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An ergonomic study of a handmade polymer clay crafter workshop

دراسة إرغونومية لورشة حرفي عجينة السيراميك

Submitted in accordance with the requirements for the degree of Master of Psychology in the subject Work and organization Psychology and Human resources Management

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It does not matter what difficulties you are going through, as long as you know that you will get what you want.

I dedicate this fruit of my effort to everyone who has supported me and was with me from near or far

I thank my parents for praying for me and enduring all my requirements. My sister, who has always believed in my success more than I did myself, and my brother for his support and prayer for me, until I reached this moment.

I cherish my supervisor, who was my friend and mother before being a professor.

As well as the crafter that did not skimp on extending a helping hand academically and personally.

I thank all my family, friends and teachers who have always been at the service.

I would like to thank my twin, who has always been a great encouragement and support to me.

Thank you all

Abstract

The current study aimed to improve work conditions in home workshops through ergonomics.

To achieve that goal, the ergonomic approach in solving problems had been applied on a handmade polymer clay craft home workshop in Oum el Bouaghi state as a study case.

Data were collected using direct observation and interviews, in order to analyze the crafter's job, taking into account that the workshop is a sub system in her home social system.

The outputs of this analysis led to the diagnosis of some points where an ergonomic intervention would be useful, connected mainly to workplace as well as personal space organization, working postures, lighting, ventilation, and some hazards.

As a solution, two initial proposals were elaborated for the crafter's room/workshop. They were simulated and discussed with the crafter. Both proposals encompassed critical weaknesses (poor lighting, dust contamination risk, poor privacy…); therefore, a third one had been developed including moving the room/workshop to another room inside the family home.

The new design got the crafter's approval, and then experimented on the field. After 28 days, the crafter was asked to evaluate her new workshop/bedroom design. The main feedbacks included improvement of focus by increasing privacy and ergonomically arranging the workplace (clutter free, within reach tools and materials), improvement of lighting, protection of the paste from dust contamination, and improvement of postures as well. Regarding using protection tools such as gloves and mask, the crafter did not agree on using them, due to the discomfort they trigger.

Key words: ergonomics, ergonomic approach, home workshops, crafts, handmade polymer clay

مخلص الدراسة

هدفت الدراسة الحالية إلى تحسين ظروف العمل في الورشات المنزلية من خلال الإفادة مما توفره الإرغنوميا. ولتحقيق ذلك تم تطبيق المقاربة الإرغنومية في حل مشكلات العمل في ورشة عمل منزلية لحرفية سيراميك بأم البواقي.

تم جمع البيانات باستخدام الملاحظة المباشرة والمقابلة، لتحليل عمل الحرفية باعتباره نسقا فرعيا في نسق اجتماعي أشمل هو البيت العائلي. وكانت مخرجات تحليل البيانات تحديد مواطن التدخل الإرغنومي، التي تعلقت بشكل رئيسي بـ: تنظيم الفضاء الخاص بالعمل وكذا الفضاء الشخصي، وضعيات العمل، الإضاءة، التهوية، وبعض المخاطر.

ولمعالجة المشكلات التي تم تشخيصها، تم في البدء اقتراح تصميمين لغرفة/ورشة الحرفية، إلا أن كليهما شملا نقاط ضعف مهمة (قصور في الإضاءة، خطر تلويث الغبار للعجينة، نقص الخصوصية...)، مما أدى إلى بلورة اقتراح ثالث يتضمن نقل الورشة إلى غرفة أخرى بالمنزل العائلي.

بعد موافقة الحرفية على التصميم الجديد، وتجريبه لمدة 28 يوما، طلب منها تقييم هذا التصميم، فأبدت رضاها عنه من حيث:

- تحسين تركيزها من خلال زيادة الخصوصية في مكان العمل، وكذا التنظيم الإرغنومي له (التخلص من الفوضى، وتنظيم الأشياء في المتناول).
- تحسين الإضاءة
- حماية العجينة من التلوث بالغبار
- تحسين وضعيات العمل وبالتالي التخلص من آلام الظهر وتشنج الأرجل والأيدي
- حماية الأدوات والمواد من التكسير أو الفقدان

إلا أنها لم تقبل استخدام الكمامة والقفازات أثناء، نظرا لما يسببانه من إزعاج لها.

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1. Problematic

In 2021, the National Social Insurance Fund for Salaried workers had recorded 42.032 authorized work accidents in Algeria; 38.225 among them happened in the workplace. (Algeria news agency, 2021, national fund, economics)

Such accidents had prompted scientists and specialists since many decades ago, to search how to increase both safety and comfort at work. As a result, Ergonomics among other scientific fields had known increasing interest.

Defined as the design of the workplace, equipment, machine tool, products, environment and system; taking into consideration the human's physical, psychological capabilities, and optimizing the effectiveness and productivity of work system (safety, health, and wellbeing of the workers) (Jeffery. E. Fenandez, 1995, p 19), ergonomics is -in short- the study of making work safe, effective and comfortable.

According to the International Ergonomics Association, there are three domains of ergonomics: physical, cognitive, and organizational. Whether it is a factory, an office or a workshop, any workplace could benefit from what these areas of ergonomics can provide as improvement.

As crafts are gaining more and more interest and economic growth in our country, with 18.2% increase in artisans' statistics in 2022, it would be very beneficial for them to profit from ergonomics and for us as Occupational psychology and ergonomics researchers a good opportunity to develop skills and competences in this area of applied sciences.

A large range of artisans in Algeria is working at home. Bakers, tailors, perfumers, soap makers, handmade polymer clay designers and more others are the kind of artisans that could have home workshops. Inside their homes, their

work place could be a separate room (in best cases), the kitchen, or just a corner in a room. Thus, the main challenge these artisans could face is how to organize their workshops, knowing that a poorly designed workplace, may lead to many difficulties including misuse of space, inadequate space for the undertaken tasks…etc. That could negatively affect artisans and may hinder their work process.

Handmade polymer clay artisans for instance, may during the process of preparation, forming, coloring, designing, gluing, varnishing… get distracted by not finding some tools, or they lose ideas and focus as soon as they move to get a material or a tool, not to mention consequences of inadequate posture.

The Ergonomic approach could be useful in this case. Based on well understanding one's work, characteristics, difficulties and needs, it would be effective in improving the design and organization of home workshops, and thus increase the comfort, safety and the wellbeing of our local artisans.

The main objective of this study therefore is to apply the ergonomic approach on a handmade polymer clay home workshop as a case study, in order to improve its design and organization.

2. Theoretical background

Algeria is one of the countries, which supports the small enterprises and finance them. This increasing care is due to the benefits, which society could benefit through them, including:

-Contributing to youth employment.

-Reducing importation and encouraging local production.

-Preserving the culture of the country through products (Jellali Bouchref &others, N.D, p 177, 178).

These kind of projects can be big such as private schools, clinics and hospitals...etc. or small like craft workshops, covering: carpenters, mechanics, jewellers, bakers, tailors, perfumers, soap makers, copper artisans, weaving artisans, handmade polymer clay designers and more others. Most of them work in home workshops.

2.1. Handmade polymer clay craft

Recently, there has been an increase interest in using polymer clay in Algeria. On Facebook for instance, we can find many pages and groups interested in this field "The ceramic creations -kharbacha and art-"for example. it is a group created around four years ago includes already 25K subscribers, another one called "The art of ceramic paste**"**, created 3 years ago has already 74K, with 419 subscribers during just last week (3rd week of May).

Polymer clay is one of the most pastes used to make things, especially for home decoration. Despite the simplicity of its components, it produces beautiful things, including jewelleries, home decoration, key rings, dolls, household utensils decoration (cups, lids, plates, spoons and forks…).

2.1.1. Handmade polymer clay preparation:

To prepare polymer clay the following ingredients are needed:

-1 cup of natural starch.

- 1 cup of white glue.

-1 tablespoon of Vaseline.

-Any kind of emollient cream you use at home.

-Plastic bags for food preservation.

-A pot intended for cooking materials on fire.

-Industrial colorants.

-Wooden spoon to stir and mix ingredients.

-Gloves to provide protection while preparing the paste.

To make the dough, first the starch and Vaseline are mixed in a bowl, using a wooden spoon then placed on a medium heat, stirring continuously. After that, white glue is added, and the stir is kept until all the mixture forms a homogeneous, non-sticking paste.

The last step is dyeing the dough as desired, using one or more of these the following methods:

- Watercolours by mixing colours with the paste, either before or after sculpting.
- Food colours added either before or after sculpting.
- Glossy lacquer colouring, used on the sculptures to make them firm and shiny.

Two hours after the manufacture, the paste is ready to be used, and the remaining dough is placed in sealed bags. After forming the paste, the products must be exposed to the air, to completely dry. (https://www.edarabia.com)

2.2. Handmade polymer clay craft workshop

A handmade polymer clay workshop does not necessarily need a lot of space nor equipment and tools. However, a typical polymer clay workshop contains:

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- A working space providing air circulation, but as far as possible from any source of dust, because, dust can contaminate the paste, and air helps varnished products to dry as well as protecting the artisan from smells.
- A working table, on which the polymer clay kneaded, coloured, then sculpted. Obviously, a comfortable chair especially for the back is necessary too, since most work is done in a sitting posture.
- A space equipped with heating source for preparing the paste, and close to the working table.
- A storage space and containers for products needed in paste preparation (cornstarch, vinegar, glue, petroleum jelly...), as well as for keeping the paste soft and usable.
- Needles used to make points, lines, latters…and small details.
- Embossings and ball ended tools in different sizes used for making cavities.
- Silicone tools to smooth the paste.
- Spatulas in different sizes for carving details.
- Blades in different shapes used in cutting and shaping as well.
- Sandpaper and stencils to create patterns.
- Brushes for coloring, and shinning.
- Tweezers used to catch the small pieces.

Fig1: Polymer clay craft tools

Source: https://ar.aliexpress.com/item/1005005443108518.html?srcSns=sns_WhatsApp

2.3. Requirements of a well-organized workshop

To maintain a well-organized workshop in any craft, well experienced crafters know there are some rules to follow, in order to keep it safe, allowing the artisan to work comfortably and effectively. These guidelines include mainly the following points.

- **Everything has a specific place:** without this rule stuff can start floating around, which may waste time, trying to find them, or replace them by new ones, i.e. waiting money as well.
- **Grouping items together**: meaning things used together should be placed in a group, for example: after the handmade polymer clay dough is prepared, the artisan dyes it with the colours needed in every design. Therefore, putting all the colours and materials used for dyeing together would help economizing time and energy.
- **Placing items close to where they are used the most**: organizing items in access zones according to their frequency of use helps a lot to avoid wasting time moving from here to there, bringing things from far places.
- **Optimizing the use of the available space**: vertical spaces such walls can provide useful alternatives, especially in small spaces. Designing for instance upper cabinets and shelves could keeping used and needed items within easy reach. (https://youtu.be/sSaKwxtrNmk)

Such recommendations and more are simply the outcomes of an extremely indispensable scientific domain in all human activity, crafts including called "Ergonomics"

2.4. Ergonomics:

The word "ergonomics" derived from the Greek words 'ERGON' (work) and 'NOMOS' (law). It considered as the technology of work design- based on

the human biological sciences: anatomy, physiology, and psychology. (W.T.Singleton, 1972, p9).

Others (ISO 6385) may call it "Human factors" and define it as the scientific discipline concerned with understanding of the interactions among humans and other elements of a system, and the profession that applies theory, principles, data and methods to design, in order to optimize human well-being and overall system performance. (Jan DUl & Bernard Weerdmeester, 2001, p1)

Therefore, ergonomics is the study of human while working; in order to make work safe, comfortable and effective (*fig 2*).

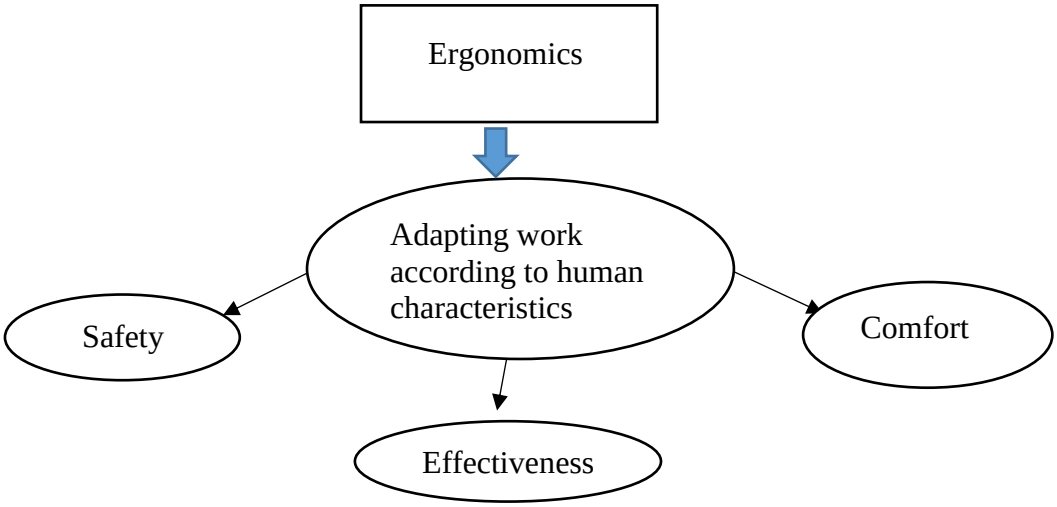


Fig 2: Ergonomics Goal

2.4.1. Domains of ergonomics:

According to the International Ergonomics Association, ergonomics comprise three main fields (*fig 3).*

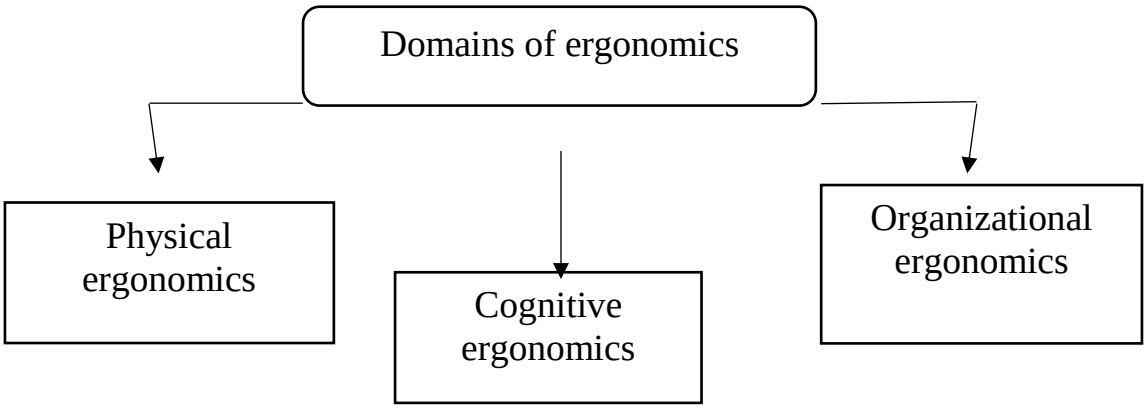


Fig 3: Ergonomics domains.

a. Physical ergonomics:

This domain focus on human anatomical, anthropometric, physiological and biomechanical characteristics in their relation to physical activity (working postures, materials handling, repetitive movements, work-related musculoskeletal disorders, workplace layout, physical safety and health) (International Ergonomics association).

b. Cognitive ergonomics:

This field is concerned with the information processing models and mental processes such as attention, perception, memory, and reasoning. That affect interaction between humans, and other components of the system in order to improve the adaptive capabilities and competencies of the system, focusing on the capabilities of human and machine together.

c. Organizational ergonomics:

This domain is interested in sociotechnical systems, including user satisfaction, morale and confidence through work organization, communication, work group, supervision pattern, reward and punishment methods, human resources management, monitoring and follow-up… within the framework of the interaction of all these factors.

2.4.2. Benefits of ergonomics in home workshops

A home workshop is not a normal working space; being a part of a home adds some specificity to its characteristics that ergonomists must take in consideration when assessing, designing or redesigning, in order to make it adapted to the users. That is, there are variables, which we should focus on during an ergonomic study of a home workshop. Those highlighted bellow are connected especially to polymer clay craft workshop.

2.4.2.1. Environment conditions:

a) **Lighting**: Light is one of the most important physical condition at the workplace; it has a big impact on workers' health, safety and performance.

Light intensity, position, glare, colour, flicker, veiling reflections…can be a source of discomfort or hazard for the workers. (Arunesh Chandra & others, 2009, p 914; HSE, 1997, pp7-9). Regarding polymer clay crafters, sculpting puppets or animated graphics needs accuracy and focus, thus poor/intense lighting, incorrectly positioned lighting, or glare might cause symptoms like eye-strain, headaches, stress and even accidents. The following table shows the impact of different luminance ratio on perception.

Luminance ratio	*Perception*
1	none
3	moderate
10	high
30	too high
100	far too high
300	extremely unpleasant

Tab 1: Perception according to luminance ratio

(Jan DUl & Bernard Weerdmeester, 2001, p84)

b) **Sound level**: Noise can greatly affects the worker's health and safety especially when it is very loud. Hopefully, in polymer clay craft, there is no such risk. However, this creative craftwork needs patience, and attention, therefore, noisy environment can affect the crafter's focus and thus his/her performance.

c) **Climate:** In the workplace, climate should be convenient for the worker and appropriate for the nature of the work. In polymer clay craft as an example, ergonomist needs to pay more attention to temperature and ventilation.

- **Temperature**: Taking into account that polymer clay craft comprises mostly seated, thinking tasks and light manual work, also to prevent polymer clay paste from dryness and stay usable, a mild temperature 16-24C° would be very convenient (*tab 2*).

Type of work	Air temperature (°C)
Seated, thinking task	18–24
Seated, light manual work	16–22
Standing, light manual work	15–21
Standing, heavy manual work	14–20
Heavy work	13–19

Tab 2: Temperature standards (Jan Dui and others, 2001, p 89)

- **Ventilation**: A constant flow of fresh and clean air is necessary in the workplace, as well as providing good air circulation inside the place, removing polluted air and replacing it with fresh air. Some type of work need the use of safety tools wear masks and hygienic respirators to avoid inhaling harmful particles and pollution (OSHA, 2021) especially when there is a contact with chemical products or heavy dust. It means that polymer clay crafters should be aware of the necessity of a good ventilation in their workshops as well as using masks during varnishing.

2.4.2.2. Workstation position:

One of the interests of ergonomics is the workstation position, meaning where and with what the worker is doing his/her job, with purpose to provide him with enough possible space to perform his/her work effectively, safely and comfortably as well.

For that, in general an ergonomic study would incorporate tables, chairs, tools and used materials.

a) **Tables:** The table considered as one of the most important furniture in workshops, polymer clay ones included. Ergonomics helps in making tables fit both workers' anthropometric characteristics and task properties.

b) **Chairs:** The chair too is a very important part of one's office workstation. The chair has to fit the user and suit the tasks that he/she does. One style of chair may not suit every worker. For example: the "average" chair designed in some instances, to fit the average male and may not suit other users. (Office ergonomics handbook, p 10). For a polymer clay crafter, whose most work is

done in sitting position, ergonomics can assure to provide a comfortable chair.

c) **Tools and materials:** Whether they are manual tools like needles, blades… or more sophisticated tools such as phones, laptops, air pods…ergonomics is interested in making them safe and easily used.

d) **Workshop layout:** Ergonomics' benefits are not limited by what a workstation contains; it is also very useful in arranging and organizing the components. Based on studying work process and the user's different characteristics, the ergonomist can produce efficient designs.

For instance, it would very helpful for a polymer clay crafter to divide his/her working space into zones according the frequency of use as shown in the figure below.

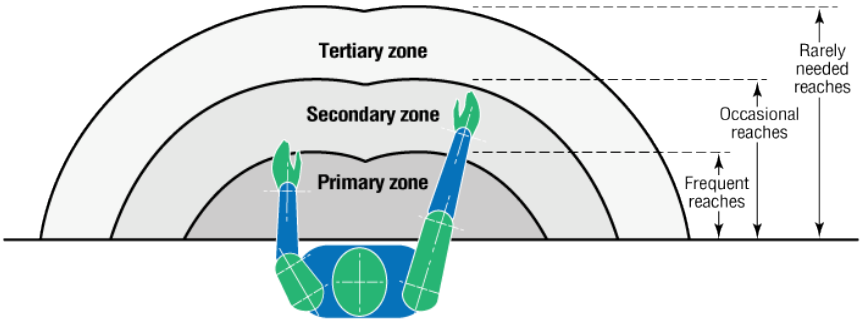


Fig 3: General guidelines for work reaches (From CSA Z412-17)

(https://www.ccohs.ca/oshanswers/ergonomics/sitting/sitting_basic.html?=undefined&wbdisable=true)

As a conclusion, we can say that ergonomics can make crafters' work and workshops easier, safer and more effective.

To gain the benefits of ergonomics in any workplace, ergonomists do not act randomly or impulsively, they adopt a specific methodology called "ergonomic approach".

2.4.3. Ergonomic approach:

Maria Reding from CPD online college had given a good definition to this approach.

> *The ergonomic approach belongs to the social sciences as its focuses on the human behaviour. A social science was found by staying humans, and how they interact with their surroundings. Using a person-centred approach, ergonomics ensures that the environment fits the people and does not force the people to fit their environment. (Maria reding, 2022)*

As shown, the three main characteristics have been highlighted; the ergonomic approach is a social science, where the person is the centre of the studies not work, and the outputs are mainly a work environment where the person can thrive physically, intellectually, emotionally, socially and professionally as well.

Whether, the ergonomists aim to perform an assessment, solve a problem, or do some improvement, they apply the ergonomic approach through the following five steps mentioned by Kerbouch 2017.

- **Step 1**: **Make sure that there is a real problem.**

  Through gathering enough data about the system (tasks, work methods products, workers' characteristics, complains…, using different tools and techniques to collect data, ergonomists can make sure that there is really a problem, or the work needs an improvement, which need an ergonomic intervention, then determine how serious that problem is.

- **Step 2** : **Define the problem**

  Based on workplace data analysis (observation, interviews, and measurements) ergonomist use different standards connected to the studied situation (environment conditions, organizational, physical, intellectual or emotional) to assess the efficiency of the system, searching for the real reasons that made the worker uncomfortable and affected negatively the work. It means that ergonomists analyze jobs

(tasks, equipment, conditions…) and evaluate the efficiency of the human-machine system interactions in order to define which part of the system needs improvement.

- **Step 3**: **Find possible solutions**

Taking into account the available resources (financial, human resources, structures…) beside the existing limits and obstacles, a creative brainstorm would lead to some proposals about how to deal with the diagnosed problem.

- **Step 4: Evaluate the alternatives**

  The outcomes of the previous step will be discussed, and compared in order to classify the produced proposals in a decreasing order, starting from the most suitable.

- **Step 5 : Submit the proposals to the managers**

  The report submitted to the managers should include the best three or four proposals, explaining how and why they can solve the problem.

- **Step 6 : Apply the solution and follow up**

  After the administration or the person of authority agree about the report and the proposals, the selected solution will be applied on field. Accompanied with a contentious evaluation process, on one hand to ensure the solution is well applied, on the other hand to collect data necessary to evaluate the efficiency, (based on work efficiency and client's satisfaction) of the applied proposal.

Method:

Base on the descriptive method, the current study used both study case and work analysis.

The former home workshop had been described and photographed, then data about tasks, technics, tools, materials, physical conditions, crafter's characteristics, needs and difficulties/discomforts… were collected using observation and interviews, and analyzed. After that, the areas where improvements could be applied had been located, some proposals elaborated, discussed with the crafter, then applied and evaluated. In the end, the new workshop had been described, and photographed as well.

1. Participants:

The study included a case study, represented in a local handmade polymer clay crafter, living in Oum el bouaghi. The crafter is a young woman of 28 years old, who started this craft 3 years ago. She lives with her family (father, mother and a single older brother, without her married six sisters and brother which live elsewhere) in a six rooms apartment, and has a workshop in her own bedroom.

The crafter is also a doctoral student in Psychology of Work and Organization at Oum el Bouaghi University, therefore, she understands well the benefits that ergonomics can provide for crafters, which encouraged her to volunteer.

It is also important to mention that the crafter has diabet 1, i.e. insulin-dependent.

2. Data Collection Instruments:

Data were collected using direct observation and interviews.

2.1. Direct observation: used to

- Form an idea about the crafter's workplace, where it is situated, its dimensions, exits nature and dimensions, used furniture.
- Get data about environment conditions like light, ventilation, noise and heating.
- Know how a handmade polymer clay is prepared, and then sculpted, and record different tasks the crafter performs, when, with what, how, and for how long?
- Discover if the crafter faces some kind of discomfort, when or in which part of the work process and what is the nature of this discomfort.
- Examine the arrangement/Organization of all items in the workplace including tools and furniture.

2.2. Interviews: used to

- Understand more about the sources of lighting and ventilation used during work (natural, artificial/ timing).
- Get more data about the crafter's conditions of life, within the family home regarding:
  - Social activities such family gatherings and visits (how frequent they are, and how many relatives are included);
  - Social interactions in the room/workshop area (how frequent different relatives have access to the workshop);
  - Different uses of the crafter's room and other rooms.
- Clarify the reasons and reasoning behind the former arrangement and organization of furniture and tools in the room/workshop.
- Learn more about the components of the polymer clay paste, as well as how it is prepared and preserved.
- Get more data about the time the crafter spends on her different tasks from the preparation until sculpting and finishing the product.

Method

- Determine the most used tools.
- Define the areas of discomfort and difficulties.
- Get a detailed feedback about the proposals especially the applied modifications.
- Know more about the crafter (interests, hobbies, habits, activities, favorite colors…).

Results

Adopting the same order as the ergonomic approach steps, the results are divided into three parts as following.

- **Part 01**: includes the first and second steps of the ergonomics approach, i.e. making sure that ergonomics modifications are really needed, and defining the problems if there are any.
- **Part 02**: includes the third and fourth steps of the ergonomics approach, i.e. finding possible solutions and evaluation of alternatives.
- **Part 03**: includes the fifth and sixth steps, i.e. the design applied then evaluated.

Part 01: Is there a real problem that needs an ergonomic intervention? What it is it does exist?

The data collected using direct observation and interviews, helped in drawing a realistic picture about the crafter, and her workshop as a sub system in the family home system, highlighting the following findings.

– The crafter’s workplace is located in her bedroom, in the family apartment, which is a ground floor flat consisted of six rooms (*fig 05*): guest living room (1), guest room (2), parents’ bedroom (3), the crafter's bedroom (4), the single brother’s bedroom (5), and family living room (6), beside a kitchen, a shower and a bathroom. The rooms are separated by a 12.25m long/1-1.5m wide corridor.

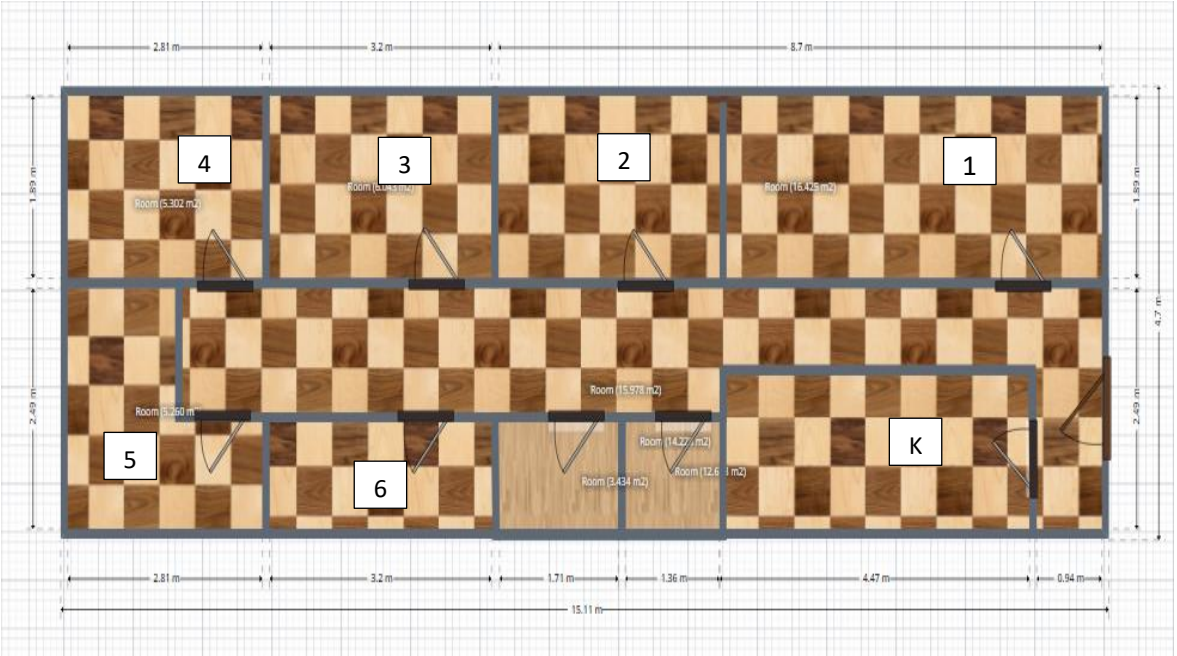


Fig 03: The crafter's workshop location in the family home

- The crafter's room/workshop is the fourth room on the right, in front of her brother's room. It a rectangle room, with the following characteristics (*fig 05, tab 03*).

Tab 03: The crafter's workshop characteristics

Characteristics	Lenght	Width	
Dimensions	4.50	4	With 3.25m height
Door	2 m	80cm	10 cm far from the wall
Window	1.50 m	1.25 m	Facing south, and 1.25 m height
Balcony	2m	1.50 m	Facing west
Paint	Banana yellow color for walls and white for the ceiling.		
Wall outlets	2, one on the right wall from the door, and the other on the balcony wall		

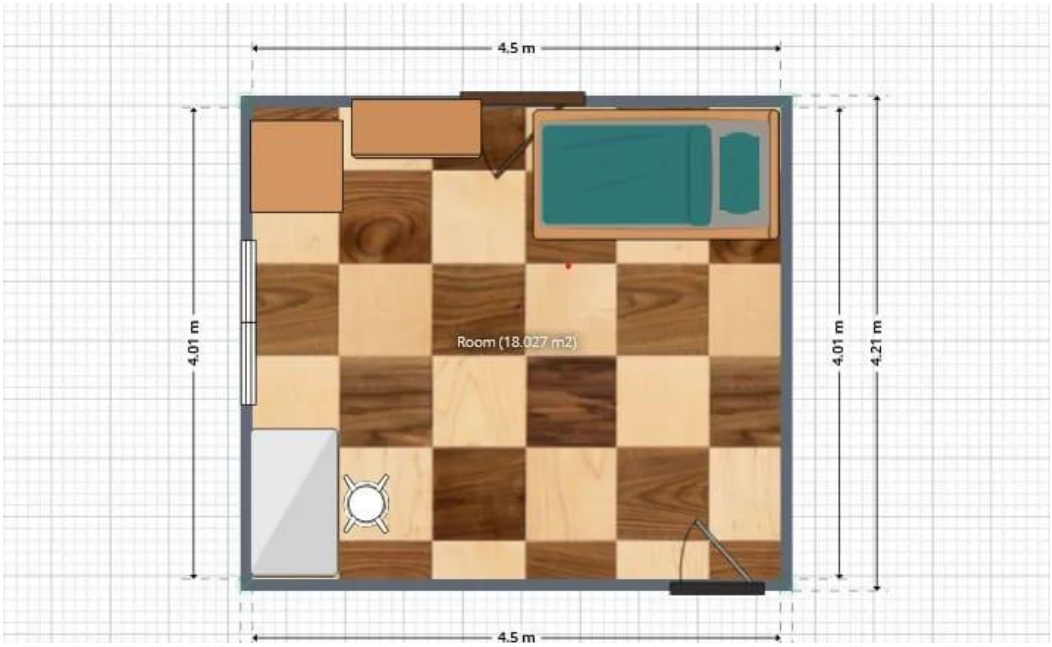


Fig 05: Arrangement of the crafter's room/workshop furniture

– Regarding lighting, the room has two exits: a balcony that is closed most of the time including the shutters due to privacy reasons (being on the ground floor), and a window facing south, i.e. not getting enough light until the afternoon. However, the paint used on the wall and ceiling (banana yellow and white) has some advantage, reflecting light. The main source of light for the crafter is therefore a 10W ceiling LED light bulb, which (due to a pillar) forms some shadow on the crafter's workplace.

Fig 07: Ceiling light forming shadow on the crafter's workplace

- As for the room/workshop ventilation, taking into consideration the strong smells, and the possible detrimental impact of both paste and warmish on the crafter. Beside the necessity of air for the sculptures to dry, the only source of ventilation available is the window, that the crafter usually leaves opened 3-4 hours when she is outdoor 5 days a week on average, besides keeping the room's door open most of the time.
- Concerning heating, the room/workshop as shown above is equipped with a hot water radiator, and an air conditioner, which provide the appropriate temperature for the paste preservation (16°-24°c).
- In relation to social conditions surrounding the crafter's work, her room/workshop has several uses:
    a) It is the crafter's personal bedroom (*fig* 08), which explains the existence of a bed (2.25/1.25m), put in the corner facing the door and very close to one of the two wall outlets. Next to it stands a five drawers plastic dresser, then on the left corner, close to the other wall outlet, a chess table is set for her coffee maker, a damaged printer and her university books (*fig* 06).

Fig 08: the crafter's bed, dresser and coffee table

We can notice that craft tools and materials' boxes are spread chaotically on the floor.

On the other left corner, close to the door, hidden by a pillar is placed a table (55cm long/30cm width/60cm height) (*fig* 09) where the crafter store her finished sculptures, protecting them from children and dust by a fabric sheet. On top of it are hanging two shelves to keep some personal items. A plastic footstool is used as a chair.

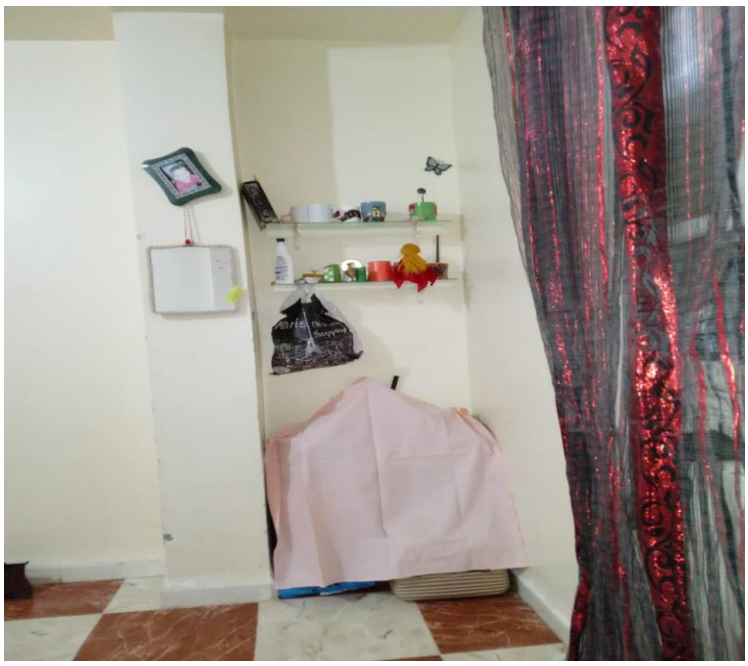


Fig 09: the crafter's storage table/corner

b) The room serves also as an extra living room, when her sisters and their children come on visits. Some of them can sometimes sleep there too. It explains one reason of her need for covering the finished products.

– As regards the specific working place, i.e. where and how exactly the crafter performs the tasks her craft requires, the table below displays details about the process from preparing the paste until wrapping the products.

Tab 04: The tasks included in handmade polymer craft process

Tasks	Tools and materials	Posture	Time span	Fig
Preparing the paste	Cornstarch, vinegar, wood white glue and oil or vaseline. Spoon, cooker, saucepan.	Standing	30-60mn	*fig* 10
Preservation of the paste	Plastic bags, refrigerator		10mn	/
Coloring the paste	Liquid colors, wet wipes.	Sitting on the bed: -crossed legs -bending on a Small table.	15mn	*fig* 11
Sculpting	Needles, embossings, silicone tools, blades, Tweezers, wet wipes, vaseline, ruler. Silicone mat, small wooden table (75/75/75cm).	Sitting on the bed: -crossed legs -bending on a Small table.	1h - 6hr	*fig* 11
Varnishing	Brushes, transparent varnish.	Sitting on the floor crossed legs.	30mn-60	*fig* 12
Drying the products	Sponge.	/	3-7days	*fig* 13
Wrapping the products	Paper bags, pens, silicon bags, hole punch, rubbers, duct tape.	Sitting on the bed -crossed legs -bending on a small table.	1h	*fig*14

Fig10: Preparing the paste

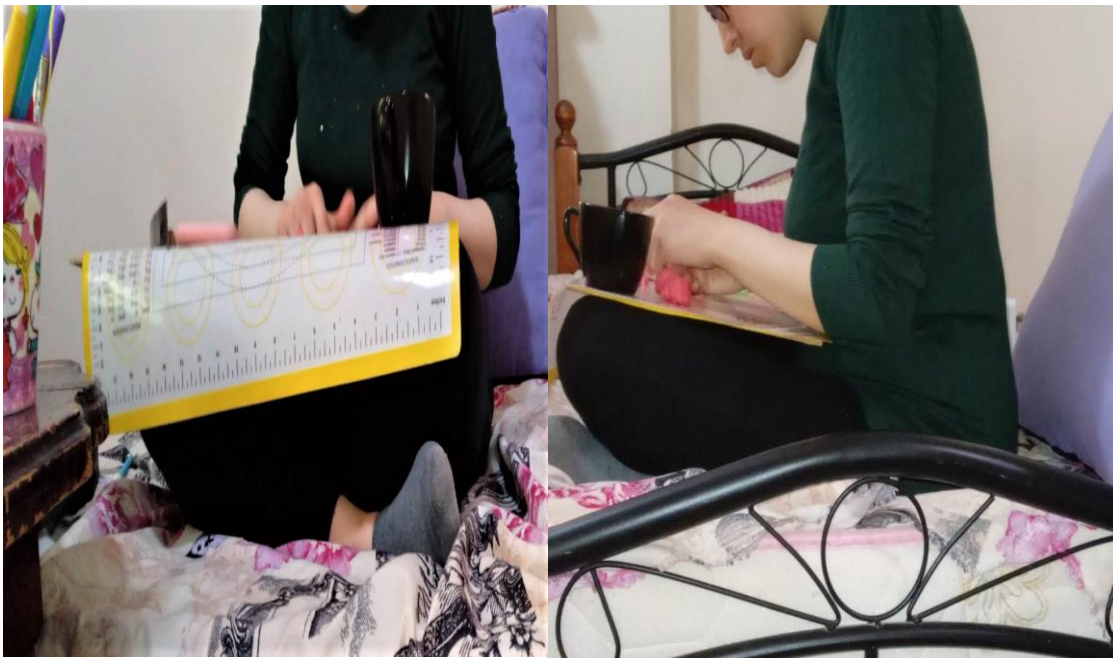


Fig 11: Coloring the paste and sculpting

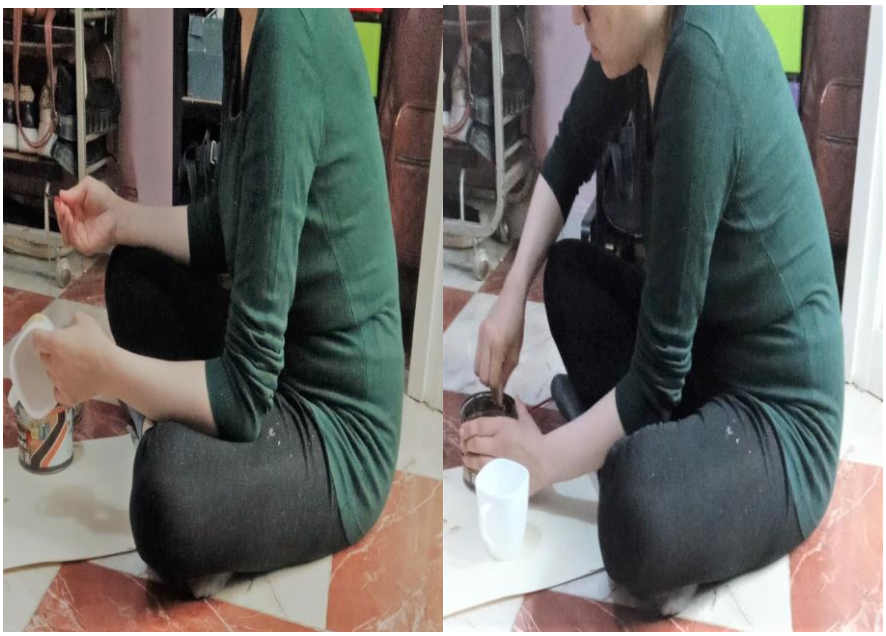


Fig 12: Varnishing

Fig 13: Drying the sculptures

Fig 14: Wrapping the products

Results

Based on the data mentioned above, we can deduce some points that could interest an ergonomist discussed in the table below.

Area	Where could an ergonomic intervention useful
Ventilation	The only source of ventilation is a window kept open daily for 3-4 hours. Comparing by the current volume of production it is enough. However, it would not be the case if the production increases.
Lighting	The crafter's work depends on details, thus needs a good lighting. The current lighting is poor and triggers eyes tiredness, especially with the shadows from the pillar (*fig*01)
Temperature	The heating system used seems to be appropriate for the crafter's work.
Postures	The crafter works mostly in three postures, ordered increasingly according to the duration as follows: - standing, - sitting on the bed with legs on the floor and back bending (35°) on a small table….far from the bed, (*fig*02) - sitting on the bed with crossed legs and back unsupported, bending (40°) on a working mat, supported by a rectangle piece of plywood (52/30cm) on her lap. (*fig*03) The two last positions are obviously not comfortable, which can explain the stiffness she has in her legs, and even in her wrists. These poor postures can lead over time to many physical problems including fatigue, back pain and multiple musculoskeletal Disorders.
Organization	- Working on the bed or the small table (*fig*04) might cause the fall of tools repeatedly, looking for them or picking them

	up consumes time and interrupt concentration, needed in creative tasks. - The poor organization of tools and materials (*fig*05) the crafter needs while working resulted in her often looking for something she wants to use, which makes her beside loosing concentration, sometimes spill liquid colors, or contaminate the paste by dust. - Due to the active social life and interactions inside the family an even into the room/workshop, the crafter faces the risk of children damaging her tools, or spoiling materials and sculptures. She therefore protects her working place using a cover (*fig*06). This protection technique is not sufficient, since the workplace is still easily accessible to children while the craft is working. Besides, it cannot include drying sculptures.
Hazards	- The crafter does not cover her hands during preparing the paste or sculpting, which could trigger some types of skin allergies especially due to white wood glue. - Arranging tools and materials boxes on the floor is neither convenient nor safe. It is time consuming, and could trigger accidents (stumbles and falls) (*fig*07), beside attract more children attention. (*fig*08) - The crafter is diabetic, therefore having insulin injection set and sweet food within easy reach when she works would be useful.

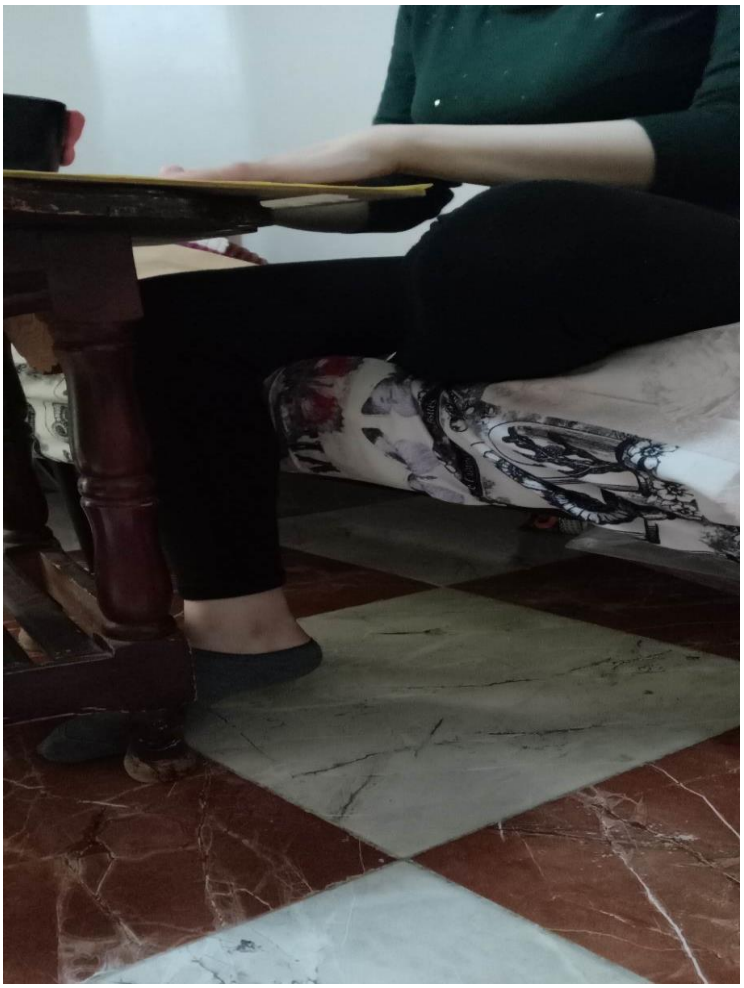


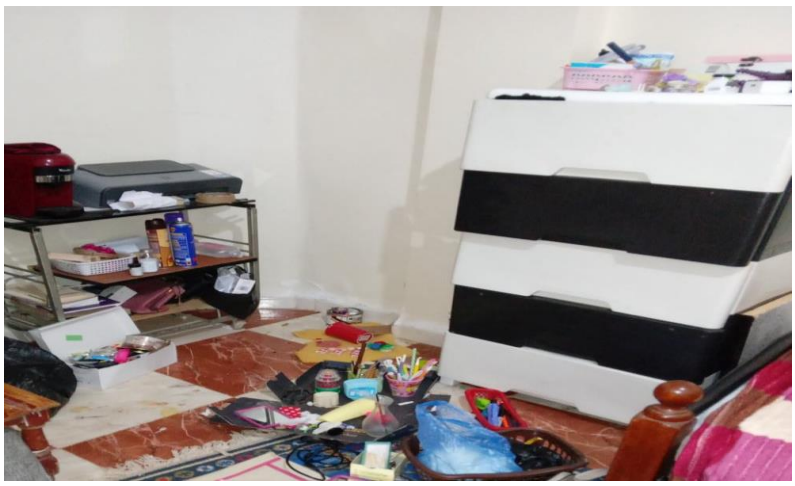
Fig 15: The crafter working sitting on the bed with legs on the floor

Fig 16: the crafter working crossed legs on the bed, bending on the table

Fig 17: Tools falling anywhere

Fig 18: the tools cluttered on the working table

Fig 19: Covering prevention strategy



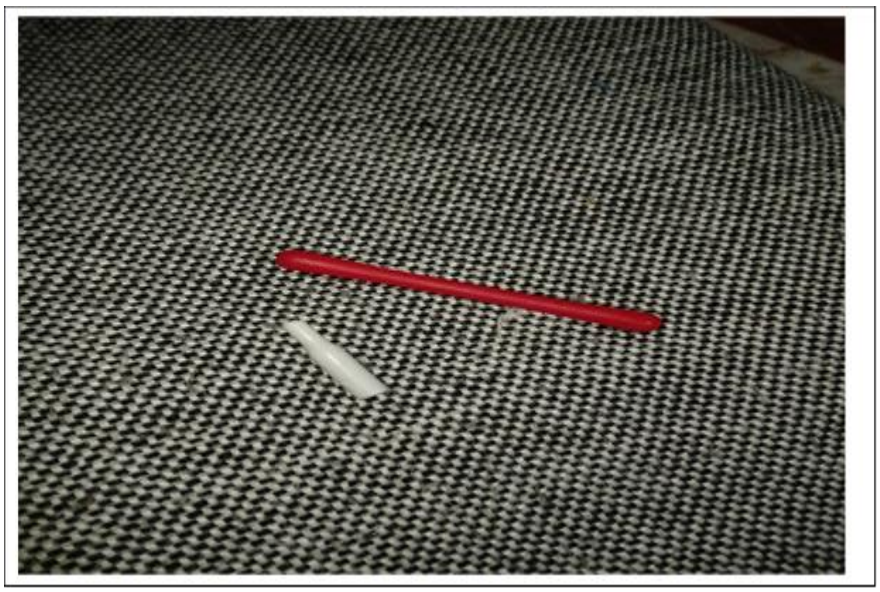


Fig 20: A damaged tool by children

Part 02: How to solve these problems?

After defining the areas where an ergonomic intervention is necessary two proposals had been elaborated, taking into account the different characteristics of the workshop and its surroundings (physical, social, psychological) as well as the budget of the crafter.

Proposal 1:

Comparing with the room/workshop as it was in part 01, the first proposal illustrated in *fig* 22 encompasses the modifications that follows:

- Removing the coffee table.
- Moving the dresser to the corner in front of the bed.
- Using a table or two to make an "L" corner desk in the left corner, inside the space between the pillar and the wall. It would be divided into two parts: one for storing tools and materials, and the other for working (coloring, sculpting, varnishing, and even drying)

- Getting a back support chair.
- Separating the working board from the rest of the room by a curtain or some other separator.

The main advantages of this proposal was gaining more space, i.e. less clutter, gaining a specific working place far from the entrance, thus far from interruptions, and where all the tools, materials and needed items could be gathered and organized. Moreover, the crafter's sitting posture would be more comfortable using a comfortable chair.

However, this design had some limits:

- The removal of the coffee table, although declutters the space, does give an alternative for storing the books. Besides, the crafter is a coffee fan, which makes the coffee maker an important item in the workshop.

Fig 21: The room/workshop as it is was before modification

Fig22: Illustration of proposal 1

- The L corner desk is close to the window, thus the risk of paste contamination by dust would increase.
- Restricting the workplace by the space between the window's side wall and the pillar, although providing more privacy, it narrows the space, triggering the risk of hurting elbows and/or the consequences of exposure to strong smells (paste and varnish) if having the window closed.
- Regarding posture, the crafter has a negative attitude towards changing the stool she is using for a back support chair. She stated that she cannot stand sitting on things made of leather of sponge, and the back support chair makes her sleepy. However, the narrow space between the working place and the wall makes the latter an alternative support for her back.

- In addition, the location is far from the main source of light, and the crafter does not approve using additional lighting source such as a desk lamp, believing that it makes her uncomfortable when working.

As a result, a second proposal had been developed as an alternative for the first.

Proposal 2:

This proposal is based on moving the workplace to the bed corner and vice versa, making the workplace facing the door as shown in *fig23* below, in addition to replace the L corner desk by a wooden table.

The only advantage realized in this change was distancing the workplace from the window/dust. However, it has some limits too, including:

- The risk that the balcony's door might hit the workplace if opened, thus probably the crafter herself if the working table is moved nearer the balcony door, i.e. less safety.

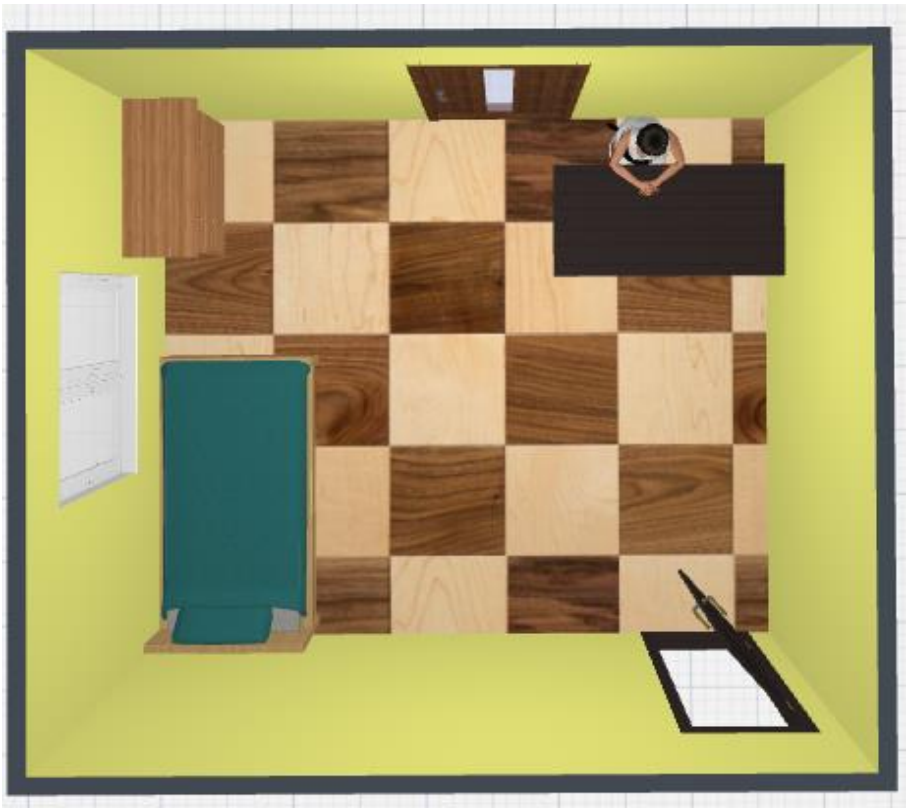


Fig23: Illustration of proposal 2

- The location of the workplace in front of the door affects the crafter's privacy, and concentration, being too close to the corridor. On the other hand sitting in front of her brother room's door would make her feel uncomfortable.

Therefore, the second proposal was cancelled, and a third one had been presented to the crafter.

Proposal 3:

Adopting a different strategy of thinking, the idea of changing the room itself aroused. Therefore, the crafter and her brother agreed to exchange rooms.

Description of the new location

The new crafter's room/workshop is an "L" shaped room. Its main characteristics are presented in the table and figure below.

Table 05: The new location characteristics

Characteristics	Lenght	Width	others
Dimensions	4.57	4.25	With 3.25m height and an L shaped side
Door	2 m	80cm	10 cm far from the wall
Window	1.50 m	1.25 m	Facing south, and 1.25 m height
Balcony	2m	1.50 m	Facing east
Paint	Light pink on one wall, and light cream on the others.		
Wall outlets	3 on three different wall (window, door, in front of the balcony walls)		
Heating	1 hot water radiator on the window's wall.		

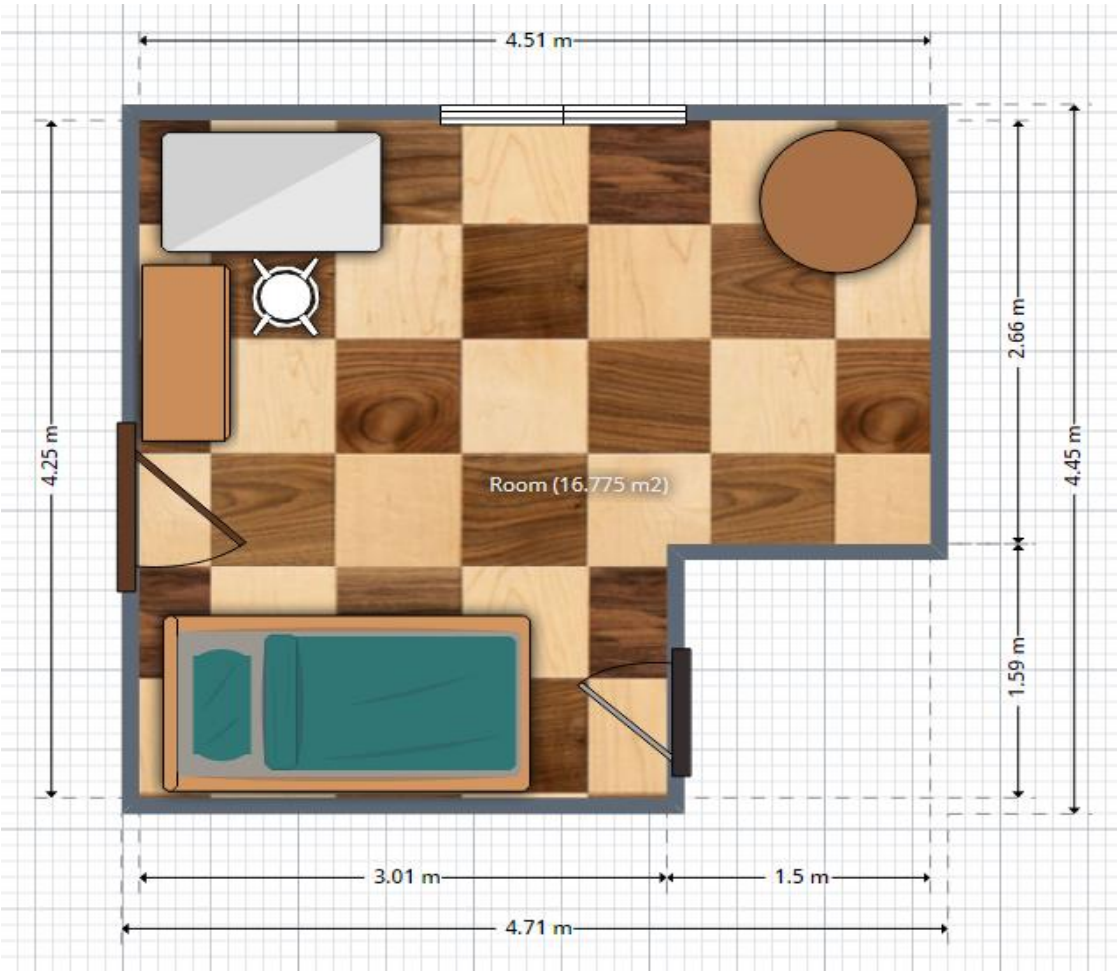


Fig 24: The new location characteristics

Regarding the organization and arrangement of furniture inside the new room/workshop, we can notice through the illustration in (*fig*24). The following points:

- The bed location is too close to the door, rising the risk of impact (*fig*26).
- There is much cluttering in the corner in front of the bed, where three furniture are placed (*fig*27)
  a) The former coffee table, used to store bags and shoes.
  b) A new table brought to the room, where all tools and materials, and books are chaotically stored.
  c) The crafter's former dresser, on which lay some personal valuable items.

Fig 25: Arrangement of the crafter's new room/workshop furniture

- Much better space and organization are given to the right corners area, containing a coffee table (the former wooden small table 75x75x75cm) with a coffee maker and a floor cushion couch (*fig*28). The crafter seems to provide more care for hosting guests than for work wellbeing.
- The same method of work is still used, i.e. working on bed and sometimes on the floor, with the tools and materials spread around chaotically.

*Fig*26: Bed too close to the door

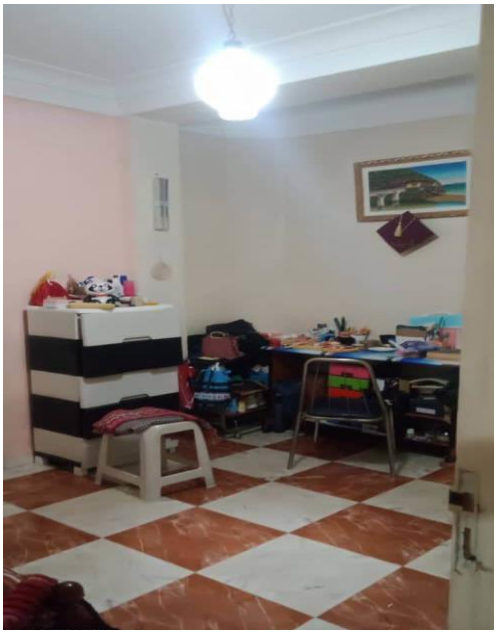


*Fig*27: Storage corner

*Fig*28: Guest-Hosting corner

The points above were discussed with the crafter, then, the third proposal, which follows was explained.

The proposal:

As illustrated in (*fig*29), it involves making the listed below changes.

Fig 29: Third proposal for the crafter's room/workshop

1. Replacing the guest corner by a real workshop corner that includes:

- A wooden rectangular table, of 1.16 long, 70 cm wide and 17 cm high (*fig*30), where the often-used items are organized within reach inclusive of:

  a) Working mat, plastic/wooden templates, mugs for similar tools (rollers, blades, cutters, brushes, pens…), iron ruler, scissors, a rectangle sponge for drying the sculptures on.

b) A can for preserving the paste, Wet wipes for keeping the crafter's hands always clean, thus prevent the paste from contamination.

c) A notebook and pen for order registration.

d) Air pods because the artist likes to listen to music while working.

e) A trash bag hanging next to the table.

*Fig*30: The crafter's working table and chair

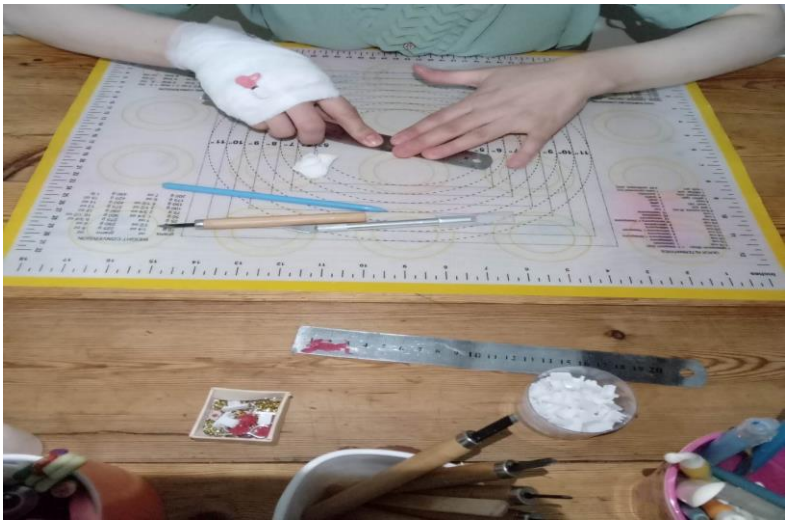


*Fig*31: The crafter's working position

- The crafter favorite plastic stool as a working chair, close to the wall that would be the main back support for her. It is 32.5cm long, 27cm wide, and 47 cm high; the crafter can comfortably have the feet on the floor, or resting on the lower part of the stool (*fig*32).

*Fig*32: The crafter's sitting position on her working stool

2. Exploiting the vertical space on the wall (left side of the crafter when working) for hanging some shelves brought from the crafter's home storage, in order to store items the crafter needs within easy reach. The shelves are in fact a wooden frame of 125cm long, 1m high, and 93cm wide, divided inside into 4 shelves with compartments (*fig*33). The items were arranged as following:

a) First shelf for the most used items: paints, Vaseline, key rings, white glue, paint tubes, alphabet templates and a screwdriver set.

*Fig*33: The storing hanging shelves

b) Second shelf for rarely used as some paints, cups and mugs, in addition to some sculptures the crafter made when she was a beginner that still have value, beside a container for transporting tools when working away from home.

c) Third shelf for the crafter's medicines and glucometer with sweet treats for emergency, besides paper staplers, and wrapping materials (bags, tape, strings…). Some unfinished sculptures too are placed there.

d) Last shelf reserved for some personal valuable items (dear presents).

3. Keeping the coffee table with the coffee maker in the same corner on the crafter's right side (*fig*37)

The pictures bellow show in details the new workshop corner, as well as the bedroom corner.

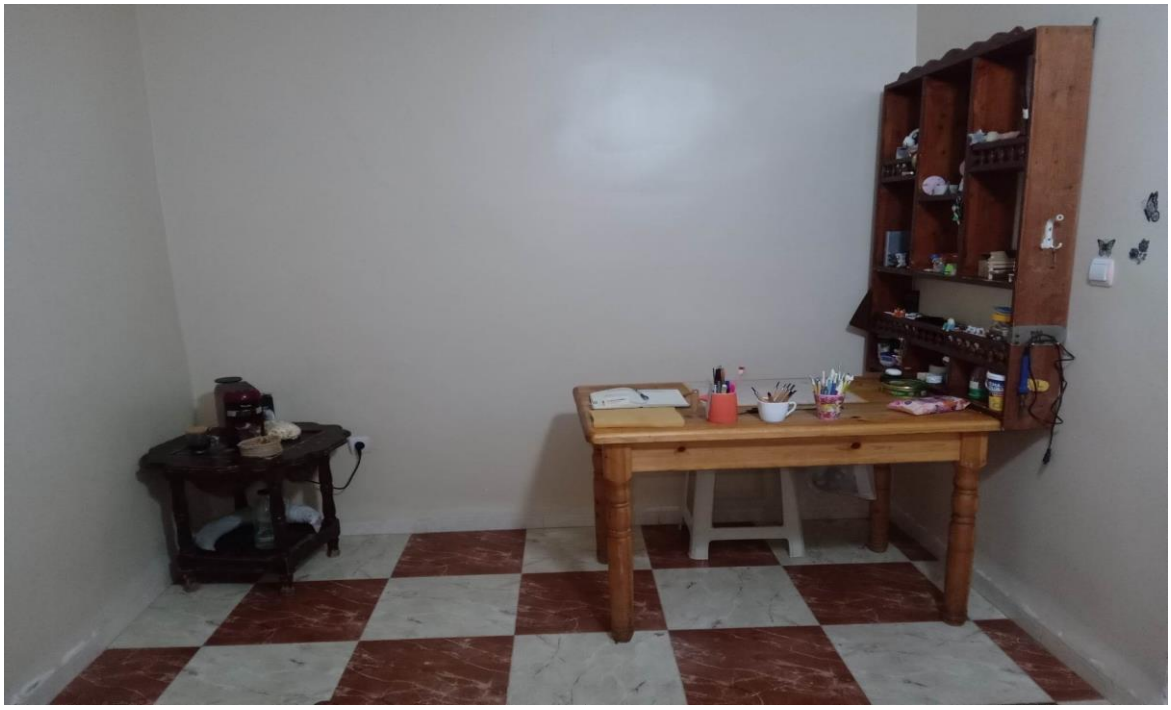


Fig34: The new workshop corner

Fig35: The workplace

Fig36: The storage shelves

Fig37: The coffee table and coffee set

4. Moving the bed to the window corner close to the dresser (*fig*38).

Fig38: The bed corner

5. Moving the storage table to the corner in front of the door to be used as a desk table.

6. Removing the small storage table, as well as the printer, and arranging shoes out of the room, and bags in the dresser.

After the third proposal had been discussed with the crafter, she approved it, and agreed on experimenting the design included.

Part 03: How does the chosen design work for the crafter?

The crafter used the room/workshop as it is designed in proposal 3 for a month (7th May-4th June), then it was evaluated during an interview. The outputs of this interview were as following.

Area	Perceived and felt feedbacks
Ventilation	Distancing the paste from the window has protected the paste from dust or other contaminants. In the same time, kept the main source of ventilation effective.
Lighting	Beside the window, the new workplace gets enough direct lighting from the second main source of light in the room, which prevents the crafter against eyes tiredness, and helps her when working on details.
Postures	- Working in sitting position on the stool became the only sitting posture used by the craft. It is now comfortable for her, especially that the crafter's feet are on the floor, and her back is straight, using the wall behind her as a support. - Standing position is used as a break to get a coffee, from the coffee corner.
Organization	- Getting a separate working space triggered a relief feeling (now she does not need neither the bed nor the floor to work on). - The tools now are well organized that she can find any tool she needs easily, (the most used ones are just in front of her no need to search for them anymore). Thus more time and energy are saved.

	-The workplace new location and arrangement increases the privacy of the workplace, preventing that children damage or spoil anything inside. No need to cover the workplace anymore. -This privacy and organization made the crafter less distracted while working.
Hazards	-Reducing the length of bending posture has reduced the crafter's back pain. -Avoiding sitting position with crossed legs stopped legs stiffness. -Having an appropriate height of table and stool has reduced wrists pain. -Unexpectedly, due to the hanging shelves, the crafter now has a place to hang her serum bag. -The crafter refused to use mask and gloves; therefore, she is still exposed to the risk of allergies.

Although, the crafter's justification for keep sitting on her plastic stool does sound scientific, after a month she is still satisfied about the last design of her room/workshop.

Conclusion

Believing that ergonomics plays tremendous role in promoting human health, safety, and well-being in various aspects at work, through designing and organizing environments to fit the needs and capabilities of individuals; the current study aimed to experiment this effect in craft home workshops environment, especially that crafts are gaining increasingly importance in Algerian economy.

Adopting the ergonomic approach in solving problems, the study included a handmade polymer clay crafter as a study case. First different data were collected using direct observation and interviews, in order to analyze the crafter's job, i.e. what she performs as tasks, uses as tools and materials, where she works, when how long, and how. Taking into account that the workshop is a sub system in her home social system.

The outputs of this analysis led to the diagnosis of some points where an ergonomic intervention would be useful. They were connected mainly to Workplace as well as personal space organization, working postures, lighting, ventilation, and some hazards.

As a solution, two initial proposals were elaborated for the crafter's room/workshop. They were simulated and amply discussed with the crafter. Both proposals encompassed critical weaknesses (poor lighting, dust contamination risk, poor privacy…), therefore, a third one had been developed including moving the room/workshop to another room inside the family home.

The new design got the crafter's approval, and then experimented on the field. After a month, the crafter was asked to evaluate her new workshop/bedroom design. The main feedbacks included improvement of focus by increasing privacy and ergonomically arranging the workplace (clutter free, within reach tools and materials), improvement of lighting, protection of

the paste from dust contamination, and improvement of postures as well. Regarding using protection tools such as gloves and mask, the crafter did not agree on using them, because they trigger discomfort.

As recommendation for future studies, ergonomic approach in solving problems could be useful in improving work environment in other crafts home workshops as well. Moreover, designing a practical guide for crafters about how to design and/or organize their home workshops ergonomically would benefit all crafters.

In addition, studies could also focus on prevention and security in workshops to using innovative tools, especially in order to find less uncomfortable alternatives for gloves and masks for instance.

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