4: Carreau and Pelletier's despecialized objects (Carreau, 2004) online, (https://libres.uncg.edu/ir/uncg/f/umi-uncg-1257.pdf)

The two designers developed a series of despecialized tool-objects and comfort-objects. The development process began by isolating the primary functions of a living room, such as sitting, containing, and arranging; and then breaking existing objects that serve these functions down into their elementary forms; planes, containers, and cylinders. Using these elementary forms as a basic vocabulary, they reassembled them into new

clusters, within one object, attempting to avoid predetermined specific functions while favoring a variety of possible uses. As a result of the exploratory design process, they created three tool-objects and two comfort-objects (Tucci, 2006).

The three tool-objects consisted of varied combinations of simple geometric shapes and enclosures (Figure 2.3) They describe their work as follows (Carreau, 2004): 'Our objects are not a collection of functions (like the Swiss Army Knife), but are truly autonomous objects embodied in a single monolithic volume. Since they all came from the same shaping process, we can find in the Tools a cohesion supported by the consistency of details like wall thickness, chamfers at the end of cylinders, filler radii, etc. However, even if the formal approach creates a strong visual cohesion amongst the objects, each has its own dominant geometric structure, its own specific personality' (Figure 2.4). The two comfort objects are almost one in the same. They designed the "Litho chair" and its counterpart, a floor cushion that is the soft version of the chair (Tucci, 2006). The design context (physical setting), the qualifiers (filters) and ergonomics (human factors) were the three primary sets of parameters defined and enforced.

However, the serendipitous generative design process begins with no functional or formal intent, but relies on the wandering of the design hand (Tucci, 2006). Thus, from the beginning and throughout the generative process, there were few design parameters such as: functions, shapes, dimensions, scale, materials, finishes, and so on. The design context (physical setting), the qualifiers (filters) and ergonomics (human factors) were the three sets of parameters defined and enforced later, during the design process, and after filtering the shape, function and scale (Tucci, 2006).

Despecialization seeks to make objects more useful to people by dissociating a specific function from an object allowing the user to define the use as they see fit. In order to make an interior object more useful than a typical specialized object, despecialization involves suspending the intent of incorporating function criteria to a later stage in the generative design process. When the object is unfamiliar, the user's relationship with the object changes. Instead of the object imposing a function upon the user, the user can creatively attribute a use to the object by choosing its orientation and function.

Despecialization means to remove function from the original intent. However, this is deceiving because the reason for despecializing an object is to embrace functional possibilities, freeing an object from the limitations of a specific task, chosen by the designer. If function is removed from the designed object, it becomes a sole artistic endeavor. This is not the case though. Despecialization seeks to make objects more useful to people by disassociating a specific function from an object allowing the user to define the use as they see fit (Tucci, 2006).

The complete avoidance of recognizable objects, a fundamental principle in despecialization, conflicts with Umberto Eco's findings that objects should not be void of familiarity. He states:

'The form of the object must, besides making the function possible, denote that function clearly enough to make it practicable as well as desirable, clearly enough to dispose one to the actions through which it would be fulfilled' (1997, p. 186).

Umberto Eco's premises are based on the theory that all objects are communication devices. Influenced by cultural training, an object's form denotes their function and connotes their social meaning, even when they are not being used. The objective of despecialization to design furniture without familiar furniture archetypes to the extreme

that the object would have no intended orientation, results in a generic form, unfamiliar to a user. At the end of Umberto Eco's argument, he suggests that designers create objects with denotation in mind so that a culturally untrained users from different profiles and backgrounds (1997). Despecialization has the potential to remove all familiar clues to its function and thus render the object without denotation and consequently without use. Therefore, the despecialization of objects must seek creating a well-balanced object that has versatility, instilled by a generic form, while still offering clues to its possible functions, familiar but not familiar (Tucci, 2006).

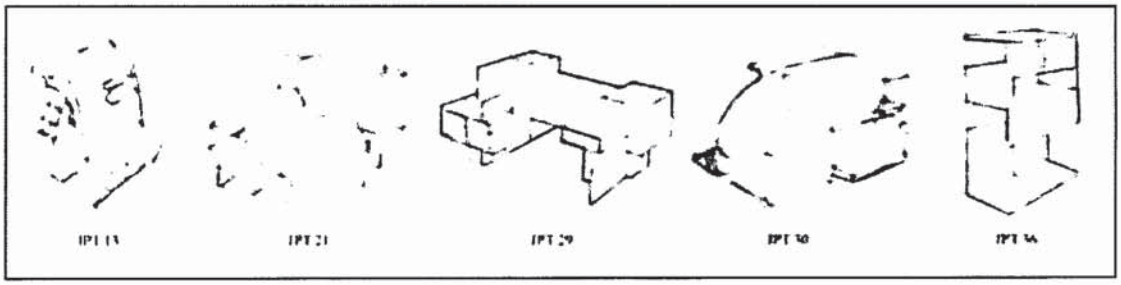


Figure 2.5: Sketches of the transformation of the office furniture done by Tucci (2006)

Tucci (2006) chose the office as the design context offered the opportunity to explore other design options, such as scale, and as a continuation of Carreau and Pelletier's research (figure 2.5). After determining the design context, the three qualifiers–workers, spacers and comforters–introduced by the designers, were further defined beyond the general definitions. The task involved listing characteristics of each qualifier that distinguished it from the other two. To avoid the qualifiers from affecting on specific characteristics in the objects, the descriptions were goal oriented and left open for interpretation. For example: offer work surface, contain, organize, manage objects and display, describe the characteristics of workers.

The final outcome of this design investigation, the prototype variant, achieves, on some level, despecialization status. The piece of furniture presented by Tucci succeeds in

functioning as a spacer, worker, and comforter without conventionally representing a known furniture type. In its horizontal position, it acts primarily as a comforter. The curvilinear form offers varied seating positions, while the flat horizontal surface acts as a low table or even additional seating. In the upright position, it acts as a worker, offering a work surface and shelving for storage. While in any of the vertical positions, the tall narrow shape allows the prototype to perform as a spacer, dividing space and when in the horizontal position it performs as spacer combining space. The low height and available seating in the horizontal orientation offers the potential of creating communal space by enabling multiple users to sit at once (Figure 2.6). Also, there is no intended position for storage. When it is placed in any orientation the ribbon form of the geometric base still affords storage opportunities (Tucci, 2006).

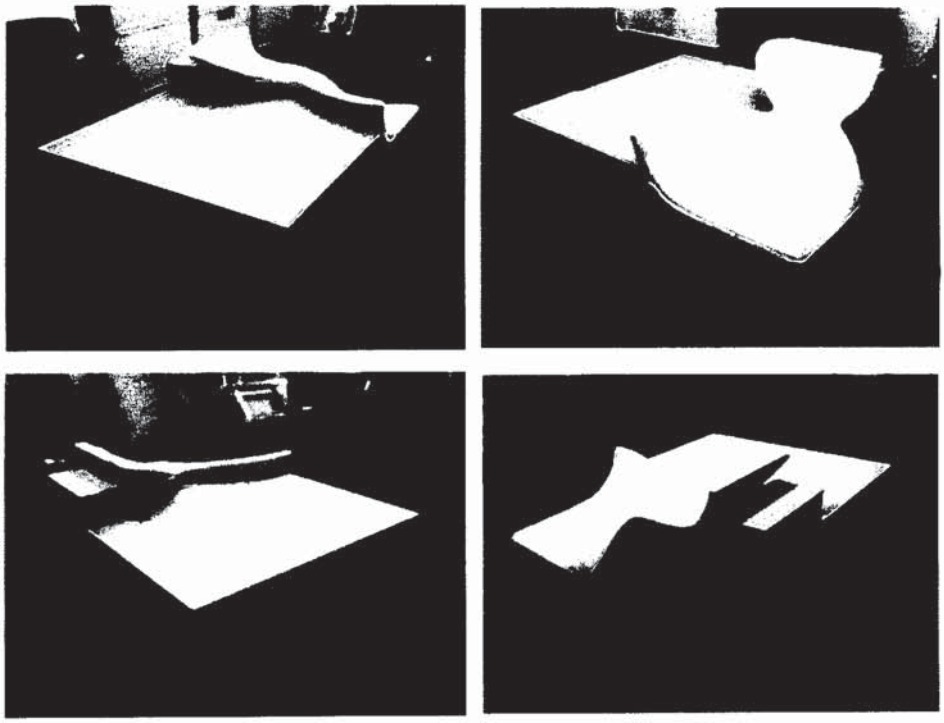


Figure 2.6: four views of the rough prototype created by Tucci representing the despecialized office furniture (Tucci, 2006).

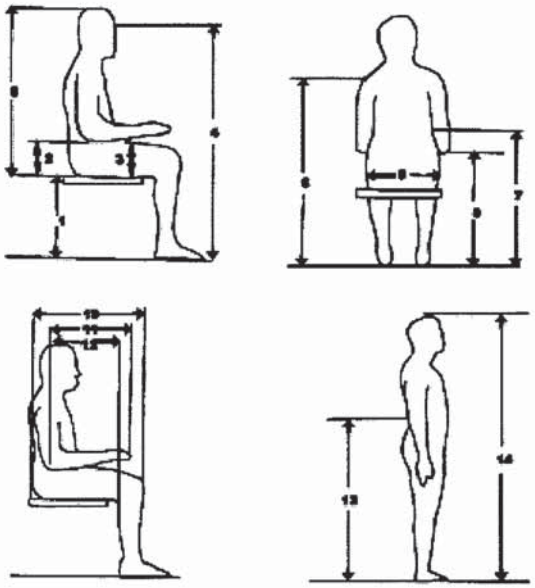
This investigation of the topic has dealt with the problem of ergonomics in a theoretical manner, despecialization of objects, proposing a possible way to apply the theory in a

serendipitous generative method. The research has provided a method for accomplishing despecialization based on the premise that despecialization is the solution to achieve ergonomics, providing a rich, creative, flexible and independent design.

2.5- ANTHROPOMETRY- An analysis of anthropometric parameters

Anthropometry is an universally applicable, inexpensive, and non-invasive method available to evaluate the measurements of the human body size, proportions, and composition (Salkind, 2006). Anthropometric parameters are one of the important reference in deriving chair dimensions and in designing comfortable furniture for students, even though the design requirements for seating are different for students (Straker et al., 2006). According to Evans et al. (1992, and cited in Munasinghe et al. 2010), there is inadequate evidence on whether educational furniture is responsible for students' discomfort, and whether discomfort can be related to an incongruity between an individual's anthropometry and the dimensions of that individual's chair and desk. However, Grimes and Legg (2004) found out that a mismatch between thigh length and seat depth is significantly related to general sitting discomfort, and a mismatch in seated elbow height and desk height is significantly related to reported neck and shoulder pain. The bodily dimensions of the user population are of primary importance in the design of workstations (Helander et al., 1987) to accommodate healthy and comfortable posture. Nissinen et al. (1994) stated that anthropometric measurements have also been taken to be a predictor of low back pain, although their role seems modest. According to Balague et al. (1993), the anthropometric parameters are one of the factors associated with physical discomfort (Munasinghe et al., 2010).

Anthropometric data have been used in the design of desks and tables in almost all modern developed countries (Parcells et al., 1999). Specific measurements such as popliteal height, knee height, buttock to popliteal length and elbow height are necessary to determine the dimensions of classrooms furniture that will enable students to maintain the correct sitting posture (Knight and Noyes, 1999; Parcells et al., 1999; Panagiotopoulou et al., 2004).



1. Seat surface height
2. Elbow height, sitting
3. Thigh clearance
4. Eye height, sitting
5. Sitting height
6. Shoulder height, sitting
7. Lowest rib bone height, sitting
8. Upper hip bone height, sitting
9. Hip breadth
10. Buttock knee length
11. Forearm finger tip length
12. Buttock popliteal length
13. Elbow height, standing
14. Stature

Figure 2.7: illustrations of 14 anthropometric dimensions (Munasinghe et al., 2010).

With reference to Ghazzilla et al, (2010) the following anthropometric measurements (Fig 2.7) were taken over a period of seven minutes for each participant: height, elbow

height, shoulder height, upper arm length, knee height, popliteal height, buttock-popliteal height.

The following measurements were taken from the furniture in the lecture theaters: seat height, seat depth, seat slope, desk height, desk clearance, desk slope.

Melemez and Tunay (2008) shed the light on the necessary anthropometric measurements of classroom furniture used in higher education. According to anthropometric measurements, and following the comparison between the taken dimensions of desks and chairs, it was observed that there was a mismatch between popliteal height and seat height, knee height and desk clearance, buttock to popliteal length and seat depth. The percentile values regarding the ergonomic design of educational desks and chairs in their classrooms were presented. The results show that there are significant differences between the anthropometric measures of Turkish students and other nations compared (Melemez and Tunay, 2008).

Uncomfortable postures could be painful and agonising due to the prolonged periods students spend at educational facilities (Aagaard- Hansen and Storr-Paulsen, 1995; Murphy et al., 2004) and several researchers have reported posture-related syndromes in students (Knight and Noyes, 1999; Milanese and Grimmer, 2004; Troussier et al., 1999). Moreover, it is possible that those postural behaviors might accompany students for the rest of their lives (Cardon et al., 2004).

Molenbroek et al. (2003) stated that, based on anthropometric data, every country can design fitting furniture for students. To accomplish this, it requires up-to-date measures from the relevant population, including at least 40 subjects from each age group and gender. They further attempted to apply such a system to Dutch, English and German students (Molenbroek et al., 2003). However, the existing anthropometric data cannot

be properly utilized by any population because of two major restraints: racial/ethnic and socio-economic differences in anthropometry, as well as periodic changes in anthropometry (Corlett and Clark, 1995; Evans et al., 1988; Molenbroek et al., 2003).

Another study carried by Melemez and Tunay (2010) showed that anthropometric measures vary widely among nations and within nations. Anthropometric measures should thus be determined through more detailed studies so that desks can be designed to provide better ergonomic conditions for university students. Despite this problem, it remains an obligation for manufacturers to account for anthropometric data in the design of their products. Manufacturers need guidelines to the protection of the physical and mental health of the users of their products depends on using equipment that has been produced according to ergonomic norms.

Furniture that is planned for use by adults should be designed for approximately 90 per cent of the adult population, that is between the 5th (female) and 95th (male) percentile of the population's physical characteristics. Furniture dimensions that are fixed (not adjustable), can be made ergonomic for the most common/50th percentile males and females (Lawson, 2013). However, it is more usually appropriate to design for the upper end of the percentile range rather than the middle or most common, since oversized furniture can more easily be accommodated by users than that which is undersized. It is worth to mention that no one is an exact percentile in all measures, that is a certain height does not determine a corresponding leg length or arm reach – people are instead a combination of various arm lengths, elbow heights, lumbar depths, and so on (Lawson, 2013).

This study will provide data on the anthropometric dimensions of Lebanese university students, which hence help creating the relationship between man (students in the case

of this study) and machinery (educational furniture), creating guidelines to the design of ergonomic future equipment to be used in the classrooms, libraries, laboratories, and theaters or conference halls of universities.

2.6- ERGONOMICS- Ergonomic design of classroom furniture for university students

Ergonomics is an area which has been of concern in both building structure and furniture, yet has failed to be continually updated to project current standards (Legg, 2007, Woodcock, 2007). Many concerns in the creation of product have added to not only limitations in educational product choices but have also allowed for the ignorance and sometimes neglect of basic ergonomics in the design of educational furniture (Burke et al., 2008).

The International Ergonomics Association (IEA) (2000, para 1) defined ergonomics as 'the scientific discipline concerned with the understanding of the interactions among humans and other elements of a system, and the profession that applies theoretical principles, data and methods to design in order to optimize wellbeing and overall performance'. McVey (2001) simplified IEA's definition of ergonomics as 'the study of relationship between people, the work they perform, and the environment in which such mental and physical activities take place' (p 1045).

The term ergonomics is derived from two Greek words: *ergos* meaning work, and *nomo* meaning natural law (IEA, 2000; Pheasant, 1991). The study of ergonomics is believed to have begun in the 15th century when Leonardo de Vinci studied human anatomy and physics. The study of ergonomics in education began in the 1920s as a graduate study on student posture and classroom furniture (Bennett, 1928, as cited in McVey, 2001).

However, the subject did not gain wide interest until the 1950s with a series of studies and publications from Harmon (as cited in McVey, 2001) on the physical effects of the educational environment (McVey, 2001) and pioneering reports by Smith and Smith in 1966 (Legg, 2007).

Researchers agreed that little attention had been paid to ergonomics in educational facilities (Bennett, Woodcock, and Tien, 2006; Legg, 2007), although the study and implementation of ergonomic practices was 'long . . . considered essential in the workplace' (Grayson, 2009, p 15). Bennett et al. (2006) indicated that ergonomics in the educational environment setting had several purposes: to implement new designs, improve current practices, protect learners' health, and enhance the learning and instructional environments. The original concept of educational ergonomics was introduced by Henry Kao; in his 1976 paper (Benedyk et al., 2008), Kao recognized the potential to apply an ergonomic work systems approach to the field of education. He outlined an interdisciplinary field of educational ergonomics that provided a systems approach to educational effectiveness. Kao saw educational institutions as essentially 'work systems where the objectives include effective and successful dissemination of knowledge and cultivation of intellectual sophistication' (Kao, 1976, p 37). More recently, Woodcock (2007) has clarified that there are two strands of activity known as educational ergonomics: the 'teaching of ergonomics and the design of environments where teaching and learning occur'. Further, the focus in this design activity has too often been confusing, due to the different needs of instructors and students.

Cornell University (2015) created an ergonomics website (CUErgo[2]) that offers information from research studies and class work from faculty and students in the

[2] http://ergo.human.cornell.edu/

Cornell Human Factors and Ergonomics Research Group (CHFERG). The stated purpose of the website was to 'focus on ways to enhance usability by improving the ergonomic design of hardware, software, and workplaces, to enhance people's comfort, performance and health' (Cornell University, 2015, para 1). Sustained efforts are being made by several organizations to endorse the science of ergonomics in the workplace (Mayo Foundation for Medical Education and Research, 2015).

The improvement and implementation of ergonomics has long been given attention in the workplace as an approach for avoidance of injury and discomfort (Grayson, 2009; Mayo Foundation for Medical Education and Research, 2015). Ergonomics in the work environment protects workers from injury and stress and provides environmental support to workers upon performing specific tasks and activities (Vischer, 2007). Workplace ergonomic approaches have improved productivity and employee morale, minimized safety and health hazards, and positively impacted companies' finances (Dul et al., 2012; Miles and Perrewe, 2011). However, ergonomics has been little researched in educational environment settings (Grayson, 2009). As ergonomics has slowly been addressed in educational facilities, the focus of ergonomics has been on optimization of new designs; improvement of existing space, equipment; and enhancement of comfort, safety, and usability (Bennett et al., 2006). Nevertheless, as considered before, the classroom becomes the work place and can be assessed for ergonomics, accordingly, similar to ergonomics in the workplace, for educational settings policies and guidelines should be in place to safeguard the physical and mental activities of students and teachers (Smith, 2007).

In 1857, Wojciech Jastrzebowski first documented ergonomics as the study of work (Rice, 1999). Ergonomics has been applied and executed in many areas and has 'achieved proven success in improving performance, productivity, competitiveness, and

safety and health in most occupational sectors' (Smith, 2007, p 45), however research on the application of ergonomics in the classroom is limited and not extensively acknowledged (Smith, 2007).

Application of ergonomics to the learning environment addresses such issues as physical factors – equipment and work area; teaching factors – instructional material, technologies, and curriculum; environmental factors – temperature and lighting; and temporal factors – schedule and length of the university day and breaks (Caldwell and Legg, 2007). Ergonomics in educational facilities are focused on issues such as mismatch between student body sizes and their desks and chairs, the weight of the students' bags and the prevalence of musculoskeletal disorders amongst students (Legg and Jacobs, 2008). Advances in this context are being made by the International Ergonomics (IEA) Technical Committee (TC) on Ergonomics for Children in Educational Environments (ECEE), which also have focused on issues such as learning environments, ergonomics pedagogy and curriculum content/structure (Legg and Jacobs, 2008). Physical fatigue and the increased potential for injury from long-term poor posture can hinder the quality of learning (Hermenau, 1999). In relation to physical factors, Saarni (2007) stated that the educational furniture attracted concern as the cases of neck-shoulder pain and low-back pain increased among teenagers. Saarni et al. (2007) rationalized that 'a possible factor behind the increase could be sitting for extended periods in stooped, static or otherwise awkward postures at educational facilities' (p 23). Sitting, when performed improperly, can have implications on other aspects of a student's life such as health, performance, motor skills like energy and strength, leisure, and physical activity (AOTA, 2002).

A basic chair is described as 'an extension of a user, with no two users being exactly alike. No two users sit, squat, or move about in the same manner' yet classroom chairs

continue to remain as a fixed design and allow little variation and unique postures (Postell, 2007, p 106). The chairs and desks used in education often lack the capability to fully adjust from the formal upright positions to accommodate an informal position for tasks such as reading or drawing. In effect the users are the ones who alter their positions to adapt to the forms of the chairs. Based on their unique learning styles and size differences, students will not all sit the same way or sit in one position throughout the entire day. They will be constantly shifting and fighting the fixed form of the desk (Postell, 2007).

The relationship between the student and classroom furniture, the proportions and anthropometric data used in the creation of standards is geared towards accommodating students who are closest to average sizes leaving many students having to adapt to those standards (Molenbroek et al., 2003). The activities that occur within the classroom dictate the positions and postures of a student (Panagiotopoulou et al., 2004). Yet these activities are not often understood or even known by the designer and mismatching occurs. Despite the obvious need for adjustable and ergonomically-correct furniture in the classroom, the furniture industry focuses more on providing ergonomically conscious furniture in offices rather than the educational environment (Panagiotopoulou et al., 2004).

2.7- CONCLUSION

This literature review summarized physical factors of the indoor environment reported to affect students' health and wellbeing. There is strong evidence to suggest that the ergonomic conditions of furniture have beneficial effects for students. This review provides a useful, practical resource for all those responsible for the design and

operation of the educational facilities, as well as for researchers investigating these factors. Although there is a growing body of literature concerning educational furniture and their effects on students, additional studies focusing on anthropometrics and ergonomics of furniture of the learning environment are required in order to provide guidance for design and to achieve the optimum environment for all students. The fundamental of the idea is that design must be continuously determined by the needs of the end-user. When it comes to the given topic, educational furniture, the concern may have two end-users: instructors and learners. And this can be achieved when using the given theory of despecialization, where it pleases an extensive range of the users' needs, developing the bond and relationship between the user and the object, as it was proved when applied in an office set, since it was proven earlier that there is a resemblance between workplace and the classroom.

3- METHODOLOGY

3.1- INTRODUCTION

Chapter two discussed four major subjects; the first addressed the relationship between furniture, educational environment, and the physical wellbeing of students. The second and third subjects involved an analysis of anthropometric parameters, and the study of ergonomics. The last part of chapter two explained the idea of despecialization and its importance and relation to this study. Chapter three presents the required datasets that pertain to answering the research objectives, which include the anthropometric measurements of the students and the measurements of the presented furniture. The chapter shows the methods that the researcher used in the study and how the data was analysed. The methodology includes observation, questionnaires, and anthropometric measurements collection.

Student life has been described to be challenging, difficult, and time-and-effort intensive, a path dispersed with competing demands and unrealized prospects (Offstein, Larson, McNeill, and Mwale, 2004). This condition has provoked an increased concern about classrooms, mainly regarding the study and design of educational furniture suitable to the needs of the students, with furniture that has the suitable dimensions according to the students' anthropometric physiognomies. This concern is made clear by several studies; these studies show a clear incongruity between anthropometric characteristics and the dimensions of the furniture under study (Brewer et al. 2009; Castellucci, Arezes, and Viviani 2010; Cotton et al. 2002; Dianat et al. 2013; Feathers,

Pavlovic- Veselinovic, and Hedge 2013; Panagiotopoulou et al. 2004; Ramadan 2011; Van Niekerk et al. 2013).

In order to explore the characteristics of the physical environment that affect students' wellbeing and performance and consequently explore the possibility of despecialization as an approach that would enhance physical wellbeing among the students , this chapter represents a continuation of the exploratory research, taking NDU as a case study. It presents the required data sets, variables and methods used to collect and analyse them in answering this objective. Based on the ground of the literature, a methodology has been developed in order to benefit from the global experience to the Lebanese case. The following step is about testing the importance of the information gathered to accomplish the objectives of the study. Through the following method, a clear demonstration of the match/ mismatch between the used educational furniture and the anthropometric data of the students was established. Moreover, the anthropometric data collected from the local Lebanese students will be used to establish the ideal measurements for the Lebanese students and will be a cornerstone to reach the despicialized piece of furniture attempting to fulfill the comfortability of the students and their needs.

3.2- ETHICAL CONSIDERATIONS

As with any research study that incorporates human participants, there are some delicate issues that the researcher encountered, such as getting into classes for observation, asking the students for their anthropometric measurements, and asking them to fill the survey. Approval is required from the Institutional Review Board to work within the university with the instructors and student participants (see Appendix

A). A protocol for this study was submitted, outlining the data collection methods. Consent forms were written for the different departments where the study will be conducted (see Appendix B). In addition to the faculty participation, the class instructor is also required to consent to participation and allowance of classroom time (see Appendix C). This was established by sending a consent email to each department chairperson, and consequently the chairperson guided the researcher how to contact the available instructors. Emails were sent to those instructors for consent.

3.3- RESEARCH METHODS DESIGN

The research design is the logical plan for getting the needed information that answers the initial set of questions in order to reach the objectives. It involved several methods of data collection: observation, questionnaire in addition to the collection of anthropometric data of the students. These methods will help with the investigation on the educational furniture features that are affecting the student's physical wellbeing, determining the match/mismatch of anthropometric measurements with respect to the presented educational furniture, how students visualize their furniture, how satisfied are they, what kind of furniture is presented in the university, and the behavior of the students toward the presented furniture.

The research performed is an explanatory, causal research, which enlightens the how and whys the furniture (desk) affects the students' physical wellbeing. Furthermore, the data was gathered cross-sectionally, and involved a mixed collection method (both quantitative and qualitative). This study is of qualitative nature that is actual in identifying the imperceptible factors of the human side and in understanding the practice of daily life. This choice not only allows the researcher to conduct her study

descriptively but also contributes to a more constructivist interpretation of the social world through the interaction of individuals (Bryman, 2012). And it is of quantitative nature where it determines the relationship between one thing (an independent variable) and another (a dependent or outcome variable) within a population. It is both descriptive and experimental, where establishes associations between variables and causality (Babbie, 2010).

3.4- DATA SETS

Permission to measure the dimensions of the furniture in each classroom was granted by the departments concerned. The rationale and procedure for this study was explained to the participants, and their informed consent were sought and obtained. In reference to the Literature Review (Ghazilla et al., 2010), the following anthropometric measurements (Fig 2.7) were taken over a period of seven minutes for each participant; their shoes removed:

- Height: the vertical distance from the floor to the top of the participant's head, while standing erect, and looking straight.
- Elbow height: with the participant's elbow flexed 90 degrees, the vertical distance from the bottom of the tip of the elbow to his/her seated surface.
- Shoulder height: the vertical distance from the top of the participant's shoulder at the acromion process to his/her seated surface.
- Upper arm length: the difference between the elbow height and shoulder height.
- Knee height: with the participant's knee flexed 90 degrees in a seated position, the vertical distance from the resting surface of the foot to the top of the knee cap, just above the patella.

- Popliteal height: with the participant sitting and the knee at 90 degrees of flexion, the distance from the foot resting surface to the popliteal space.
- Buttock-popliteal height: with the participant's knee flexed at 90 degrees, the distance/length from the posterior surface of the buttock to the popliteal surface (thigh length).

The following measurements will be taken from the furniture in the lecture theaters:

- Seat height: the distance from the floor to the highest point on the front of the seat.
- Seat depth: the distance from the back of the sitting surface of the seat to its front.
- Seat slope: the direction and angle of the slope of the seat's sitting surface.
- Desk height: the distance from the floor to the top of the front edge of the desk.
- Desk clearance: the distance from the floor to the bottom of the front edge of the shelf under the writing surface.
- Desk slope: the angle at which the writing surface of the desk slopes.

Other furniture dimensions, such as desk width (measured as the horizontal distance between the lateral edges of the desk) and desk depth (the distance from the back to the front of the top surface of the desk) were not measured as their suitability criteria are not dependent on anthropometric measurements taken but on the functional requirements that may be derived from them.

An inextensible tape measure (Butterfly Brand; Shanghai Kearing Stationary Co, Shanghai, People's Republic of China) was used for all anthropometric measurements (overall height, elbow height, shoulder height, upper arm length, knee height, popliteal height, and buttock–popliteal height) of the subjects and the dimension of the furniture

(seat height, seat depth, desk height, and desk clearance). Measurements were recorded in centimeters.

3.5- CASE STUDIES AND SAMPLE SELECTION

Case study research enables the researcher to investigate important topics not easily covered by other methods (Yin, 2004). The overall idea is that different research methods serve complementary functions. In general, the case study has the advantage when a 'how' or 'why' question is being asked about a contemporary set of events over which the investigator has little or no control (Yin, 2007, p 12). The distinctive topic for applying the case study method is pertinent here because the research addresses both a descriptive question (what happened?) and an explanatory question (how or why did something happen?) (Shavelson and Townes, 2002). The case study method will help the researcher to make direct observations and collect data in natural settings, compared to relying on 'derived' data (Bromley, 1986, p 23). The strength of the case study method is its ability to examine, in-depth, a 'case' within its 'real-life' context. It will provide a combination of analytical and statistical generalization, that will help reaching the purpose of the thesis.

In the academic year 2015-2016, 111280 students accommodated for higher education (Central Administration of Statistics in Lebanon, 2016). Of these students, 6256 students were enrolled in NDU campuses, with a total of 5.62% of the Lebanese students. This study was conducted in the three campuses of NDU, but was treated as one study case instead of considering each campus as a study case of it own. Evidence in chapter 2 (p 17) showed that anthropometric data change even within the same country, NDU was chosen as the case study for the variety of student background, and its large population. According to the university's statistics held by the Office of

Institutional Research and Assessment, OIRA, NDU attending students are from the five different governates in Lebanon (Beirut 3.4%, Beqaa 4.2%, Mount Lebanon 76.9%, North Lebanon 11.6%, South Lebanon 2.8%, and undefined 1.01%), which means that the university has students that come from all over Lebanon representing an average percentage of the total number of students of each governate (Beirut 11.6%, Beqaa 16.2%, Mount Lebanon 35.2%, North Lebanon 24.5%, South Lebanon 11.9%). this case study will be used to understand the everyday activities of the classroom, patterns of behavior, and patterns of interaction with furniture that materialize in the classroom environment. As for the sample size, it will be defined according to the population of the university. The population size will be obtained from the number of students in the university, and sample of convenience will be to select participants. The sample size for NDU will be obtained from the equation (Odunaiya et al, 2014),

$$n = N/ (1 + N [e]^2)$$

where n is sample size to be determined, N is the population size, and e is the level of precision. The level of precision is [+ or -] 5%. Therefore, n= 6256/ (1+ 6256[0.0025]), n= 376.

3.5.1- Questionnaire Survey

Questionnaire surveys are an effective way to get opinions of a large number of respondents (Milne, 1999). After having the IRB approval, questionnaires were distributed in each chosen classroom to gather more information about the desks used (see Appendix D and E). It included questions about the sex and age of the participant, how many courses are they involved in, and the duration of each course. The gathered information was used to evaluate how comfortable students are while using the presented desks in their classrooms. It explored whether they have suffered any

physical pain or injury caused by the university furniture. This kind of study method yields to a qualitative study explaining how students perceive the desks they are using, how the desks are affecting their wellbeing, and what aspects of a desk need to be changed. The questionnaire left room for suggestions of how to enhance the used furniture with an open- ended question at the end of the questionnaire in addition to description lots when evaluating each part of the desk. It is not always sample size and scale that can be examined to design furnishings but also listening to the users of the space. In the case of our study, the process of consulting students about their environment through open answer questions in the questionnaire improves designers understanding (Grosvenor, 2005). The importance in engaging students' opinion is to strike a delicate balance between how information is collected and conveyed. The need for this delicate balance is evident in the simple fact that "users often say one thing, do another and feel something else" (McDonagh et al. 2009, p 433).

3.5.2- Observation

Because a case study should take place in the natural setting of the case, it benefits from observations, where some relevant behaviors or environmental conditions will be observed. Direct observations can be made throughout a field visit, including those occasions during which other evidence, such as questionnaire surveys are being collected (Yin, 2004).

After contacting the chairpersons of each faculty visited, the researcher was guided to many instructors that agreed on the terms of the observation in their classes. Consent was given by those instructors, and the researcher explained the reason of her visit to the classrooms to the corresponding students. The observations took place during

various days of the week, at various times of day during the opening hours of the university. Classes period vary from one to three consecutive hours, so the observed classes were chosen in a way that let the researcher observe all different period classes. The three campuses are closed on the weekends. The observation time varied depending on account of the participants' dynamic moving on and off the desk.

During the classroom observations, examinations included notation of student activities occurring within the classroom and observed student positions and actions, in addition to the kind of furniture presented in each classroom. This data supported the identification of student interactions with the existing furniture, limitations and benefits presented with existing furniture, and description of relationships between student positions to potential classroom activities. During the observation sessions, the researcher took notes on the used furniture and the reactions of the students while using the available furniture using a behavioral mapping. Behavioral mapping is a form of observation and documentation used to record 'the location of subjects and [measure] their activity levels simultaneously' in relation to the built environment (Cosco, Moore, and Islam, 2010, p 1). This method has been used in the study of learning environments to 'illustrate the method's sensitivity for coding built environment characteristics' and therefore, behavioral mapping is a valid method in obtaining information regarding student behavior and activities (p 1). The modified categories of observing sitting postures at universities is as follows: back – straight, flexed, rotated, or flexed and rotated; upper limbs (arms) – neither supported, one supported, or both supported on desk; buttocks and lower limbs – buttocks resting on the rear of chair, front of chair or standing or walking; neck – straight, flexed or rotated. All postures were recorded in relation to an upright sitting posture (Cosco, Moore, and Islam, 2010). While

observing, the researcher had several informal conversations with different students during the break.

3.5.3- Visual Documentation

For additional documentation and reference, the researcher also took photographs of the used furniture and pictures of the students while using the given furniture. Photo-documentation is a research method that provides a means of data collection and analysis that can capture aspects of research matter without the distorting effects of other methods (e.g. recall bias) or when words alone are not adequate (Ray and Smith, 201

3.6- DATA ANALYSIS

A helpful staring point is to 'play' with the data and disaggregate it to be able to examine and analyze it (Yin, 2007, p 147). One set of analytical manipulations has been comprehensively described and summarized by Miles and Huberman (1994, cited in Yin, 2007) and includes:

- Putting information into different arrays;
- Making a matrix of categories and placing the evidence within such categories;
- Creating data displays – flowcharts and other graphics – for examining the data;
- Tabulating the frequency of different events;
- Examining the complexity of such tabulations and their relationships by calculating second-order numbers such as means and variances;

• Putting information in patterns, explanation building method or using some other temporal scheme.

In a case study, it may be needed to do data collection and data analysis together for the need to master the intricacies of the study's substantive issues while also having the patience and dedication to collect data carefully and fairly- potentially hiding (if possible) the researcher's own substantive thoughts (Yin, 2004). This does not only help in directing the research, but also establishes a link between the different methods used and the Literature Review. This is exactly what was done, where the researcher was analysing the data collected and correlating all the methods together while still gathering more information. Although each method has its own way of analysis, but most of the students that were observed answered the questionnaires, and most of them gave their anthropometric measurements. Consequently, this helped the researcher to correlate the answers given by them concerning their comfortability toward each aspect of the desk, the used desk, and their anthropometric data. This way of analysis lead to a new pattern that helped the researcher confirm the reason of match/ mismatch between students' measurements and their desks. In addition to that, this way of analysis established a link between the primary and secondary data.

Clustered bar charts were designed to analyse the anthropometric data collected from the university for their very specific purpose (Appendix F and G), where they represent the different anthropometric measurements giving their maximum, minimum, and median value. Statistical analysis was the second step that helped in showing how much one variable is affected by another and show the correlation between these variables. Each clustered bar chart represented the anthropometric measurements of both the female and male cases, having descriptive statistics of the minimum and maximum values, median, mean, and standard deviation for all anthropometric variables. The data

was compared with the sample desk used in each university to check the probability of mismatch between the anthropometric data and the measurements of the desks.

The dimensions of the educational furniture were measured in each classroom. The standard body dimensions required were calculated from the mean of the sample size, and this served as the normal value or standard dimension for determining the ergonomic suitability of the furniture in each classroom. The standards of measuring suitability were determined by measuring anthropometric mismatches.

Anthropometric mismatches are the number and percentage of the students where the body match or mismatch with the furniture were calculated based on the rules adapted from Parcells et al. (1999). The mismatch rules that were used in this study were followed in order to determine mismatch between certain body dimensions and their corresponding design parameter as listed below:

- Popliteal height and seat height mismatch: a mismatch is defined when the seat height is either >95% or <88% of the popliteal height.
- Buttock–popliteal length and seat depth mismatch: a mismatch is defined when the seat depth is either >95% or <80% of the popliteal height.
- Knee rest height and desk height mismatch: a mismatch is defined as occurring when a desk is <2 cm higher than the knee height.
- Elbow rest height and desk height mismatch: according to Parcells et al acceptable desk height is determined by the equation

$$hE = hEv + U([1 - \cos\theta]) + \cos\theta\,[1 - \cos\beta]),$$

where hE is the vertical distance from the top of the desk to the student's sitting surface, hS is the shoulder height, hEv is the elbow height, U = hS − hEv is the upper arm length, θ is shoulder flexion, β is shoulder abduction.

According to Chaffin and Anderson (2001), the minimum and maximum acceptable angle of the shoulder during writing is 0–25 degrees for shoulder flexion and 0–20 degrees for shoulder abduction. For flexion angles, the corresponding cosines are 1 (0 degrees) and 0.9063 (25 degrees) and for abduction angles, the corresponding cosines are 1(0 degrees) and 0.9397 (20 degrees). Applying the cosines to the previous equation, desk height is determined by,

- Minimum desk height = Seat height + hE,

Where hE = hEV + U [(1 − 1) + 1(1 − 1)] = hEv

- Maximum desk height = Seat height + hE + hS

Based on the above dimensions, it is concluded that a mismatch of elbow–shoulder height and desk height is defined as when the desk was either shorter than the minimum desk height or taller than the maximum desk height. Some terms were used in the analysis like "fit", "below fit", and "above fit" by the researcher to approach the idea of when the measurements are within the acceptable range of the equivalent equations, less than the range, and more than the range correspondingly. It is however important to note that the relationships used in this study are not the only ones available. Therefore, other relationships may be used for comparison purposes until there is a consensus and a common standard among researchers.

For the questionnaires, data was manually transferred from the questionnaires into excel spreadsheets to create charts and even diagrams (Appendix H). Each question was

categorized in number and placed as a column heading, and use one row for each person's answers. Then assign each possible answer a number or code. This enabled the researcher to compare the given answers within the same campus, and between one campus and another. Moreover, a correlation was established between the answers given in the questionnaires and the anthropometric measurements of the same respondent in order to be able to tackle the exact problem there are facing, and validate the answers given.

The observations were noted by the researcher through written words and supported by quick sketches when information was better documented in pictorial images (Appendix I). A series of student positions was coded and represented by a color and letter. The color related to the time while the letter related to the students' position. Immediately following an observation, the information was transcribed to code themes and patterns among other observations. The data was used to identify students' positions and actions.

Photographs were taken using a digital camera. They were taken of a vacant case study desk either at the end of the class period. The images were shot to include a well-rounded understanding of the object to be studied. Images were imported on the researcher's computer and descriptions were applied to each photograph to explain what was captured creating a reference tool that could be revisited after leaving the universities.

After analysing each and every acquired data, a layering or overlapping of the different data set was set, and a link was established creating a relationship between the students and their environment. Aesthetic and functional elements were adopted to identify the

qualification of despecialization and find how possible this theory can address the issue raised concerning the university desk.

3.7- ASSUMPTIONS AND LIMITATIONS

Although this research was carefully prepared, it still has limitations and shortcomings. One of the limitations to this study is the time factor. The researcher was not able to make a significantly large research in the duration of one semester. Although observation helps the researcher access the situation and people involved in the research in situations where questionnaires can not aid, but it is a time-consuming process where observing cannot be rushed. It sometimes reduces the interest of both observer and observed to continue their observation process and the validity of observation is always difficult. Many of the phenomena of observation cannot be defined with sufficient precision and do not help in drawing a valid generalization, that is why they are usually supplemented by other methods. Moreover, observation is a highly technical job. One is never sure that what he/she is observing is the same as it appears to his/her eyes. Two persons may judge the same phenomena differently. One person may find something meaningful and useful from a situation but the other may find nothing from it. Since the assessment of the observation was conducted by the author herself, it is unavoidable that in this study, certain degree of subjectivity can be found when analyzing the behavior of the students.

Accordingly, when conducting questionnaires, there is a chance of lack of conscientious responses, there's no way to know if the respondent has really thought the question through before answering. It is difficult to check misinterpretations and unintelligible replies by the respondents. In spite of their advantage questionnaires lack

the flexibility of interviews and permit the measurement of verbal behavior only. Plus, the analysis of the data should have been as three case studies (three campuses each on its own) instead of making it as one case study (the three campuses as one unit). Concerning the anthropometric measurements, and considering the amount of measurements and proportions taken, and the different equations used to calculate their combination with the corresponding furniture, a complex pattern was established. The complexity examined is difficult to represent simply, and may be difficult to present accessible and realistic pictures of that complexity in writing. The reason why the searcher followed the set of analytical manipulations described and summarized by Miles and Huberman (1994, cited in Yin, 2007).

4- RESULTS

4.1- INTRODUCTION

The data collected from the case study classrooms of the three campuses of NDU (Main, Shouf and North) was analyzed to identify and define classroom activities and student behavior noted during the observations. A total of 433 students filled the survey in the three campuses, 215 males and 218 females, where 382 students volunteered to give their anthropometric measurements, 198 males and 184 females. The data noted from the observation were combined with the responses filled in the survey by the observed students, who also volunteered to give their anthropometric measurements, all together to find a pattern of aesthetic and functional elements that would fulfill the needs of the students to reach their wellbeing through despecialization

4.2- EXISTING FURNITURE DESIGN OF THE EDUCATIONAL ENVIRONMENT

The twelve classrooms used in this study are representative of the different furniture dimensions of the seat and writing surface combinations that exist at the three campuses of NDU (Table 4.1). Three different kinds of furniture were presented in the main campus (Figures 4.1, 4.2 and 4.3). North and Shouf campus had the same kind of furniture in lecture rooms as in the lecture rooms of the main campus, but it was different in the studio classrooms, where cushioned alterable office chairs and adjustable tables were used, where students can adjust both the height and slope of the table (Figures 4.4 and 4.5). When asked about the university furniture, the director of physical plant at the office of Administration stated that the university furniture was

bought from different suppliers and not custom made. They are actually common type of desks used at school and universities. No further information about the suppliers was given. Of the selected classrooms, 73.6% had unpadded, wooden seats having two seats attached to each other that were not retractable, with a metallic structure that attaches writing platforms to them (Figure 6). The seminar rooms had hard plastic seats with four metal legs with a right-sided writing retractable platform (Figure 4.2). These seats were not attached to one another.

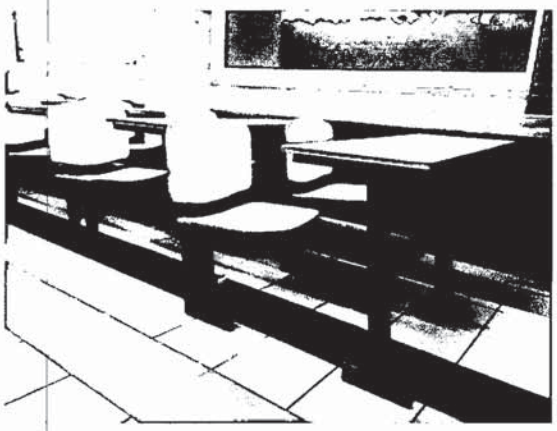


Figure 4.1: Lecture room furniture presented in the main campus (by author, October 2017)

Figure 4.2: furniture presented in seminar rooms in the main campus (by author, October 2017)

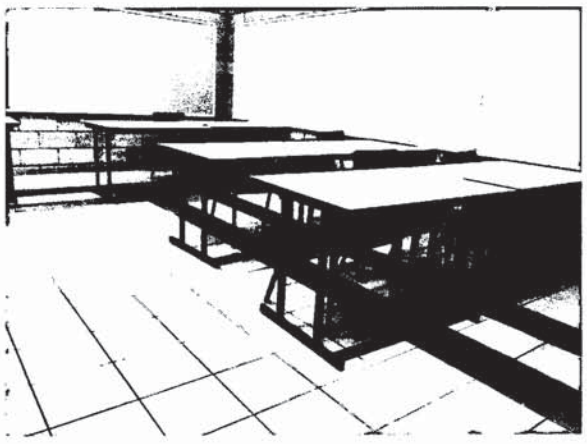


Figure 4.3: Studio Furniture in the main campus (by author, October 2017)

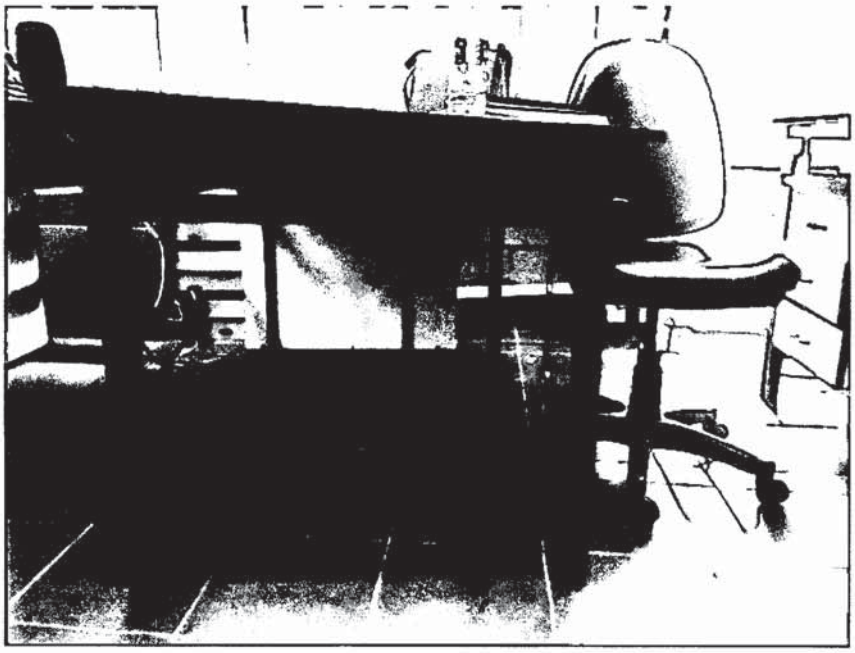


Figure 4.4: Studio furniture in the North campus (by author, November 2017)

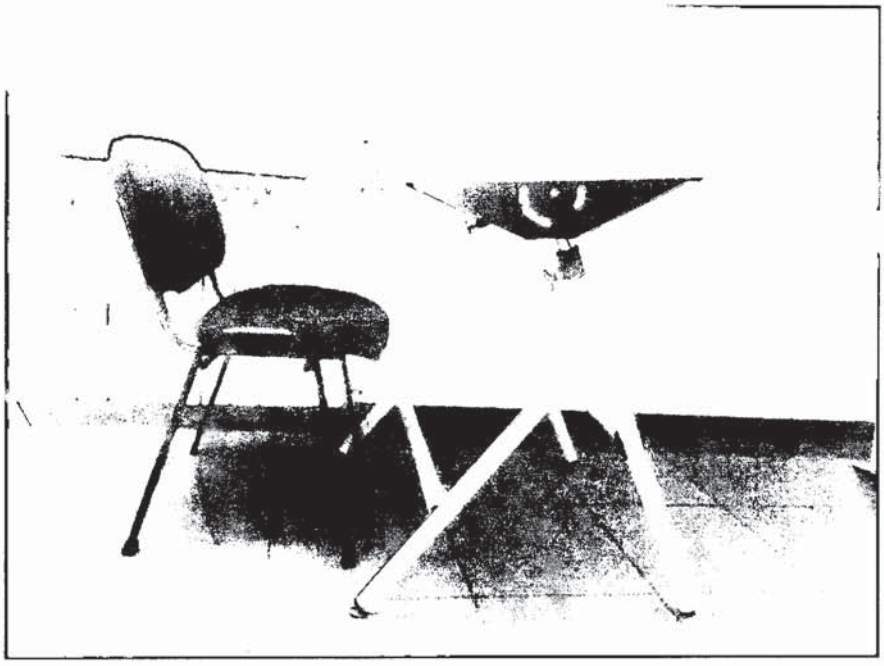


Figure 4.5: Studio Furniture in the Shouf campus (by author, November 2017)

VENUE	Seat height (cm)	Seat Depth (cm)	Seat Slope (degrees)	Desk height (cm)	Desk slope (degrees)	Desk clearance (cm)
Faculty of Architecture, Art and Design (Lecture rooms)	43	45	90	67.5	90	66
Faculty of Architecture, Art and Design (Studios)	46	44	90	73.5	90	70
Faculty of Humanities	44	40	90	65	90	62.5
Faculty of Business Administration and economics	44	40	90	65	90	62.5
Faculty of Architecture, Art and Design (North campus)	44	40	90	65	90	62.5
Faculty of Architecture, Art and Design (Shouf campus)	44	40	90	65	90	62.5

Table 4.1: Furniture dimensions of the selected lecture rooms and studios (by author)

4.3- EDUCATIONAL FURNITURE AND STUDENTS' BEHAVIOR AND WELLBEING

Through examination of the classrooms, several student interactions were observed with the existing furniture that included sitting on chair, leaning on furniture, moving the furniture, rocking in a chair, using supplies, kneeling on chairs, and using the table and desk surfaces (refer to page 8). These interactions were observed between students and chairs, tables, desks and other items throughout the classroom. The observed accounts of these actions showed that the majority of student interactions took place

while seated on their chairs, although the posture, leg placement, and direction differed depending on the activity and individual student preferences. Students rarely sat using the back rest as a back rest and often were found to use the back rest more as an armrest while turning in a chair or as an area to easily grab onto from a standing position. When sitting on a chair, students were observed sitting on the edge, hanging half of a side, sitting on knees, in a crouched position, one leg up and one leg down, legs tucked under or around legs, crossed-legged, standing with one knee on the chair, straddling chair, tipping forward, leaning their backs to the wall, constantly getting up and walking around, stretching, tilting chair forward, sitting in chair backwards, balancing on two legs, and stack chairs (Table 4.2). Students were looking for a convenient way for them to sit, and kept changing their position over and over, adapting different postures. Though it is a normal phenomenon for a person to change positions where the body undergoes some major and minor movements while seated, but the observed movements were overrated according to acquired knowledge from the Literature Review. An overall analysis of these observed positions showed that it was challenging to predict precisely how a student would position themselves during an activity, but rather that they constantly moved and explored the range of capable positions.

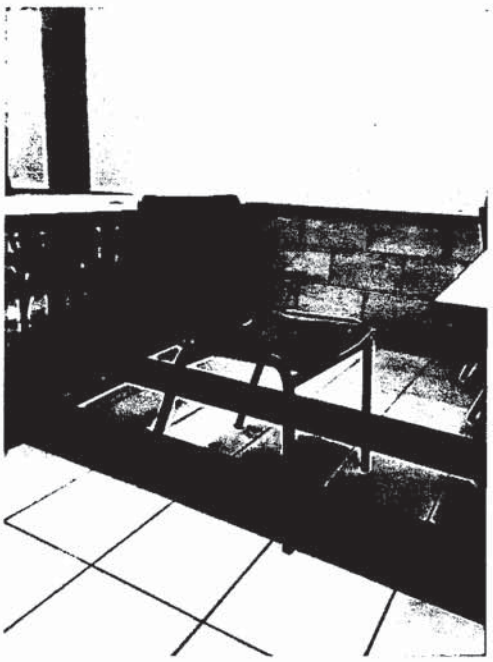


Figure 4.6: Chair presented in the studios of the main campus (by author, October 2017)

Figure 4.7: Studio chair presented in the Shouf campus (by author, November 2017)

Figure 4.8: Studio chair presented in the North campus (by author, November 2017)

The interactions with the desks and tables included leaning over to write, stretching, placing elbows on desk, placing arms, leaning from a standing position, sitting on desktop, place head down, hanging off side, leaning onto neighboring desks, leaning

across to see other's work, and assembling art projects. The table and desk surfaces were used for a variety of activities including writing, drawing, leaning, and resting heads. The students continually interacted with the desk and table surfaces throughout the day mostly using the closest surface. A trust between student and desk existed due to the stability of the desk. This trust encouraged students to use the tables and desks surface as a support tool, by leaning their elbows on the desks, they were able to balance their heads and support their upper body.

In the studio classrooms, three kinds of chairs were presented in the three campuses, where simple wood chairs were in the main campus (Figure 4.6) stable office chairs were in Shouf campus (Figure 4.7), while in the North campus adjustable chairs were offered (Figure 4.8). Students selected the areas first for group and individual activities. The attraction to these areas in both North and Shouf campuses was comfort, whereas in the main campus, the furniture was more rigid. Students expressed that in the questionnaire, where they stated their preference for office chairs in their workspace, whether it is an ordinary classroom or a studio setting.

The movement of furniture by students in the studio classrooms was most seen with small chair movements, pulling chairs out, and pushing chairs in. When students did venture across the classroom with a chair, they lifted it over their head or were subjected to struggling with trying to move the chair legs around existing furniture. For shorter chair movements from one table or desk cluster to another, students slid chairs across the floor. When pulling a chair in to sit, students wrapped their feet around the legs and slide it in small distances. In even smaller movements of furniture, desks were shifted and aligned by students. In addition to these direct interactions with the furniture, several actions seen in the classroom were indirectly affected by the furniture

in the classroom including walking about the room through traffic paths created by the furniture arrangements.

Figures	Class activity	Duration of the session	Time during the session
	lecture	1.5 hour	After 25 minutes
	studio	3 hours	After 80 minutes
	lecture	2 hours	After 40 minutes
	studio	3 hours	After 30 minutes

Table 4.2: Students' postures during the classes (by author)

4.4- ANTHROPOMETRIC MEASUREMENTS OF STUDENTS AND MEASUREMENTS OF THE DESKS

Tables 4.3 and 4.4 show the anthropometric data of the students at the university, classified by sex. The minimum and maximum values, median, mean, and standard deviation were calculated for all anthropometric variables according to the campus and according to the sex of the participants. The maximum and minimum values, mean, and standard deviation were computed for the 397 participants. Measurements of height showed the highest variation within the male (±7.7 cm) and female participants (±7.3 cm), meaning that there is a significant variation of height between male students and female students. According to the following measurements (Table 4.3 and Table 4.4), and using the stated equations, relation between the students measured body parts and the most common desk (classroom desk presented in figure 4.1) used in the university were compared and related to the observations and questionnaires in order to detect the cause of discomfort among the students, and understand the ideal measurements for the desk design. The findings of the given relations are presented in the suitability part of the chapter. The terms used in the analysis "fit", "below fit", and "above fit" were used by the researcher to approach the idea of when the measurements are within the acceptable range of the equivalent equations, less than the range, and more than the range correspondingly.

	min	max	median	mean	±SD
height	148	187	167	166.1	7.3
elbow height	12	30	20	19.7	3.8
shoulder height	47	67	57.5	57.2	4.1
upper arm length	29	44	36	36.4	3.4
knee height	33	63	52	52.8	4.5
popliteal height	39	53	44	44.6	3.2
buttock- popliteal height	42	65	54	53.7	4.8

Table 4.3: Anthropometric dimensions of the female students of NDU

	min	max	median	mean	±SD
height	155	196	178.5	179	7.7
elbow height	12	38	20	20.4	4.1
shoulder height	51	70	60	59.8	4.5
upper arm length	25	48	40	39.1	4.7
knee height	43	67	56.5	56.6	4.5
popliteal height	42	59	48	48.4	3.7
buttock- popliteal height	43	67	56	55.4	5.1

Table 4.4: Anthropometric dimensions of the male students of NDU

4.4.1- The Relation of Students Body Dimensions with the Seat and Writing Surface Dimensions

- Popliteal–seat height relation: the seat height was too low for 57.3% of the participants, fit for 22.5% of the participants, and too high for 20.2% of the participants in this study.
- Buttock–popliteal seat depth mismatch: the seat depth was too shallow for 72.3% of the participants, fit for 24.3% of the participants, and too deep for the rest of the 3.4% of participants.

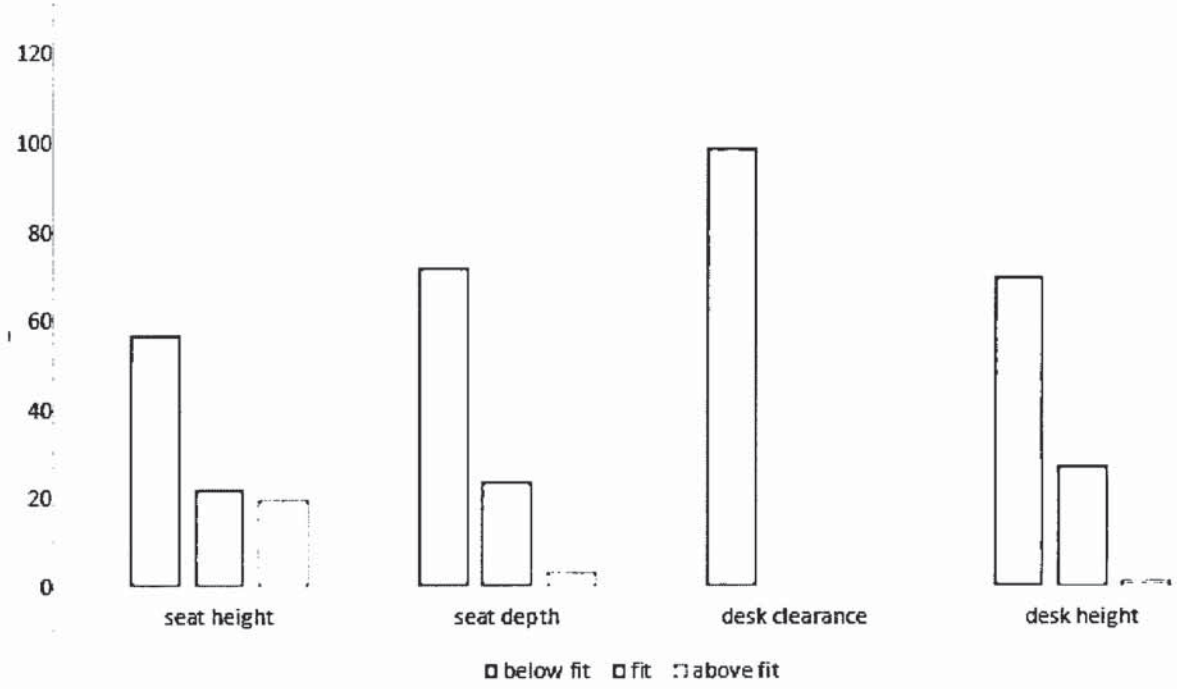


Figure 4.9: Percentage suitability of the seat and writing surfaces for all participants.

- Knee–desk height mismatch (Figure 4.9): the desk was fit for 99.4% of the participants, but was too low for 0.4% of the participants.

- Elbow–desk height mismatch: the elbow–desk height was high for 70.6% of the participants, fit for 27.7% of the participants, and too low for the remaining 1.7% of the participants in this study.

Figure 4.10: percentage popliteal- seat height mismatch classified by sex.

4.4.2- Relation Based on Seat Height and Seat Depth Combinations

The seats in the lecture rooms were too short for 57.3% of the participants, 22.5% fit, and 20.2 % above fit (Figure 4.10). The seats' depth was below fit for 72.3%, fit for 24.3%, and 3.4% above fit for the participants (Figure 4.11). The desks clearance was 99.4% below fit, 0.4% fit, and 0.2% fit for all the participants. While the desk height was below fit for 70.6% of the students, 27.7% fit, and 1.7% above fit (Figure 4.12).

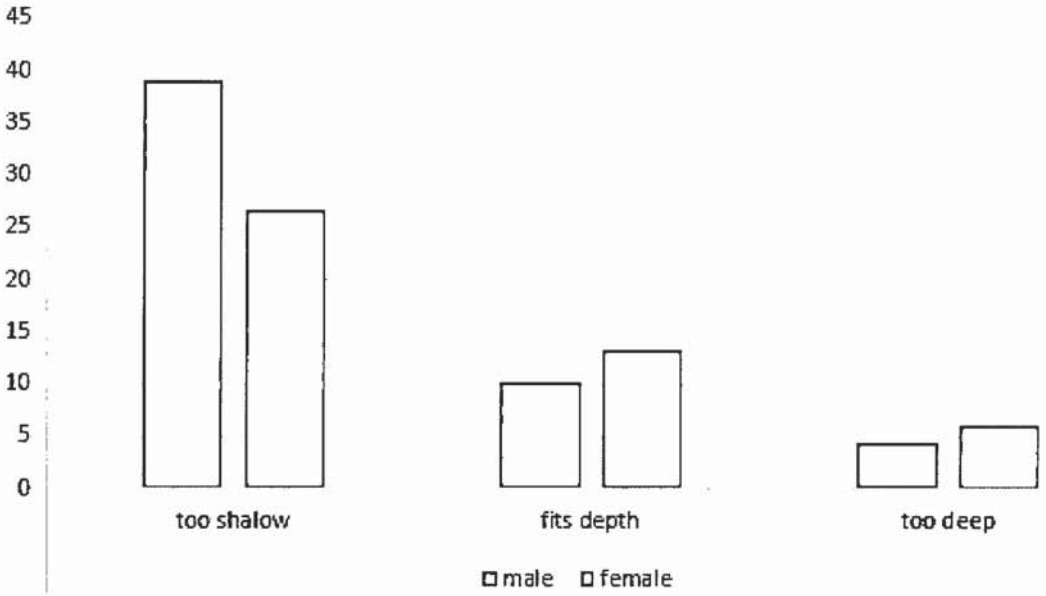


Figure 4.11: percentage buttock- popliteal height mismatch classified by sex.

4.4.3- Suitability of the seats and writing surface dimensions to student body dimensions

The seat height was too low for 62.3% of the participants in 71.4% of the selected lecture classrooms (Figure 4.13). According to Saarni et al (2007), seats that are too low result in the adoption of a kyphotic posture by the users while writing. The seat height was fit for 19.4% of the participants in 54.6% of the selected classrooms, and they were too high for 17.9% of the participants in 27.3%. Panagiotopoulou et al (2004) stated that seats that were too high were inappropriate, as they caused students to conform to a kyphotic posture. The seats were too shallow for 76.3% of the participants. According to Agha (2010), seats that were too shallow increase muscular

work in the back while trying to maintain balance. The seat depth was fit for 23.3% of the participants in 63.6% of the selected lecture theaters.

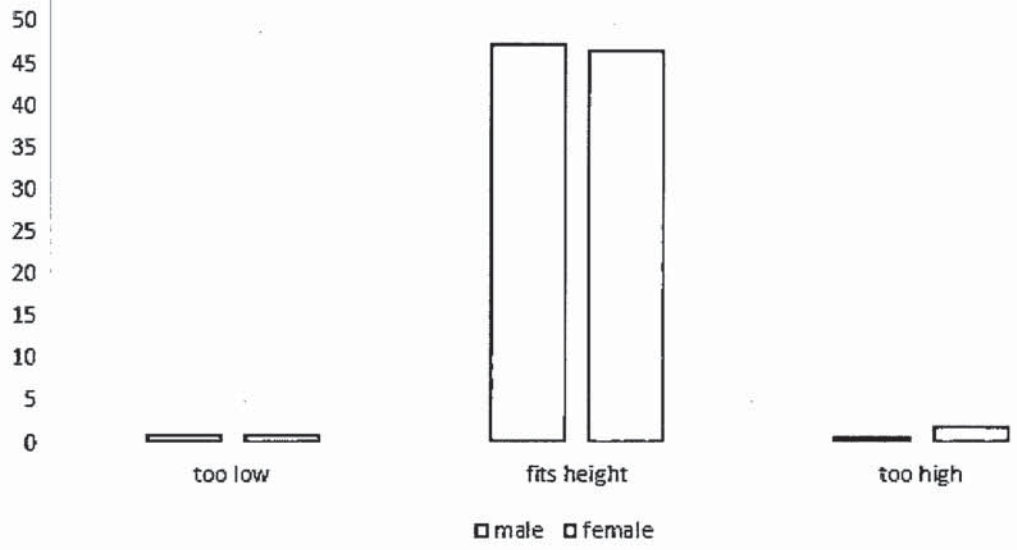


Figure 4.12: percentage knee- desk clearance mismatch classified by sex

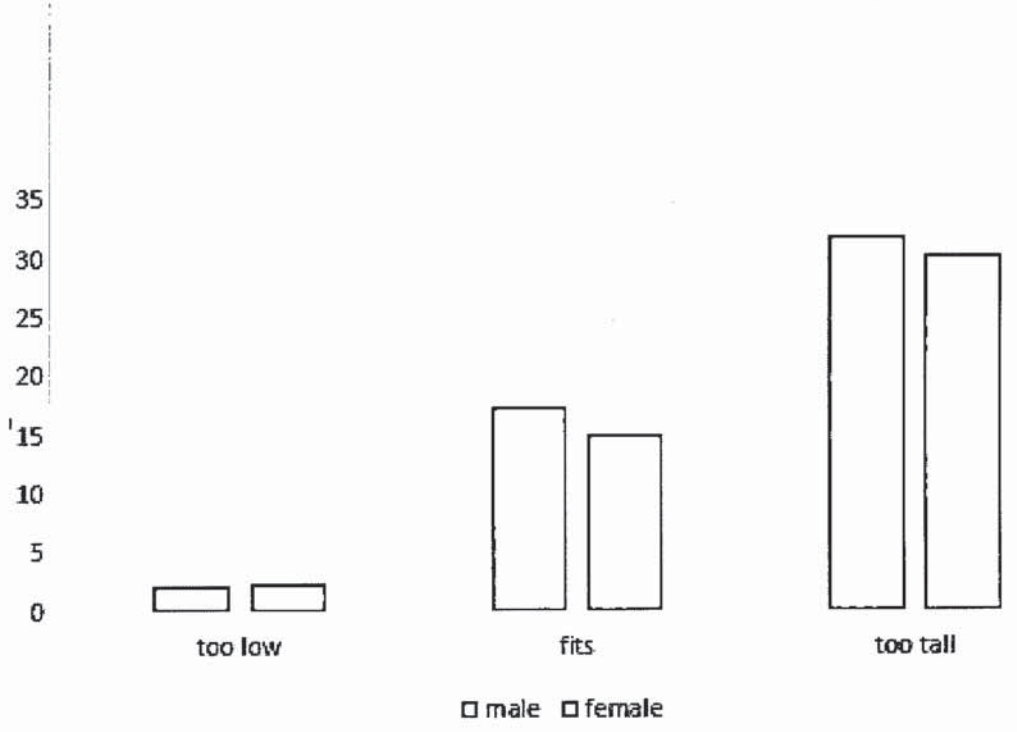


Figure 4.13: Percentage elbow- desk height clearance classified by sex

According to Castellucci et al (2010), seats that are too deep cause compression of the popliteal fossa and lead to the adoption of a faulty posture. The desk clearance was too low for 0.5% participants. The desk clearance was fit for 94.5% of the students in all the selected classrooms. The desk height was too low for 0.8% of the participants in 9.1% of the selected lecture theaters, fit for 25.8% of the participants in 63.6%, and too high for 73.4% of the participants. According to Gouvali and Boudolos (2006), desks that are too tall required students to flex their shoulders more than 25 degrees and abduct them more than 20 degrees in order to support their elbows, thereby resulting in quick onset of fatigue in the muscles of the upper limbs. In summary, 80.4% of the participants found the seat height unsuitable, while 19.6% of the participants found it suitable. The seat depth was unsuitable for 76.7% of the participants, while 23.3% of the participants found it suitable. The desk clearance was suitable for 94.5% of the participants but unsuitable for 4% of the participants. The desk height was unsuitable for 74.2% of the participants but suitable for 25.8% of the participants in this study. Milanese and Grimmer (2006) described that there exists an optimal anthropometric/furniture dimension relationship, and deviations from that optimal relationship among a vast majority of the population will make the furniture unsuitable. In agreement with this finding, it can be concluded that the desk clearance is the only suitable furniture dimension, while the desk height, seat height, and seat depth are unsuitable for the students at the university.

4.4.4- Suitability based on seat height and seat depth combination

Seventy-five percent of the participants found the seats too short and too shallow. In the students' opinion, the seats were "too short but fitting depth"; "fitting height but too

shallow"; "fitting height but too deep"; "too high and too shallow"; and "too high but fitting depth" for 24.6% of the participants. This may be due to the variability of furniture dimensions in the classrooms at the University campuses. Only 0.4% of the entire sample population of students found seats that fit both height and depth. It has been revealed that furniture with very low percentage of fit among a population must have been constructed without ergonomic consideration for that population (Castellucci et al, 2010). It is observed that the seats at the University are unsuitable, and the reason for this is that adequate ergonomic consideration was not given in the design itself.

4.4.5- Suitability based on desk height and desk clearance

Desks were fit in clearance and in height for 25.5% of the participants. The desks were fit in clearance but had a low height for 0.8% of the participants, and were low in clearance but fit in height for 0.4% of the participants in this study. The desks were fit in clearance but too tall in height for 73.3% of the participants.

It is important to note at this point that these findings may present challenging health implications. 61.2% of the students attending lectures at various classrooms of the University who filled the survey stated that they have faced musculoskeletal problems such as neck pain, back pain, etc. Besides these health hazards, learning problems could be another challenge. When a student sits in an uncomfortable seat and experiences musculoskeletal problems, either as a result of muscle fatigue or musculoskeletal pain, the student may lose concentration, which may culminate in poor academic performance (Ekcelman et al., 2001). Moreover, most suggestions given by the students specified that they would like to have adjustable seats and tables, and more clearance to use their laptops along with their books.

4.5- LIMITATIONS AND ADVANTAGES OF THE EXISTING FURNITURE

In observing the students in the lecture rooms, limitations presented by the existing furniture included such obstacles as hindering of positions, incompatible dimensions, safety, and non-personalized furniture. Student's positions were hindered with the solid backs of the chairs. The metallic structure of the lecture rooms' desks was keeping students from placing their legs wherever they wanted. Students constantly sought to sit comfortably on the chairs, obviously designed for a legs forward seated position, which limits the way students may move within their own seat. The design of the chair also worked against the idea of easily turning to view other students. This banned the students from communicating with each other or anticipating in group work. The configurations of the rooms required that students turned to view the front, where the smart board and the instructors' desk are placed. Plus, the metallic structure of the adjustable tables in the studio of the North campus is too low, which made students lower their chairs in order to be able to place their legs under the table, resulting to have a big difference in the height of both the chair and table (table became too high when students lowered the chairs). In addition to that, though office chairs were used in those studios, but students and instructors were struggling to find a chair that is not broken and can be comfortably used.

In examining the relationships between students and furniture it is obvious that, just as there are limitations, there are positive elements recognized. The table surfaces proved adequate for writing or drawing according to their dimensions. Stable structures continually supported the weight of any student during simple actions and when they decide to stretch on furniture placing greater weight and stress on the form. These beneficial elements, including stability in the desks and tables, were supported with the

use of office chairs in the both North and Shouf campus, in addition to the adjustable drawing tables they were using in these two campuses.

4.6- DISCUSSION AND FINDINGS

During the observation sessions the researchers performed, another time factor was noticed that was not discussed in the previous chapters. It was noticed that the reaction of students observed at the early hours of the day was different than those who were observed during late hours of the day. Afternoon students showed more discomfort and expressed more physical pain in the questionnaires than those who attended the earlier classes. That is to say that the researcher had to take into consideration that some students were having their first or second course, and others were in their third course and add a corresponding question in the questionnaire. Moreover, the graduate students that attended late classes were attending their first and only course of the day, but most of them were coming back from their jobs.

Based on the results of this study, it was concluded that the design and dimension combination of furniture in each of the classrooms is ergonomically unsuitable for a significant number of students at NDU. Despite the fact that the three campuses of the university provide five different types of educational furniture, the vast majority of them cannot find any appropriate combination for an acceptable seating arrangement. The university has different designs of furniture which were not appropriate. Plus, the lack of association between ergonomic mismatch and discomfort/ pain was obtained. This furniture is designed by local manufacturers without proper consideration of the anthropometry dimension requirements of the students. The studies of different researchers showed that there was a significant difference between the desk height and

the sum of elbow rest height and popliteal height of the students. Such mismatch may induce physical problems in those using the furniture. Students usually attend lectures in classrooms for a long period of time (about 4-5 h/day) in a sitting posture with ill designed classroom furniture. Incompatible furniture forced the students to adopt unnatural postures (lateral bend, forward bend, twisting, etc.) in the classroom for long periods.

Comparing the median, mean and standard deviation of the different anthropometric data of both male and female students at NDU, an average of dimensions of the different parts of the desk was obtained, that represents the ideal dimensions of a desk that would suit the NDU students. Referring to Lawson (2013) in the Literature review (p 27), furniture dimensions that are fixed (not adjustable), can be made ergonomic for the most common 50th percentile males and females. These dimensions are represented in table 4.5.

Desk parts	dimensions
Chair height	41 – 42.1
Chair depth	44.8
Chair plane to top of back rest	39.2
Table height	69- 71.6
Table depth	57
Length of table	51

Table 4.5: Recommended dimensions of the desk (by author)

The results of this study provide baseline information on the anthropometric measurements of students at the university level and on the suitability of the classrooms. These measurements lead to a combination of furniture dimensions that may be appropriate for university students (Table 4.5). Moreover, the results probably reflect the conditions at other universities in Lebanon.

5-CONCLUSION

This study is an exploratory research and relied on a case study where it intended to explore the research question and helped in having a better understanding of the problem that many Lebanese students are facing. It has identified a major challenge to health and learning of students at NDU, and proved the presence of mismatch between the anthropometric measurements of the students in relation to the furniture they are using.

Exploratory research is effective in laying the groundwork that will lead to future studies. Based on the knowledge gained from the literature and the original research components of this thesis highlighted by the importance of anthropometrics and ergonomics in the context of educational furniture in Lebanon, despecialization may be a possible approach to address the problems that were revealed through the accomplished analysis. Despite of the limited data found on this theory, and the limited tryouts done, the researcher found that more importance may be given to this theory. By using despecialization as a solution for the design malfunction presented in the used furniture, the desk will be used by all users, grounded on an ergonomic based design.

The desk is intended to support the needs of university students, engage active relationships, promote flexibility, allow for movement, provide multiple positions, encourage creative use, and enable building, while respecting their anthropometrics and being ergonomic. The university students need desks that support their bodies despite their sizes. They need to be seated on desks that can hold them for hours without causing them fatigue, and consequently motivate them and help them concentrate. This

can be achieved by isolating the primary functions of the classroom, such as sitting, containing, and supporting, and then breaking existing object (the desk) that serves these functions down into their elementary forms; planes, linear elements, containers (as storage for books and tools used by students), and cubes (the seats of the desks). By categorizing the functions of the desk, the designer is classifying it to a comfort and an object tool as it was done by Carreau and Pelletier. Consequently, the desk will have the most potentials such as having a generic form, offering work surface and storage, offered work surface and extensive storage, attracts students' attention and appears to have a novel form.

It is obvious that resources may place limitations on providing proper furniture, and that lack of knowledge about suitability of furniture could cause an institution with resources to provide improperly designed furniture to their students. There is a need to gather student anthropometric data which is presently lacking to work toward providing a better learning environment. Conducting similar studies in other Lebanese universities would be an appropriate strategy to this end. In addition, determining the health and learning problems associated with improperly designed furniture is also necessary. Such studies would help to develop an anthropometric standard for Lebanese students, which will serve as useful information for the construction of educational furniture, and inform policy making at the university executive level in working toward adequate ergonomic consideration before the construction of furniture in classrooms.

While the findings of this study are suggestive, they are based only on data from a sample in a single university district. The definition of mismatch focused on only a few furniture dimensions, such as height and seat length, disregarding the contributions that surface tilt, slope of back rest, and moldings may make to the fit to body dimensions. From the above findings and considering that this is a relatively small sample in

relation to the size and diversity of Lebanese students, it is recommended to develop an anthropometric database of students and on the basis of it, at the time of renewal of furniture, take into consideration this information. Moreover, there is a time factor that should be taken into consideration when conducting further researches, concerning the time of the day, and the number of courses attended by students through the day, where discomfort levels were expressed differently by students in the morning and in the afternoon.

The nature of this study encourages new studies involving end-users in the design process as the design being a user-centered. User- centered design refers to the use of rigorous and validated engineering tools to designs that focus on user goals. This includes the physical wellbeing goals for all the users that directly reflects the safety, effectiveness, and user satisfaction of the desk they may be using. This can be achievable when the six dimensions of user- centered design are incorporated (Comfort, safety, health, usability, functionality and psychological appeal). This is the stage when details about the target user (students) of design object (the desk) start playing their role where potential education level and professional background, influential social factors and typical environments of product usage are considered. On this basis, deeper research on preferences and peculiarities, special aspects of interactions, specifying ideas with important details of target audience's preferences, emotional and physical perception traits are used.

Through the consideration of developmental appropriate design elements, the desk is intended to promote physical, cognitive, social, and effective development. With the ability to rock, stack, and rotate, the product itself encourages the students to become physically active while using the desk and challenges them with balancing, lifting, and manipulation activities. Intellectual challenges are present through the consideration of

product placement, product exploration, and product creativity. Through the act of doing things with these products, students engage in shared activities that may strengthen social skills and social awareness with other students in the class like in the studio classes.

In conclusion, during the study that includes participants in a design process provides valuable information, working from basic forms can enable the production of despecialized objects beneficial for imaginative use, and that a design is never complete when the user continually, through use and adaptation, has the ability to change the function and meanings. The design process is continuous, even after it leaves the designers hands, when a product is designed for creativity, flexibility, change, and independence.

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APPENDIX A- INSTITUTIONAL REVIEW BOARD APPROVAL

NOTICE OF INSTITUTIONAL REVIEW BOARD APPROVAL

To : Christine Mady, PhD

From : Jocelyn Matar Boumosleh, PhD

Chair, IRB

Date: June 29th , 2017

RE: Protocol Ref'#: IRBSU17_3_FAAD

Protocol Title: **"Educational Well-being Driven by Despecialized Contextual Design"**

The above-mentioned research proposal was APPROVED following IRB Review for the duration of the protocol

- All changes or amendments to your protocol or consent form require review and approval by the IRB BEFORE Implementation
- If the research has been completed or if you wish to terminate the study, please notify the IRB via email at jboumosleh@ndu.edu.lb

Sincerely,

Jocelyne Matar Boumosleh

Ghazi Asmar, AVPRGS

ASSISTANT VICE PRESIDENT FOR GRADUATE STUDIES

APPENDIX B- CONSENT FORM FOR QUESTIONNAIRE OF PROFESSIONAL PRACTICE

CONSENT FORM FOR QUESTIONNAIRE OF PROFESSIONAL PRACTICE

Questionnaire for students

The board of the university, hereby gives consent to Yasmin El Hage, a master student in the Faculty of Design at Notre Dame University, to conduct a questionnaire among the students of the university as a part of a study.

We give permission to use the data collected and other information that may be collected, in the writing of the study.

The Board Director's Signature	Date
Researcher's Signature	Date

APPENDIX C- CONSENT FORM FOR OBSERVATION OF PROFESSIONAL PRACTICE

CONSENT FORM FOR OBSERVATION OF PROFESSIONAL PRACTICE

Observation of the university students in the lecture rooms

The board of the faculty, hereby gives consent to Yasmin El Hage, a master student in the Faculty of Design at Notre Dame University, to conduct observation sessions in the selected lecture rooms of the faculty as a part of a study.

We give permission to use the data collected and other information that may be collected, in the writing of the study.

The Board Director's Signature	Date
Researcher's Signature	Date

APPENDIX D- COVER LETTER FOR QUESTIONNAIRE

NOTRE DAME UNIVERSITY
—LOUAIZE—
جامعة سيدة اللويزة

Dear participants,

My name is Yasmin el Hage, and I am a master student at NDU. I am conducting a study on the university students for my research.

Completing this questionnaire will only take few minutes. The information will remain confidential, and your name will not be included. If you choose to participate, please answer all questions as accurately as possible, and return the questionnaire or ask for my help.

Thank you for taking time to assist me in my research. If you require additional information or have any question, please contact me at the number listed below.

03310709

Sincerely, Yasmin el Hage

APPENDIX E- QUESTIONNAIRE

Educational Wellbeing Driven by Despecialized Contextual Design

NOTRE DAME UNIVERSITY — LOUAIZE — جامعة سيدة اللويزة

Dear students,

Through this brief survey, your answers will be helpful in studying the ergonomic comfort of the desks you are using in the university. Please take a moment to fill it out as accurately as possible. Your response will only be used for the purpose of the research. Thank you for your time and suggestions.

1. **Your gender**
   ☐ Male ☐ Female
2. **Your age**
   ☐ 18-21 ☐ 22-26 ☐ 27-31 ☐ 32 and above
3. **How many courses are you enrolled in per semester?** _____
4. **Duration of each course:**
   _____ hours _____ days per week
5. **Have you ever suffered or knows someone who suffered from physical injury or pain caused by a university desk?**
   ☐ Yes ☐ No
   if yes, please describe what kind of injury or pain
   _____
6. **What do you appreciate about the desk you are currently using?**
   ☐ Size ☐ Design ☐ Adjustability ☐ Ergonomic comfort
   others, please specify_____

Please continue on the other side ⇨

7. **What do you dislike about the desk you are currently using?**
   ☐Size ☐Design ☐ Adjustability ☐ Ergonomic comfort
   others, please specify_____

8. **Please evaluate the following regarding the desk you are using, 1 being unacceptable and 5 being excellent and describe its convenience.**

Seat Pan Comfort	1	2	3	4	5	Describe:
Backrest comfort	1	2	3	4	5	Describe:
Seat height	1	2	3	4	5	Describe:
Seat width	1	2	3	4	5	Describe:
Table height (clearance)	1	2	3	4	5	Describe:
Table width	1	2	3	4	5	Describe:
Writing position	1	2	3	4	5	Describe:
Reading position	1	2	3	4	5	Describe:
Leg position	1	2	3	4	5	Describe:
Overall comfort of the desk	1	2	3	4	5	Describe:

9. **In your opinion, how could desks in the university be improved to suit you? / to meet your needs?**

_____

_____

_____

Thank you for participating in our survey.

APPENDIX F- QUESTIONNAIRE RESPONSE

student	1	2	3	4.1	4.2	5	6	7	8.1	8.2	8.3	8.4	8.5	8.6	8.7	8.8	8.9	8,10
1	M	1	3	2	2	Y	N	E	4	1	3	4	4	3	2	2	1	2
2	F	2	4	1.5	4	N	1	E	4	1	3	5	4	3	3	3	1	2
3	F	1	4	1.5	4	N	N	E	3	1	2	5	5	4	2	2	2	3
4	M	1	4	3	5	Y	N	E	3	2	3	5	5	2	1	2	2	2
5	M	1	5	2	5	Y	N	E	2	1	3	4	5	3	2	3	2	3
6	M	1	5	2	5	Y	N	1	3	1	4	4	4	3	1	2	1	2
7	F	1	4	2	2	Y	2	1	2	1	4	4	4	4	2	2	2	2
8	M	1	4	1	4	N	2,4	E	1	0	3	4	5	4	2	2	2	3
9	F	2	5	1	5	Y	N	E	1	0	4	3	5	3	2	2	1	2
10	F	2	5	1.5	5	Y	N	2	1	1	3	4	5	3	1	2	1	3
11	F	1	5	2	5	Y	N	1,2	2	1	4	4	4	2	3	3	2	2
12	M	1	4	2	2	Y	N	E	2	1	4	3	4	4	2	2	2	2
13	M	1	4	3	4	N	N	E	1	2	3	5	4	4	2	3	2	3
14	M	1	5	2	5	N	N	E	4	1	4	5	5	4	3	4	2	3
15	M	2	5	3	5	N	N	1	5	1	4	5	4	3	2	4	1	2
16	F	1	5	3	5	Y	N	E	4	1	4	5	5	3	1	2	1	3

17	F	1	5	3	5	Y	N	E	3	0	4	4	5	3	2	3	1	2
18	M	1	5	2	5	Y	N	1	3	0	3	4	4	3	2	3	2	3
19	F	1	5	1.5	5	Y	N	1	3	0	3	5	5	3	2	3	2	2
20	M	1	4	1	4	Y	1	E	2	1	3	4	4	4	3	4	1	2
21	M	1	4	1	4	Y	N	E	2	0	4	4	4	3	3	4	2	3
22	F	1	4	1	4	Y	2	1	1	1	4	5	5	2	1	2	2	3
23	M	2	4	1.5	2	Y	N	1,2	4	1	4	5	5	3	1	2	1	3
24	M	1	3	1.5	2	N	N	E	2	1	3	5	4	4	1	2	1	3
25	F	3	1	3	1	N	N	E	3	1	5	4	5	4	2	2	1	2
26	F	2	1	3	1	N	N	1	2	1	3	4	4	3	2	2	2	2
27	F	1	5	2	4	Y	N	E	3	1	4	5	4	3	2	2	2	4
28	F	1	5	3	4	Y	1,2	E	2	0	4	5	5	3	2	3	2	4
29	F	2	4	3	2	Y	N	E	2	0	3	4	5	4	3	4	1	3
30	M	2	4	3	2	Y	N	E	2	0	3	5	4	4	2	3	1	2
31	M	1	4	2	2	N	1	1,3	1	0	4	4	5	3	3	4	2	2
32	M	2	5	2	4	Y	1,2	1.4	5	1	4	5	5	2	2	4	1	2
33	M	1	5	3	4	Y	1,2	1.4	4	1	3	5	4	2	2	4	2	3
34	M	1	4	3	4	Y	N	4	4	1	3	5	5	3	1	2	1	2
35	F	2	4	3	5	Y	N	4	2	1	4	4	4	2	2	3	1	3
36	M	2	4	2	2	N	N	4	2	0	4	4	5	2	1	2	2	3

37	F	1	4	2	2	N	2	E	1	1	4	4	5	2	2	3	2	3
38	F	1	5	1	4	Y	1	E	3	0	4	4	4	3	3	3	2	2
38	F	1	5	1	4	Y	1	E	3	0	4	5	4	3	2	2	1	3
40	M	2	5	1	5	Y	N	1,2,4	1	0	5	4	4	2	2	2	1	2
41	M	2	4	2	2	N	N	1,2,3	4	1	4	5	5	3	3	3	1	2
42	M	2	5	2	4	N	N	E	4	1	4	5	5	2	3	2	1	2
43	F	1	4	2	4	Y	2	E	4	1	4	4	4	3	4	3	2	3
44	F	1	3	1	2	Y	1,2	E	3	1	3	5	5	3	3	4	2	1
45	F	1	3	1.5	2	Y	N	E	3	1	3	4	4	3	4	3	2	2
46	F	2	4	1.5	4	Y	N	E	2	1	3	4	4	4	3	3	2	2
47	M	2	4	1	2	N	N	E	3	2	4	4	3	3	3	3	1	2
48	M	2	4	2	3	Y	N	1,4	3	1	3	5	4	3	2	2	2	2
49	M	1	4	2	3	Y	N	1,2	3	1	4	5	5	3	2	2	1	1
50	M	1	5	2	5	Y	N	1,3	2	2	3	5	4	2	3	3	2	2
51	F	1	5	2	5	N	N	E	2	1	3	4	4	3	4	4	2	3
52	M	1	4	1	4	Y	1	E	2	1	4	4	4	3	2	2	1	2
53	F	1	5	1	5	Y	N	E	2	1	3	4	4	4	1	2	2	3
54	M	1	3	1	2	Y	N	1,3	3	2	4	4	5	3	3	1	2	3

55	M	2	2	1.5	2	Y	N	E	3	1	3	5	4	3	3	2	1	3
56	F	1	5	1.5	5	Y	N	E	3	2	3	5	5	2	4	3	2	3
57	F	1	5	1.5	5	Y	N	E	4	1	3	5	4	3	3	4	2	2
58	F	1	4	1	4	N	1,2	E	4	2	4	5	4	2	3	3	2	2
59	F	2	5	1	5	N	N	E	4	1	3	4	4	3	2	3	1	3
60	M	2	2	2	2	N	N	1,4	4	2	3	4	3	3	3	2	1	2
61	M	1	4	2	4	Y	N	1,3 ,4	4	2	3	4	3	4	4	2	1	3
62	F	2	3	2	3	Y	2	2	4	2	4	5	4	3	3	2	1	2
63	M	2	3	2	3	Y	N	E	3	2	5	5	5	3	4	3	1	3
64	M	2	2	3	2	Y	N	E	3	1	5	5	4	4	3	2	1	2
65	F	1	5	3	5	N	N	E	3	1	4	4	3	4	2	2	2	3
66	F	2	5	2	5	Y	N	E	3	1	3	5	4	4	2	3	2	3
67	F	1	5	3	5	Y	N	E	3	1	4	4	4	4	3	2	1	3
68	M	2	4	3	5	Y	N	E	2	1	3	5	4	3	2	3	2	3
69	M	2	4	2	4	Y	N	E	2	2	4	4	5	3	2	2	2	3
70	M	1	5	2	5	Y	N	E	2	1	3	5	4	4	4	3	1	3
71	M	1	5	2	4	N	N	E	3	2	4	5	4	3	3	2	1	3
72	F	1	4	1	4	Y	1	E	3	1	3	5	4	4	4	3	1	3
73	F	1	5	1	5	N	1,4	1,2	4	1	3	5	5	3	3	2	2	3

74	M	2	3	1.5	2	Y	N	E	4	2	4	4	5	4	2	2	1	3
75	F	2	3	1.5	2	Y	N	E	4	1	3	4	5	3	1	2	2	2
76	M	1	5	1.5	5	N	N	E	3	1	4	4	4	4	2	3	2	2
77	M	2	5	2	5	Y	N	E	2	1	4	5	4	4	3	3	2	2
78	F	1	4	2	5	Y	3	1,3	4	1	3	4	5	3	4	4	2	2
79	F	1	5	2	5	N	1	1,4	2	1	5	5	4	3	3	2	1	2
80	F	1	4	2	5	N	N	E	3	2	4	4	5	4	2	2	2	1
81	M	2	4	2	5	Y	N	E	4	2	4	5	4	3	3	1	2	2
82	F	1	5	1	5	Y	N	E	4	2	4	5	4	4	3	2	2	1
83	F	1	5	1	5	Y	N	E	3	1	3	4	4	3	4	4	1	2
84	M	1	5	1	5	Y	N	E	2	1	3	4	5	3	3	3	1	3
85	F	1	5	1	5	N	N	E	2	3	3	5	3	4	4	4	2	2
86	M	2	4	1.5	5	Y	N	E	4	1	5	4	5	3	3	3	1	3
87	M	1	4	2	4	Y	N	E	3	2	3	4	4	3	3	2	2	3
88	M	2	5	1	5	Y	N	E	2	1	3	5	5	2	2	3	1	2
89	F	1	4	2	4	Y	1	E	3	1	4	5	3	3	3	4	1	3
90	F	1	5	2	5	Y	1,2	E	4	2	4	4	5	2	2	2	1	2
91	M	2	4	1	4	N	1	E	1	1	3	4	4	2	2	2	2	3
92	M	1	5	1	5	Y	1	E	1	2	4	5	4	2	3	1	1	2
93	M	1	5	1.5	5	Y	1,2	E	4	2	3	5	4	3	4	2	2	2

94	F	2	5	2	5	N	N	E	3	2	3	5	3	3	2	3	1	2
95	M	1	5	1	5	Y	N	E	2	1	3	3	4	3	2	2	1	2
96	F	2	4	2	4	N	N	1,2	4	1	4	3	4	4	3	3	2	3
97	M	1	4	2	4	Y	N	1	2	1	3	4	5	3	4	1	1	2
98	F	1	5	1	5	Y	N	E	3	3	4	4	4	3	3	2	2	2
99	M	2	5	1	5	Y	N	E	3	2	3	4	4	3	4	3	2	1
100	M	2	5	1	5	N	N	E	4	2	3	5	5	3	3	4	1	1
101	M	2	4	2	4	N	1	E	2	3	3	5	5	4	2	2	1	1
102	F	1	4	2	4	Y	N	E	3	1	4	4	5	3	3	4	1	2
103	F	1	4	1	4	Y	N	E	3	2	3	5	4	3	3	2	2	2
104	F	1	5	2	5	Y	N	E	2	1	4	4	4	4	3	1	2	3
105	F	1	5	1	5	Y	N	1,2	3	1	3	5	5	3	3	3	1	3
106	F	1	5	2	5	N	N	2	4	1	3	4	5	5	2	3	2	2
107	M	1	5	2	5	N	N	2,3	2	1	4	4	4	5	4	3	2	3
108	M	2	4	2	2	Y	N	E	1	1	4	4	3	4	3	3	3	2
109	M	2	5	1	5	Y	N	E	1	2	4	4	3	5	3	3	1	2
110	M	1	5	1.5	5	Y	N	E	2	2	4	5	5	3	3	2	1	2
111	F	2	4	1.5	2	Y	N	E	4	2	3	5	4	4	2	3	2	2
112	M	1	5	2	5	Y	N	E	3	2	3	5	4	3	2	2	2	3
113	M	2	4	2	4	N	N	E	2	1	3	4	5	4	2	3	2	2

114	F	1	4	1	4	Y	N	E	3	1	4	3	3	5	3	2	1	3
115	F	1	5	1	5	Y	1	E	4	2	4	5	3	3	2	3	2	2
116	F	1	5	2	5	Y	1,2	3,4	2	1	4	4	4	4	3	2	1	2
117	M	1	5	1	5	N	N	E	3	1	4	5	5	4	4	4	2	2
118	F	2	3	1	3	N	N	E	4	1	4	4	4	2	4	4	1	1
119	M	2	3	2	3	Y	N	E	3	1	4	4	5	3	3	2	2	2
120	M	1	4	1	2	Y	N	1	2	2	4	5	5	4	2	3	2	3
121	F	2	4	1	2	Y	N	1,2	4	1	3	4	4	3	3	3	2	2
122	F	1	5	2	5	Y	N	E	4	1	4	4	4	4	4	3	1	2
123	F	2	3	3	4	Y	N	E	2	2	3	5	4	3	3	2	2	2
124	M	1	5	3	5	N	N	E	3	2	4	5	4	5	3	3	2	2
125	M	1	4	2	4	Y	N	1,3	3	1	4	4	4	3	2	3	2	2
126	F	1	4	2	4	Y	N	1,4	3	1	4	4	4	2	3	2	2	3
127	M	1	5	2	5	Y	N	E	4	1	3	3	5	4	4	2	1	2
128	F	2	3	1.5	2	N	N	E	3	1	4	4	5	3	4	2	1	3
129	M	2	4	1	2	Y	N	E	4	2	4	4	5	4	3	2	1	2
130	F	2	3	2	2	Y	N	E	4	1	3	4	4	3	4	3	1	2
131	M	2	4	2	4	Y	N	E	2	2	4	5	5	3	3	2	2	3
132	M	2	5	1	5	Y	N	E	2	1	4	4	4	3	4	3	2	2
133	M	2	5	2	5	N	N	E	1	1	3	5	5	4	4	1	1	3

134	F	1	4	3	4	Y	N	E	1	1	4	4	4	3	4	3	2	2
135	F	1	5	3	5	N	N	E	2	1	3	4	5	4	4	4	2	3
136	F	1	5	2	5	Y	N	E	2	2	4	4	4	5	3	3	1	3
137	M	1	4	3	4	N	N	E	2	1	3	4	4	4	3	2	1	3
138	F	1	5	1	5	Y	N	1,2	4	2	4	5	4	3	2	2	1	2
139	F	2	3	1.5	2	Y	N	E	2	1	3	4	4	5	2	1	2	2
140	M	2	2	3	2	Y	N	E	2	2	4	5	4	4	1	2	2	3
141	M	1	4	2	4	Y	N	E	3	1	3	4	4	3	3	3	2	2
142	M	1	5	2	5	N	1	E	3	2	4	5	4	4	3	1	2	3
143	F	2	1	3	1	Y	N	E	3	2	4	5	3	3	4	2	1	2
144	M	2	1	3	1	Y	N	E	3	2	4	5	3	4	4	3	1	3
145	M	1	5	1.5	5	N	N	E	3	2	4	4	4	5	2	2	1	2
146	F	1	4	2	4	Y	N	E	3	1	4	4	5	4	3	1	2	2
147	F	1	5	1	5	Y	N	E	3	1	3	3	5	3	3	3	2	2
148	F	2	1	3	1	N	N	E	2	1	4	4	5	2	4	2	1	3
149	F	2	1	3	1	Y	N	E	2	1	4	4	4	4	4	1	2	2
150	F	2	1	3	1	Y	N	1,4	4	2	3	4	4	5	3	1	1	3
151	F	1	5	1	5	N	N	1,3	4	1	5	5	4	4	3	2	2	2
152	M	2	4	1.5	4	Y	N	1	4	1	3	4	5	3	3	3	1	3
153	M	1	5	2	5	Y	N	E	3	2	5	5	4	4	3	3	1	2

154	M	1	5	2	5	Y	1	E	2	1	5	4	5	3	3	4	2	3
155	M	2	3	2	2	Y	N	E	2	1	3	5	4	4	3	3	1	3
156	F	2	3	2	2	Y	N	E	2	1	3	5	3	4	4	4	2	2
157	M	1	4	1.5	4	Y	N	E	3	1	2	4	3	4	4	2	2	3
158	F	1	5	2	5	Y	2	1,2	4	2	4	3	4	3	2	3	2	2
159	M	2	3	2	4	N	N	1	4	1	4	4	4	4	3	4	2	3
160	M	1	5	1	5	Y	N	E	2	1	3	5	4	4	3	4	1	2
161	M	2	3	1	2	Y	N	E	2	2	4	4	4	4	3	3	3	3
162	F	1	5	1	5	N	N	E	3	2	4	5	5	2	2	3	2	2
163	F	2	2	3	4	Y	4	E	3	1	3	4	4	3	3	2	2	2
164	M	1	5	2	5	Y	N	E	3	1	3	3	4	5	4	3	2	3
165	F	2	4	2	4	Y	N	1	3	2	4	4	5	5	4	4	2	2
166	F	2	3	2	2	N	N	E	2	1	3	5	4	4	4	3	1	3
167	F	1	4	2	4	N	N	2	4	2	4	4	5	4	2	2	1	3
168	M	2	2	3	2	Y	N	E	3	1	4	4	4	4	3	2	1	2
169	F	1	5	2	5	Y	N	E	2	1	4	4	5	3	3	2	1	1
170	M	2	4	2	4	Y	N	E	2	1	3	4	4	3	4	3	2	3
171	M	1	5	1	5	Y	1	E	2	2	3	5	4	3	3	2	2	3
172	M	1	5	1	5	Y	N	E	2	1	2	5	4	5	3	2	1	3
173	F	1	5	1	5	Y	N	E	2	1	3	4	5	3	3	3	2	2

174	F	2	5	1	5	Y	N	E	2	2	4	4	4	3	2	3	1	2
175	F	2	4	1	2	Y	N	E	2	1	3	3	4	2	3	3	2	2
176	F	2	4	2	4	Y	N	4	3	2	4	3	5	4	3	2	1	2
177	M	1	5	1	5	N	N	E	3	2	5	4	4	4	4	2	2	2
178	M	1	4	2	4	Y	N	E	2	2	4	4	3	4	3	2	3	3
179	M	1	4	2	4	Y	N	E	2	1	3	3	5	4	3	3	2	2
180	M	2	4	2	4	N	N	E	3	2	4	3	4	3	3	2	1	3
181	F	2	3	3	4	Y	N	E	3	2	3	3	5	3	2	2	1	3
182	F	2	3	3	4	Y	N	1	3	2	3	4	4	3	3	3	2	3
183	M	2	2	3	2	Y	N	1,2	4	1	3	4	4	4	3	2	2	3
184	F	1	4	2	4	N	N	E	3	2	3	4	4	3	4	3	2	2
185	M	1	4	2	4	Y	N	E	3	1	2	3	4	3	3	1	1	2
186	M	2	5	2	5	Y	N	E	3	2	4	3	3	3	3	3	2	2
187	F	2	3	3	4	Y	N	E	3	1	3	4	4	3	3	4	2	2
188	F	2	4	2	4	Y	1	E	3	1	3	4	4	5	4	3	1	1
189	F	1	4	1	4	Y	N	E	3	1	4	3	5	3	3	3	1	2
190	M	1	5	1	5	N	N	E	3	1	4	4	4	2	2	2	1	2
191	M	1	5	1	5	Y	N	E	3	1	3	4	5	3	3	3	1	3
192	F	1	5	1	5	Y	1	E	3	1	3	3	4	4	4	2	1	2
193	M	1	5	2	5	Y	N	E	3	1	3	3	5	3	3	2	1	3

194	M	1	4	1	4	Y	N	E	3	2	3	3	4	3	3	2	1	2
195	F	1	4	1	2	N	N	E	2	2	4	3	4	3	3	3	1	3
196	F	1	4	2	4	Y	N	E	2	2	4	4	3	3	2	2	2	3
197	F	2	3	2	4	Y	1,2	1,2	4	1	4	4	4	4	3	3	1	2
198	F	1	4	2	4	N	N	E	2	2	2	4	5	4	4	2	1	2
199	F	1	5	1	5	Y	N	E	2	1	3	5	4	3	4	2	1	3
200	M	1	4	1.5	4	Y	N	E	2	2	3	4	4	4	3	3	2	2
201	M	2	4	2	4	N	N	2	4	1	3	5	5	3	3	4	2	3
202	F	1	5	2	5	Y	N	2	4	1	4	4	4	4	4	2	2	2
203	F	1	4	1	4	Y	N	E	3	1	4	3	5	3	3	3	1	2
204	M	1	5	1	5	N	N	E	3	1	4	4	4	2	2	2	1	2
205	M	1	5	1	5	Y	N	E	3	1	3	4	5	3	3	3	1	3
206	F	1	5	1	5	Y	1	E	3	1	3	3	4	4	4	2	1	2
207	M	1	3	2	2	Y	N	E	3	1	4	3	3	5	3	2	1	3
208	F	2	4	1.5	4	N	1	E	4	2	4	5	3	3	2	3	2	2
209	F	1	4	1.5	4	N	N	E	2	1	4	4	4	4	3	2	1	2
210	F	1	4	3	5	Y	N	E	3	1	4	5	5	4	4	4	2	2
211	F	1	5	2	5	Y	N	E	4	1	4	4	4	2	4	4	1	1
212	F	1	5	2	5	Y	N	1	3	1	4	4	5	3	3	2	2	2
213	M	1	4	2	2	Y	2	1	2	2	4	5	5	4	2	3	2	3

214	M	1	4	1	4	N	2,4	E	4	1	3	4	4	3	3	3	2	2
215	M	1	3	1.5	2	N	N	E	1	0	3	4	5	4	2	2	2	3
216	M	3	1	3	1	N	N	E	1	0	4	3	5	3	2	2	1	2
217	M	2	1	3	1	N	N	1	1	1	3	4	5	3	1	2	1	3
218	F	1	5	2	4	Y	N	E	2	1	4	4	4	2	3	3	2	2
219	M	1	5	3	4	Y	1,2	E	2	1	4	3	4	4	2	2	2	2
220	F	2	4	3	2	Y	N	E	1	2	3	5	4	4	2	3	2	3
221	M	2	4	3	2	Y	N	E	4	1	4	5	5	4	3	4	2	3
222	M	1	4	2	2	N	1	1,3	2	0	3	4	5	4	3	4	1	3
223	F	2	5	2	4	Y	1,2	1.4	4	1	3	5	5	3	3	2	2	3
224	M	1	5	3	4	Y	1,2	1.4	4	2	4	4	5	4	2	2	1	3
225	M	1	4	3	4	Y	N	4	4	1	3	4	5	3	1	2	2	2
226	M	2	4	3	5	Y	N	4	3	1	4	4	4	4	2	3	2	2
227	F	2	4	2	2	N	N	4	2	1	4	5	4	4	3	3	2	2
228	F	1	4	2	2	N	2	E	4	1	3	4	5	3	4	4	2	2
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230	M	1	5	1	4	Y	1	E	3	2	4	4	5	4	2	2	2	1
231	F	2	5	1	5	Y	N	1	2	0	3	4	5	4	3	4	1	3
232	M	2	4	2	2	N	N	1,2	1	0	3	4	5	4	2	2	2	3

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233	M	2	5	2	4	N	N	E	1	0	4	3	5	3	2	2	1	2
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235	M	1	3	1	2	Y	1,2	E	2	1	4	4	4	2	3	3	2	2
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237	F	1	4	2	4	Y	N	E	1	2	3	5	4	4	2	3	2	3
238	M	1	5	2	5	N	1	E	4	1	4	5	5	4	3	4	2	3
239	F	2	1	3	1	Y	N	E	2	1	3	5	4	4	3	4	1	2
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242	M	1	4	2	4	Y	N	E	3	1	3	4	4	3	3	2	2	2
243	M	1	5	1	5	Y	N	E	3	1	3	3	4	5	4	3	2	3
244	M	2	1	3	1	N	N	E	3	2	4	4	5	5	4	4	2	2
245	M	2	1	3	1	Y	N	E	2	1	3	5	4	4	4	3	1	3
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250	M	2	3	2	2	N	N	E	2	1	3	3	4	2	3	3	2	2
251	M	1	4	2	4	N	N	2	3	2	4	3	5	4	3	2	1	2
252	F	2	2	3	2	Y	N	E	3	2	5	4	4	4	4	2	2	2

253	F	1	5	2	5	Y	N	E	2	2	4	4	3	4	3	2	3	3
254	M	2	4	2	4	Y	N	E	2	1	3	3	5	4	3	3	2	2
255	M	1	5	1	5	Y	1	E	3	2	4	3	4	3	3	2	1	3
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264	F	1	4	2	4	Y	N	E	2	2	4	5	5	4	2	3	2	3
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266	F	1	3	1.5	2	N	N	E	3	1	4	4	4	2	2	2	1	2
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269	F	1	5	2	4	Y	N	E	3	1	3	3	5	3	3	2	1	3
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271	F	2	4	3	2	Y	N	E	2	2	4	3	4	3	3	3	1	3
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273	M	1	4	2	2	N	1	1,3	3	2	4	3	5	4	3	2	1	2
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281	F	1	5	2	5	Y	N	1	2	1	4	3	4	4	2	2	2	2
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290	M	1	5	1	4	Y	1	E	3	1	3	3	4	5	4	3	2	3
291	F	1	5	1	4	Y	1	E	3	2	4	4	5	5	4	4	2	2

292	M	2	5	1	5	Y	N	1,2,4	2	1	3	5	4	4	4	3	1	3
293	M	2	4	2	2	N	N	1,2	3	1	4	4	4	2	2	2	1	2
294	F	2	5	2	4	N	N	E	3	1	3	4	5	3	3	3	1	3
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307	F	1	3	1.5	2	N	N	E	3	2	4	4	5	4	2	2	2	1
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309	F	2	1	3	1	N	N	1	1	1	3	4	5	3	1	2	1	3
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311	F	1	5	3	4	Y	1,2	E	2	1	4	4	4	4	3	2	1	2
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320	M	1	5	1.5	5	N	N	E	4	1	3	5	5	3	3	4	2	3
321	F	1	4	2	4	Y	N	E	4	1	4	4	4	4	4	2	2	2
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325	M	2	1	3	1	Y	N	1,4	3	1	3	3	4	4	4	2	1	2
326	M	2	3	2	2	N	N	E	4	1	4	4	4	2	4	4	1	1
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331	M	1	5	1.5	5	N	N	E	3	1	3	4	4	3	3	2	2	2
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333	F	1	5	2	5	Y	N	E	3	2	4	4	5	5	4	4	2	2
334	F	2	4	2	4	Y	N	1	2	1	3	5	4	4	4	3	1	3
335	M	2	3	2	2	N	N	E	4	2	4	4	5	4	2	2	1	3
336	M	1	4	2	4	N	N	2	3	1	4	4	4	4	3	2	1	2
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338	M	1	5	2	5	Y	N	1	2	1	3	4	5	3	3	3	2	2
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345	F	1	5	1	5	Y	1	E	3	2	4	3	4	3	3	2	1	3
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350	F	2	3	2	4	Y	1,2	1,2	4	1	3	5	5	3	3	4	2	3

351	F	2	3	2	2	N	N	E	4	1	4	4	4	4	4	2	2	2
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354	M	1	5	2	5	Y	N	E	3	1	3	4	5	3	3	3	1	3
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407	F	2	5	1	5	N	N	E	3	2	4	3	4	3	3	2	1	3
408	M	3	1	3	1	N	N	E	3	1	4	4	4	2	2	2	1	2

409	M	2	1	3	1	N	N	1	3	1	3	4	5	3	3	3	1	3
410	F	1	5	2	4	Y	N	E	3	1	3	3	4	4	4	2	1	2
411	F	1	5	3	4	Y	1,2	E	3	1	3	3	5	3	3	2	1	3
412	M	2	2	3	2	Y	N	1,2	3	2	3	3	4	3	3	2	1	2
413	F	2	5	2	4	Y	1,2	1.4	2	2	4	3	4	3	3	3	1	3
414	F	1	5	3	4	Y	1,2	1.4	2	2	4	4	3	3	2	2	2	3
415	M	1	4	3	4	Y	N	4	4	2	4	5	3	3	2	3	2	2
416	F	2	4	3	5	Y	N	4	2	1	4	4	4	4	3	2	1	2
417	F	2	4	2	2	N	N	4	3	1	4	5	5	4	4	4	2	2
418	F	1	4	2	2	N	2	E	4	1	4	4	4	2	4	4	1	1
419	M	1	5	1	4	Y	1	E	3	1	4	4	5	3	3	2	2	2
420	F	1	5	1	4	Y	1	E	2	2	4	5	5	4	2	3	2	3
421	F	2	5	1	5	Y	N	1,2,4	4	1	3	4	4	3	3	3	2	2
422	M	2	4	2	2	N	N	1,2,3	4	1	3	5	5	3	3	2	2	3
423	M	2	5	2	4	N	N	E	4	2	4	4	5	4	2	2	1	3
424	M	1	4	2	4	Y	2	E	4	1	3	4	5	3	1	2	2	2
425	F	1	3	1	2	Y	1,2	E	3	1	4	4	4	4	2	3	2	2
426	F	1	3	1.5	2	Y	N	E	2	1	4	5	4	4	3	3	2	2

427	F	2	2	3	4	Y	4	E	4	1	3	4	5	3	4	4	2	2
428	F	1	5	2	5	Y	N	E	2	1	5	5	4	3	3	2	1	2
429	M	2	4	2	4	Y	N	1	3	2	4	4	5	4	2	2	2	1
430	M	2	3	2	2	N	N	E	4	1	4	4	4	2	4	4	1	1
431	M	1	4	2	4	N	N	2	3	1	4	4	5	3	3	2	2	2
432	F	2	2	3	2	Y	N	E	2	2	4	5	5	4	2	3	2	3
433	M	1	5	2	5	Y	N	E	2	0	3	4	5	4	3	4	1	3

APPENDIX G- ANTHROPOMTRIC DATA

student	sex	height	elbow height	shoulder height	upper arm length	knee height	popliteal height	buttock-popliteal height
1	female	167	12	60	37	50	45	47
2	female	168	17	57	36	49	43	53
3	male	187	20	60	45	62	55	60
4	female	170	22	59	38	52	47	53
5	male	183	20	63	42	56	48	57
6	male	179	21	61	40	57	49	52
7	female	170	19	58	37	54	48	53
8	male	180	20	67	44	62	56	60
9	male	170	18	57	36	53	47	53
10	male	179	23	59	43	57	50	52
11	male	183	23	67	43	54	48	53
12	male	176	21	58	40	54	49	50
13	female	148	16	53	33	47	40	42
14	male	190	23	62	44	63	56	64
15	male	180	19	60	40	55	50	58
16	female	157	16	55	31	47	40	51
17	female	155	15	47	29	49	43	53
18	male	173	20	56	30	56	48	53
19	female	165	18	54	36	51	46	55

20	male	179	23	58	35	54	47	60
21	male	177	22	58	35	56	47	60
22	female	171	19	60	34	52	45	59
23	female	172	20	63	34	50	41	54
24	male	163	12	55	39	51	44	45
25	male	188	22	67	45	61	52	60
26	male	178	19	61	43	55	48	53
27	male	168	16	53	28	51	42.5	49
28	male	182	26	70	47	61	52	61
29	male	174	21	60	39	56	46	54
30	male	170	18	55	36	56	47	51
31	male	178	23	62	43	65	54	57
32	male	177	19	59	39	58	49	55
33	male	174	13	51	32	54	43	48
34	male	188	22	66	46	62	52	58
35	male	180	20	61	41	57	48	52
36	female	156	14	52	37	51	43	47
37	female	178	22	62	43	59	47	59
38	female	167	16	55	38	53	45	56
39	female	160	16	49	32	48	40	48
40	female	171	25	63	42	56	46	55
41	female	164	19	58	38	52	43	52
42	female	163	13	54	38	53	44	49
43	female	174	23	63	41	61	50	55
44	female	172	18	58	40	57	46	52

45	male	183	21	60	38	57	47	61
46	female	181	24	61	37	57	44	60
47	female	168	25	58	33	50	41	46
48	male	178	23	62	34	55	46	53
49	male	186	19	62	40	60	50	60
50	female	167	22	56	35	50	44	56
51	female	162	18	53	32	50	40	55
52	female	169	21	54	32	51	42	56
53	male	174	14	51	32	53	43	48
54	male	188	22	66	46	62	52	57
55	male	177	20	61	40	57	48	51
56	female	156	16	51	33	50	43	49
57	female	176	26	63	42	60	51	61
58	female	169	19	60	39	56	46	53
59	male	172	12	51	32	54	46	50
60	male	162	16	51	31	50	43	46
61	male	189	25	67	47	65	54	59
62	female	159	14	50	30	51	44	46
63	male	178	23	62	41	59	49	53
64	male	179	19	60	40	58	50	53
65	female	154	13	53	31	50	43	45
66	female	175	30	67	43	58	53	56
67	male	172	21	58	37	54	46	52
68	female	173	26	62	41	63	49	55
69	female	167	17	55	38	54	48	52

70	female	161	20	57	36	52	44	51
71	female	157	17	54	32	49	43	48
72	female	174	22	58	39	60	51	56
73	male	173	16	53	32	51	43	51
74	male	177	21	60	41	57	47	54
75	female	162	20	57	36	52	44	51
76	male	182	23	64	44	66	51	59
77	male	171	16	54	36	53	43	48
78	male	155	14	52	32	50	42	48
79	female	157	16	53	31	49	40	49
80	female	157	13	51	36	52	42	50
81	male	187	23	66	46	62	51	57
82	male	192	26	63	44	63	53	59
83	male	176	19	60	40	57	47	53
84	female	169	24	60	39	56	46	59
85	female	162	21	58	36	52	44	51
86	male	173	18	57	38	56	47	54
87	female	187	23	66	44	62	51	55
88	female	169	18	57	39	56	45	54
89	male	176	12	58	41	53	47	49
90	male	170	16	52	32	53	45	50
91	female	164	15	56	34	33	46	49
92	female	172	21	61	41	58	51	54
93	male	191	19	65	47	63	54	56
94	male	196	23	64	48	67	58	60

95	male	179	16	60	43	59	50	53
96	female	162	16	54	33	50	43	49
97	female	174	26	62	40	60	50	62
98	male	177	19	59	39	58	48	54
99	female	166	18	58	41	55	48	51
100	female	167	22	59	36	55	45	55
101	female	168	23	62	39	52	43	53
102	female	160	19	53	34	49	42	55
103	male	187	19	58	39	48	59	63
104	female	165	25	61	36	52	42	60
105	female	173	22	59	37	52	45	63
106	male	169	38	63	25	56	46	47
107	female	168	24	58	36	51	43	50
108	male	188	21	61	40	57	48	61
109	male	184	21	61	40	58	49	56
110	male	183	24	64	40	56	47	56
111	male	185	20	60	40	58	47	58
112	female	166	22	59	37	52	43	54
113	female	161	23	59	36	53	44	57
114	male	171	20	54	34	43	51	52
115	male	173	16	52	35	45	56	58
116	male	181	23	60	37	56	44	62
117	male	190	17	59	42	60	52	64
118	female	164	20	55	35	51	42	54
119	male	183	23	61	38	51	47	56

120	male	189	16	58	42	61	49	65
121	male	187	26	61	39	58	47	58
122	female	161	17	53	36	50	42	58
123	male	174	23	60	37	55	48	61
124	male	175	19	55	38	57	47	58
125	male	178	22	61	39	59	48	43
126	female	180	21	62	41	58	50	62
127	male	178	26	64	38	54	44	55
128	female	172	17	55	38	55	44	62
129	female	169	19	54	35	54	46	57
130	male	193	24	67	43	60	50	67
131	male	187	21	61	40	58	48	60
132	female	161	21	54	33	53	43	55
133	male	180	20	60	40	53	44	55
134	male	186	29	69	40	59	49	65
135	female	168	26	63	37	55	44	65
136	female	159	19	54	35	52	44	57
137	female	152	21	55	34	49	39	53
138	male	177	26	62	36	55	45	59
139	female	162	20	56	36	50	40	58
140	male	173	20	57	37	55	46	57
141	female	170	20	59	39	54	47	46
142	male	166	20	54	34	54	44	57
143	male	173	20	56	30	56	48	53
144	female	164	18	54	36	51	46	55

145	male	179	23	57	35	54	47	60
146	male	177	22	58	35	56	47	60
147	female	171	19	61	34	52	45	59
148	female	170	19	63	34	51	41	54
149	male	163	12	54	38	51	44	43
150	male	188	22	67	45	60	52	60
151	male	178	19	61	43	55	48	53
152	male	167	16	53	28	51	42.5	48
153	male	182	25	71	48	60	53	61
154	male	173	21	60	39	56	46	54
155	male	170	18	55	36	56	48	52
156	female	164	19	58	38	52	43	52
157	female	163	13	54	38	53	44	49
158	female	173	23	63	41	61	50	55
159	female	172	19	58	40	57	46	52
160	male	183	21	61	38	57	47	61
161	female	181	24	61	36	57	44	60
162	female	168	25	58	33	51	41	46
163	male	178	23	62	34	55	45	53
164	male	186	19	62	40	60	50	59
165	female	167	22	56	35	50	43	56
166	female	162	18	53	32	50	40	54
167	female	167	20	54	31	51	42	56
168	female	157	18	54	32	49	42	48
169	female	175	21	58	39	60	51	55

170	male	173	16	53	32	51	42	51
171	male	177	21	60	41	57	47	53
172	female	163	20	57	36	52	44	51
173	male	182	23	64	44	66	51	59
174	male	173	17	53	36	53	42	47
175	male	155	14	51	32	49	42	48
176	female	156	16	54	31	49	41	49
177	female	157	12	52	36	52	42	51
178	male	188	23	67	45	62	51	57
179	male	192	25	63	44	63	53	58
180	male	175	18	61	40	57	48	53
181	female	169	23	60	39	55	46	59
182	female	161	22	57	35	52	44	52
183	male	173	17	57	38	56	47	54
184	female	188	22	66	44	61	51	55
185	female	169	19	57	39	55	45	53
186	male	175	13	56	40	53	47	49
187	male	170	17	52	32	53	44	50
188	female	165	15	55	33	33	46	48
189	female	172	19	61	41	57	50	54
190	male	192	19	66	47	63	54	57
191	male	196	22	64	49	67	57	60
192	female	152	21	55	34	49	39	53
193	male	177	26	62	36	55	45	59
194	female	162	20	56	36	50	40	58

195	male	173	20	57	37	55	46	57
196	female	170	20	59	39	54	47	46
197	male	167	20	53	34	55	44	56
198	male	173	19	56	31	56	47	53
199	female	164	18	53	36	51	46	55
200	male	179	23	57	35	54	47	61
201	male	177	21	58	35	56	47	60
202	female	171	19	61	34	51	45	59
203	female	170	19	63	34	51	41	55
204	male	163	12	54	37	51	44	43
205	male	188	22	66	45	59	52	61
206	male	187	20	60	45	62	55	60
207	female	170	21	59	38	52	47	53
208	male	184	20	63	42	55	48	57
209	male	179	21	61	40	57	49	52
210	female	172	20	57	30	56	49	53
211	female	165	19	54	37	51	46	56
212	male	179	23	58	34	54	47	59
213	male	176	21	57	35	56	47	60
214	female	171	19	59	34	52	45	61
215	female	174	21	58	39	59	51	56
216	male	172	15	54	32	51	44	51
217	male	177	22	60	42	57	47	54
218	female	162	20	57	36	52	43	51
219	male	182	23	63	44	65	51	58

220	female	171	16	54	36	53	43	48
221	female	170	21	59	37	52	48	53
222	male	183	19	63	42	55	48	56
223	male	179	21	62	40	58	49	53
224	female	171	18	60	33	52	44	59
225	female	172	20	63	35	50	41	54
226	male	163	12	55	39	51	43	45
227	male	188	22	66	45	61	52	60
228	male	178	18	61	43	54	48	53
229	female	168	16	54	28	51	42.5	49
230	male	182	26	70	46	61	52	61
231	male	174	21	60	39	56	45	54
232	male	183	21	60	38	57	47	61
233	female	181	24	61	36	57	44	59
234	female	168	24	58	33	49	41	46
235	male	178	23	62	33	55	46	54
236	male	186	19	62	40	60	50	60
237	female	167	21	56	34	50	43	56
238	female	162	18	53	32	50	40	54
239	female	169	21	54	32	51	41	56
240	male	174	14	51	33	53	43	48
241	male	188	22	66	46	62	52	57
242	male	176	18	60	40	57	47	53
243	female	169	24	59	39	56	46	59
244	female	162	21	58	36	51	44	50

245	male	173	18	57	38	56	46	54
246	female	187	23	66	43	62	51	55
247	female	173	17	55	35	56	47	53
248	male	173	20	55	30	56	49	53
249	female	165	18	54	36	51	46	56
250	male	179	23	58	35	54	48	62
251	male	177	21	58	34	56	47	60
252	female	171	19	59	34	52	45	59
253	female	174	22	58	40	60	51	56
254	male	173	16	53	32	51	43	52
255	male	177	21	59	41	56	47	54
256	female	162	19	57	36	52	44	51
257	male	182	23	63	44	65	51	59
258	female	171	16	54	36	53	43	49
259	male	187	20	60	45	62	54	60
260	female	170	22	59	38	51	47	53
261	male	183	20	63	43	56	48	57
262	male	179	21	62	40	57	49	52
263	female	167	19	56	36	50	45	52
264	male	174	14	51	32	54	43	48
265	male	188	22	65	46	62	52	58
266	male	180	20	61	42	57	48	52
267	female	156	14	52	37	52	43	47
268	female	178	22	62	43	59	48	59
269	female	167	16	55	38	53	45	57

270	female	160	16	49	32	48	41	48
271	female	171	25	63	42	57	46	55
272	female	164	19	58	37	52	43	52
273	female	168	20	59	37	55	45	53
274	male	183	20	60	38	57	47	61
275	female	181	23	61	36	57	44	60
276	female	168	25	58	33	50	41	46
277	male	178	23	62	33	55	45	53
278	male	186	19	62	40	61	50	61
279	female	167	22	56	35	50	43	56
280	female	162	18	53	32	49	40	55
281	female	169	21	54	31	51	42	56
282	male	174	14	52	32	53	43	48
283	male	188	21	66	46	62	52	57
284	male	179	22	57	35	54	47	60
285	male	177	22	58	34	56	47	60
286	female	171	19	60	34	51	45	59
287	female	174	22	58	39	60	50	56
288	male	173	16	53	32	51	43	52
289	male	177	21	60	41	57	46	54
290	female	162	20	57	36	53	44	51
291	male	182	23	64	43	66	51	59
292	female	171	16	53	36	53	43	48
293	male	176	18	60	40	57	47	53
294	female	169	23	60	38	56	46	59

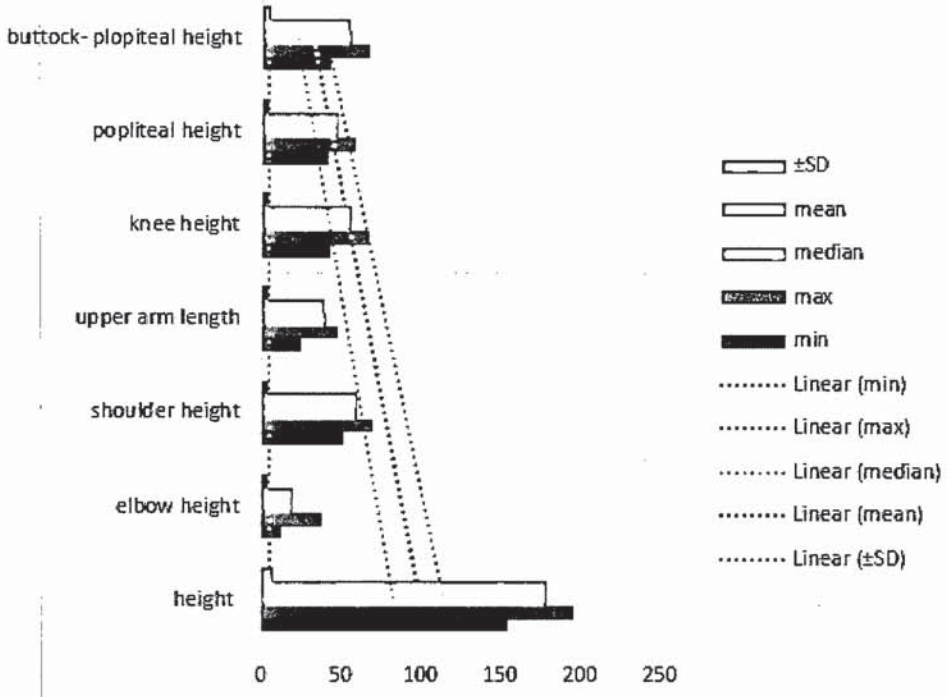
295	female	162	21	57	36	52	44	51
296	male	173	18	57	37	56	47	54
297	female	187	23	66	44	61	51	55
298	female	170	22	59	38	52	46	53
299	male	183	20	63	42	56	48	56
300	male	179	21	61	40	57	50	52
301	female	171	19	60	33	52	45	59
302	female	172	20	64	34	50	41	54
303	male	163	13	55	39	51	44	45
304	male	188	22	66	45	62	52	60
305	male	178	19	61	43	55	48	53
306	male	168	16	54	28	51	42.5	49
307	male	182	26	70	47	60	52	61
308	female	174	21	60	39	56	47	54
309	male	174	13	51	32	54	43	47
310	male	188	22	66	46	62	51	58
311	male	180	20	61	41	56	48	52
312	female	156	14	52	36	51	43	47
313	female	178	22	61	43	59	47	59
314	female	167	17	55	38	53	45	56
315	female	160	16	47	32	48	40	48
316	female	171	24	63	42	56	46	55
317	female	164	19	58	38	53	43	52
318	female	165	18	54	36	51	46	54
319	male	179	23	58	35	54	47	60

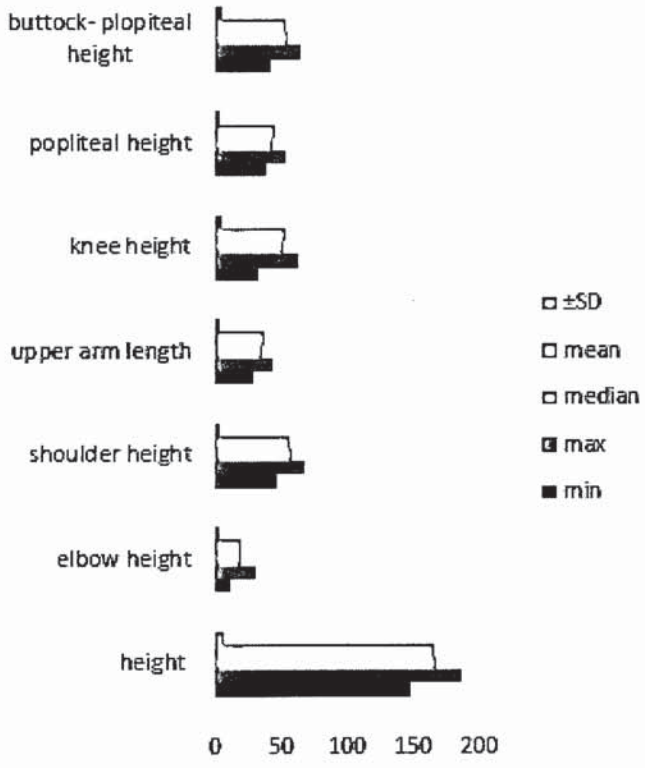
320	male	177	22	58	35	56	47	61
321	female	171	19	60	34	52	44	59
322	female	169	18	58	34	51	42	56
323	male	183	21	61	38	57	47	61
324	female	181	24	61	36	57	43	60
325	female	168	25	58	33	51	41	45
326	male	178	23	62	34	55	45	53
327	male	186	19	62	40	59	50	60
328	female	167	22	56	34	50	44	56
329	female	162	18	52	32	50	40	55
330	female	169	20	54	32	51	42	56
331	male	174	14	50	32	53	43	48
332	male	188	22	66	45	62	52	57
333	female	170	20	53	32	48	41	54
334	female	175	21	62	44	57	43	57
335	female	155	13	50	35	51	42	47
336	male	174	13	51	33	54	43	48
337	male	188	21	65	46	62	52	58
338	male	180	20	60	41	57	48	52
339	female	156	14	52	38	51	44	47
340	female	178	22	62	43	59	47	60
341	female	167	16	55	38	53	44	56
342	female	160	16	49	32	47	40	48
343	female	171	25	63	43	56	46	55
344	female	164	19	57	38	52	43	52

345	female	170	21	59	38	52	47	53
346	male	183	20	62	42	56	48	57
347	male	179	21	61	41	57	49	52
348	female	174	22	58	39	61	51	56
349	female	173	16	53	32	51	42	51
350	male	177	21	60	41	57	47	53
351	female	162	20	57	36	53	44	51
352	male	182	23	64	44	66	52	59
353	male	171	16	54	37	53	43	48
354	female	163	12	54	39	51	44	45
355	male	188	20	67	45	61	52	60
356	male	178	19	60	43	55	48	53
357	male	168	16	53	27	51	42.5	49
358	male	182	26	70	47	60	52	61
359	male	174	21	60	39	56	45	54
360	male	183	21	60	38	57	47	60
361	female	181	24	61	37	57	43	60
362	female	168	25	58	33	52	41	46
363	male	178	23	62	33	55	46	53
364	male	186	19	61	40	60	50	60
365	female	167	21	56	35	50	44	56
366	female	162	18	53	31	50	40	55
367	female	169	21	53	32	51	42	56
368	male	174	14	51	31	53	43	48
369	male	188	22	66	46	61	52	57

370	male	187	20	60	45	62	54	60
371	female	170	22	59	38	52	47	54
372	male	183	20	63	42	55	48	57
373	male	179	21	61	41	57	50	52
374	female	174	22	58	38	60	51	56
375	female	173	16	52	32	51	43	51
376	male	177	20	60	41	57	47	54
377	female	162	20	56	36	52	44	51
378	male	182	23	64	43	66	51	59
379	male	171	16	54	36	52	43	48
380	male	177	22	58	35	56	46	60
381	female	171	19	60	34	52	45	60
382	female	167	17	55	32	49	42	55

APPENDIX H- CLUSTERED BAR CHARTS





Session 6 — 30/oct/2017

FAAD — Dr. May — 1 to 4 pm

Studio Classroom (Presentation session)

- The furniture presented is the same as all studios (check pic) [inserted above: "studios"]
- No. of students: 18 — 5 males, 13 females
- students are looking for their comfort spot around the room
- moving the furniture all around
- some are still moving around

1:10
- 2 students (male + female) are sitting on the table. (writing on their lap)
- 3 " have their hands supporting their heads leaning on the table
- 4 have their elbows on the table (either writing or just supporting their body)
- even the Dr got up the chair & is leaning on the back

1:13 →
- 1 student got another chair to support her legs
- " has one leg under her & the other swinging
- 1 student is supporting his head with his shoulder.
- the guy on the table is constantly moving his head & back.

- 1 student is moving her back left & right trying to comfort her ba[ck]
- 3 mkatafin.

1:21 →
- the guy that was sitting on the table moved to a chair
- 1 guy is sitting as follows: hand hugging the back rest of the chair, crossed legs supported by the table
- 1 student stood up & is leaning against the wall.
- the guy stood up again & is sitting now on the table again
- she is back to her seat within 5 mins

... 7at a2ud kl shwai aktar ...

1:30 → 1 student is using her lap as support for her writing instead w) the table infront of her

1:35 → → the same student stood up again & is supporting her body against the wall

- 1 girl is trying to [illegible] desks.
- the guy that keeps sitting on the table & then on the chair moved again to the chair → in 2 mins he got out of class.
- the guy that was [illegible] now has his foot on the chair [illegible].

1:45 → - 1 girl moved her phone for posture (website)
- 1 girl is leaning her head on her friends shoulder
- the guy with foot on the chair just stood up moving both legs taking short walks around.

1:54 → a girl with good posture is moving on her chair trying to [illegible] her back (same girl)
- [illegible] supporting their elbows against the desks.

2:00 → the students are asked to choose their own corner to be used as their own studio, move the furniture they use (table, chair, panel)

Session 7

Dr Ahmad

Oct-30

5-8pm

(Studio Session)

- N°of students : 3 (females) + the Dr.

- Presented furniture - some of previous students

5:30

① - student had her legs crossed, back leaned forward, hands holding her head, both elbows on the table.
- she places her back backward but has a poor posture. (not all comfy)

② - has her legs crossed, back to the back, leans in the chairs back with the laptop.

5:45

③ - crossed legs, leans forward with her laptop.

④ - The Dr is using the same furniture as the students
- he has his back rested to the back.
- crossed legs.
- hands on the table.
- leans forward occasionally then takes his first posture.
- turns around occasionally.

TED

Students need to change their seats when they need to check the smartboard

the [illegible] using the desk as a seat.

6:30 - After watching a 15 min video:

- During the movie the Dr kept moving..
- the students asked for a break
-
take a break & got back to class at 6:50

[illegible]

—▷ the students are leaning forward in order to be able to use their laptop.

—▷ the Dr. changed his seat & got an adjustable office like chair with wheels & fabric

—▷ The researcher is about to cry of her back pain.

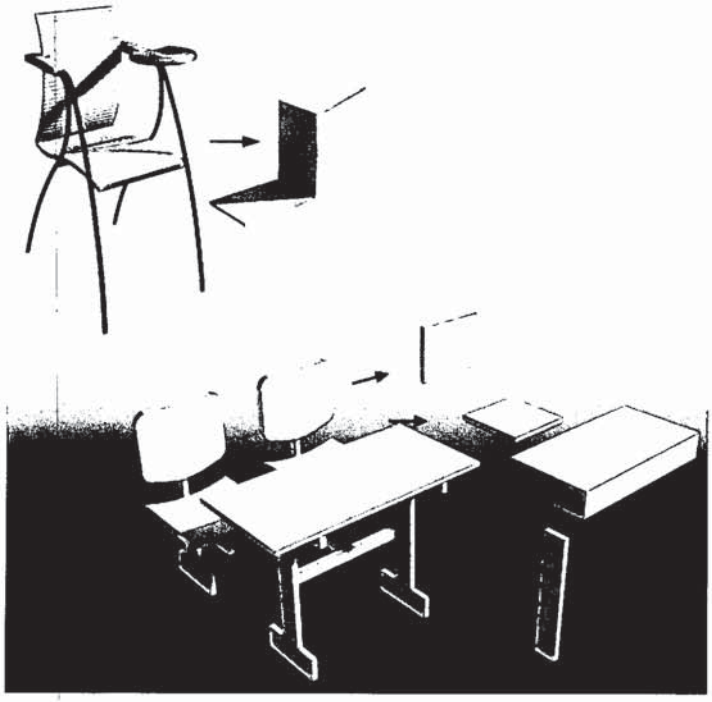
7:00 —

—▷ they need to adjust their posture in order to be able to draw.

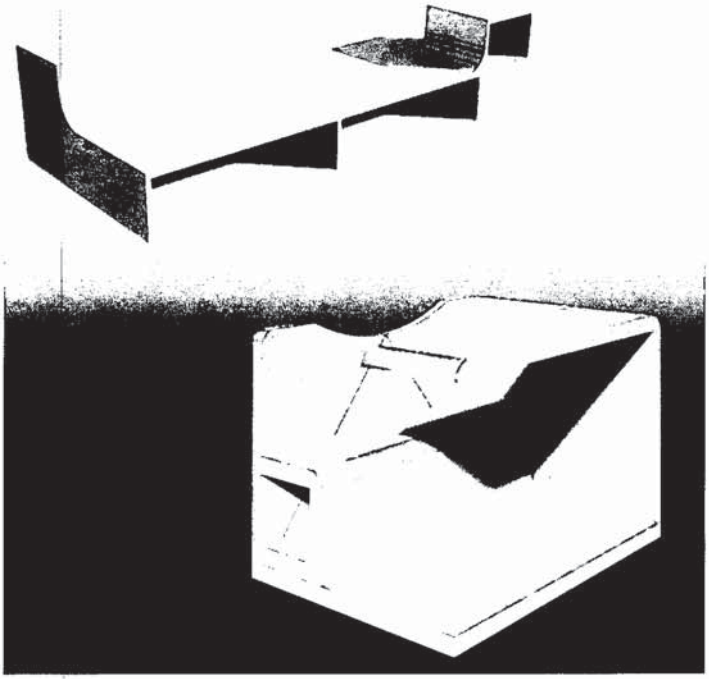
—▷ students are leaning backward (tez 7°1) & having [illegible] positions legs crossed & [illegible] expanded feet

[illegible]

APPENDIX J- SKETCHES OF A DESPECIALIZED DESK



Simple surfaces and volumes created out of the main desks (by author).



Unfamiliar shapes created out of the surfaces and volumes (by author).