"Designing a Training System for Handmade Rope Production Using Rice Straw and Employing Artificial Intelligence to Achieve Sustainable Development"

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Abstract

Using rice straw in rope making is one of the promising solutions in the field of handicrafts, as it helps convert agricultural waste, which is typically burned and causes environmental pollution, into products with environmental and economic values. This research is based on sustainability theories and the integration of modern artificial intelligence technologies to develop a training program aimed at teaching individuals how to effectively use rice straw in rope making, as well as utilizing these ropes to produce eco-friendly products and market them through an integrated smart system.

The theoretical framework of this study is based on the concepts of vocational training, the use of sustainable materials, and artificial intelligence. It highlights the importance of organized training programs in enhancing the competencies of the workforce, particularly in the context of traditional crafts such as rope-making using rice straw. The framework also explores the potential of artificial intelligence technologies in improving design processes, quality control, and expanding market access. Together, these elements form the foundation for developing innovative, environmentally friendly products while empowering local artisans through modern training tools and digital technologies.

The developed training system in this study focuses on equipping individuals with practical skills in sustainable handcrafted production, particularly in handcrafting ropes from rice straw. The training program combines traditional handcraft techniques such as twisting and braiding with modern methods, including the integration of artificial intelligence in product design and enhancement. High-quality rice straw fibers were selected, cleaned, soaked, and optionally dyed using natural methods to ensure durability and flexibility. The handmade ropes were then completed and assessed for quality and market suitability.

The effectiveness of the training was evaluated through organized surveys targeting both beneficiaries and artisans. The results showed a high level of satisfaction, strong enthusiasm for participation, and an awareness of the system's potential in supporting sustainable development, enhancing entrepreneurship, and creating income-generating job opportunities.

Keywords

Training System; Rope Production; Handicrafts; Rice Straw; Artificial Intelligence; Sustainable Development.

الملخص

يعد استخدام قش الأرز في صناعة الحبال من الحلول الواعدة في مجال الحرف اليدوية، حيث يساهم في تحويل المخلفات الزراعية التي عادةً ما يتم حرقها، مما يؤدي إلى تلوث البيئة، إلى منتجات ذات قيمة بيئية واقتصادية.

استند هذا البحث إلى نظريات الاستدامة ودمج التقنيات الحديثة في الذكاء الاصطناعي لتطوير برنامج تدريبي يهدف إلى تعليم الأفراد كيفية استخدام قش الأرز في صناعة الحبال بشكل فعّال، بالإضافة إلى توظيف هذه الحبال في إنتاج منتجات صديقة للبيئة وتسويقها عبر منظومة ذكية متكاملة.

يعتمد الإطار النظري لهذه الدراسة على مفاهيم التدريب المهني، واستخدام المواد المستدامة، والذكاء الاصطناعي. حيث يؤكد على أهمية البرامج التدريبية المنظمة في تعزيز كفاءات القوى العاملة، لا سيما في سياق الحرف التقليدية مثل صناعة الحبال باستخدام قش الأرز. كما يستعرض الإطار إمكانيات تقنيات الذكاء الاصطناعي في تحسين عمليات التصميم، وضبط الجودة، وتوسيع نطاق الوصول إلى الأسواق. وتشكل هذه العناصر مجتمعة أساسًا لتطوير منتجات مبتكرة وصديقة للبيئة، مع تمكين الإطار النظري لهذه الدراسة يعتمد على مفاهيم التدريب المهني، واستخدام المواد المستدامة، والذكاء الاصطناعي. حيث يسلط الضوء على أهمية البرامج التدريبية المنظمة في تعزيز كفاءات القوى العاملة، وخاصة في سياق الحرف التقليدية مثل صناعة الحبال باستخدام قش الأرز. كما يستعرض الإمكانيات التي تقدمها تقنيات الذكاء الاصطناعي في تحسين عمليات التصميم، وضبط الجودة، وتوسيع الوصول إلى الأسواق. وتشكل هذه العناصر مجتمعة أساسًا لتطوير منتجات مبتكرة وصديقة للبيئة، مع تمكين الحرفيين المحليين باستخدام أدوات التدريب الحديثة والتقنيات الرقمية.

يركز نظام التدريب المتطور في هذه الدراسة على تزويد الأفراد بمهارات عملية في مجال الإنتاج الحرفي المستدام، خصوصًا التصنيع اليدوي للحبال من قش الأرز. يجمع برنامج التدريب بين تقنيات الحرف اليدوية التقليدية مثل الزوى والتضفير، والأساليب الحديثة، بما في ذلك دمج الذكاء الاصطناعي في تصميم المنتجات وتحسينها. تم اختيار ألياف قش الأرز عالية الجودة، وتنظيفها، ونقعها، وصباغتها اختياريًا باستخدام طرق طبيعية لضمان متانتها ومرونتها. بعد ذلك، تم الانتهاء من الحبال المصنوعة يدويًا وتقييم جودتها ومدى مناسبتها للسوق.

تم تقييم فعالية التدريب من خلال استطلاعات رأي منظمة استهدفت كلًا من المستفيدين والحرفيين. أظهرت النتائج معدل رضا مرتفعًا، وحماسًا قويًا للمشاركة، وإدراكًا لإمكانات النظام في دعم التنمية المستدامة، وتعزيز ريادة الأعمال، وخلق فرص عمل.

الكلمات المفتاحية

منظومة تدريبية ؛ صناعة الحبال ؛ الحرف اليدوية ؛ قش الأرز ؛ الذكاء الإصطناعى ؛ التنمية المستدامة.

1/ Introduction

The utilization of agricultural waste in sustainable industries has gained significant attention in recent years due to its potential environmental, economic, and social benefits.[1] One of the most abundant agricultural by-products is rice straw, which is often burned, leading to severe environmental pollution, including the formation of the black cloud in many regions.[2] This practice negatively impacts air quality, public health, and natural resources, making it essential to explore alternative ways to repurpose rice straw into valuable products.[3]

Rice is one of Egypt's most important strategic and export crops and a staple food for many people. [4] It is used in starch production and as animal and poultry food through rice husk.[5]

According to the food and agriculture organization (FAO) to Cereal production in 2024 is estimated at near-average 23.7 million tons in Egypt.[6]

Although rice is grown across Egypt, the government restricts its cultivation to the "Rice Belt" governorates—Dakahlia, Kafr El-Sheikh, Sharqia, Beheira, and Gharbia—due to the availability of irrigation water and to protect the soil from degradation. [7]

Rice straw is an organic material and a natural byproduct of the rice crop or paddy, widely available to farmers worldwide.[8] On a global scale, it is the third most abundant agricultural residue, following sugarcane bagasse and maize straw.[9]

Rice crop residues rank about 3.3 million tons.[10] In the past, rice straw was collected manually and used in industries like pulp, paper, fertilizers, and animal fodder.[11] With modern technology, collection has become costly and labor-intensive. Only 20% of rice straw is utilized, while 50% is burned by farmers to clear fields, releasing greenhouse gases (CO_2, CH_4) and toxic pollutants (CO, SO_2, NOX), leading to respiratory diseases and soil degradation.[12] Burning also destroys beneficial microorganisms essential for soil productivity. Thus, there is an urgent need for cost-effective and sustainable solutions.[13]

In line with Egypt direction to utilize rice straw as an important environmental and economic resource.[14] This study aims to enhance the use of rice straw in sustainable hand ropes, achieve economic returns, and improve the technical understanding of how to integrate artificial intelligence into production processes to create a smart training system that bridges the gap between traditional craftsmanship and modern technology.[15]

The research problem

The environmental pollution caused by burning rice straw and the formation of the black cloud represents a serious environmental issue that negatively affects public health and natural resources. Additionally, the lack of an effective training system that integrates handicraft techniques with artificial intelligence ensures the provision of sustainable job opportunities in rural areas.

Objective

Designing a smart training system in the field of handicrafts, specifically for rope production using rice straw, and utilizing artificial intelligence to achieve sustainable development.

In general, Handcrafts training programs aim to enhance the social and ethical responsibility of community by raising trainers' awareness of the country's goals, fostering a sense of belonging and teamwork, and identifying training needs to meet societal requirements and develop training program-related skills. They also seek to equip trainers with the necessary knowledge and skills to perform their tasks efficiently and to provide a well-trained workforce that meets the needs of a growing handcraft market. Finally, the programs focus on ensuring training effectiveness by utilizing both internal and external resources to develop competencies and promote sustainable development.

Importance of the research

The significance of the research can be outlined in three points. It helped identify the target groups that need training. It played a crucial role in assisting to design scientific training

programs that effectively align with the real needs, goals, aspirations, and job responsibilities. It offers an effective use of artificial intelligence to produce intentional designs.

Challenges

- Finding a rope-making technique using rice straw.
- Enabling trainees with non-technological backgrounds to use artificial intelligence programs.
- Lack of awareness about the benefits of recycling rice straw.
- Providing rice straw in the trainees' locations in provinces that do not produce rice.

Methodology

The researcher follows the inductive approach in collecting information and data, then uses the descriptive-analytical method to describe and analyze the data related to rope production from rice straw, including market studies, training materials, environmental and economic impacts, and the challenges associated with using artificial intelligence to improve work efficiency and environmental sustainability.

2/ Theoretical Framework

2/1 Training Concept

The presence of professionally trained staff and employees with entrepreneurial traits and suitable educational backgrounds significantly strengthens an organization's capabilities by ensuring a skilled workforce.[16] Training and development programs focus on enhancing employees' skills, improving their competencies, and aligning their performance with organizational expectations. These programs also contribute to shaping employees' behaviors and professional identities. Training is a crucial aspect of human resource development, facilitating the transfer of technical knowledge, leadership skills, team organization, and empowering individuals. While development focuses on long-term growth, training typically targets short-term goals, providing systematic and scientific methods to improve technical and operational skills, especially in tasks involving machinery or technology.[17]

According to Wayne F Cascio17, ―Training consists of planned program designed to improve performance at the individual, group, and /or organizational levels. Improved performance, in turn, implies that there have been measurable changes in knowledge, skills attitude, and/or social behavior. Training focuses on fostering individual growth, helping people gain confidence and competence in both their personal lives and professional roles. At its core, training is a learning process, with a wide range of methods and opportunities available for acquiring new knowledge and skills. It can be concluded that training not only enhances professional abilities but also contributes to personal development, making individuals more capable and confident in various aspects of life.[18]

2/2 Design a training system

An effective training program as shown in figure (1) is built around a well-organized schedule that outlines its goals, learning outcomes, key topics, instructional methods, participants, trainers, evaluation techniques, and training venues. Its primary purpose is to address operational challenges, such as inefficiencies in the supply chain. By focusing on these gaps, the training program enhances workforce performance and supports smoother, more reliable service delivery.[19]

2/3 Good rice straw fibers

Selecting the best rice straw for use in rope-making and handmade products is a crucial step to

FIG. 1: TRAINNING PROCESS

ensure the final product's quality and durability. It is preferable to use straw with specific characteristics that make it more flexible and resilient when shaped into ropes or handwoven items. The straw should be collected at the right time after harvesting as shown in figure (2), while the stalks are still firm and naturally pliable, before they become overly dry or brittle .[20]

2/4 Ropes manufacture

The ancient Egyptians developed rope making techniques in 2500 BC which are still in use today as shown in figure (3).[24] Rice straw has been effectively used in various practical applications due to its low cost, local availability, and eco-friendly nature. Among the various

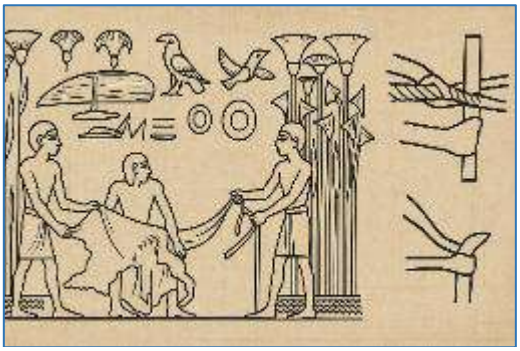

FIG. 3: DEPICTION (REDRAWED) OF ROPE MAKING USING WEIGHTS IN THE TOMB OF NEFER, SAQQARA. RIGHT: CLOSE-UP OF THE MAN SEATED IN THE CENTER ENGAGED IN THE PROCESS.

applications, rope production presents a promising solution within the handicrafts industry. Rope-making is an ancient craft that has been practiced for centuries, yet modern technological advancements offer new opportunities to enhance its efficiency and sustainability. So, Straw can be twisted into rope using either hand tools or a specially designed machine as shown in figure (4). Nowadays, this rope is mainly used for packing materials like concrete pipes is widely applicable for protecting trees and bricks, securing vegetable bundles, and other similar

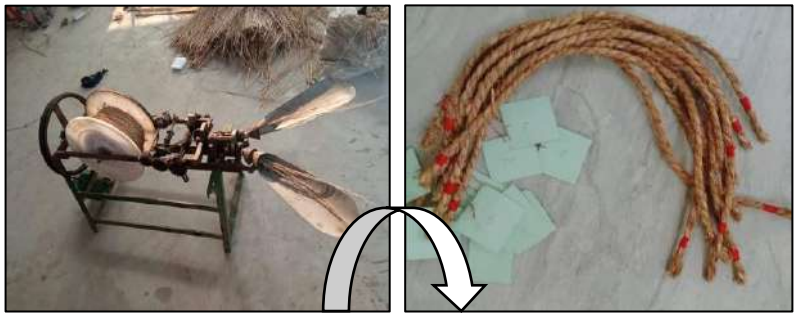

Fig. 4: BRRI(Bangladesh Rice Research Institute) straw rope maker: The BRRI straw rope maker was fabricated in a research workshop to twist straw into rope and increase the versatile use of a straw.

uses. Straw rope products must meet modern standards of precision, appropriate size, and shape without distortion, and be durable and uniform, with woven straw ropes ideal for furniture in tropical climates due to their strength.

There are only two basic ways for using the fibers to make a cord by hand: Braiding (or plaiting) and twining (or twisting). Twisting or braiding strands of these materials together made them stronger than single untwisted fibers. This process helps create a strong, durable braided rope suitable for high-friction applications.

2/4/1 Hand-twisting (or twinning)

Fibers are twisted together to form a stronger, tighter structure. You can twist fibers in one direction (called single ply) or twist multiple plies together in opposite directions (plying) to make a thicker, stronger cord as shown in figure (5).[25]

2/4/2 Hand-braiding (or plaiting)

As illustrated in figure (6): Instead of just twisting, fibers are woven over and under each other

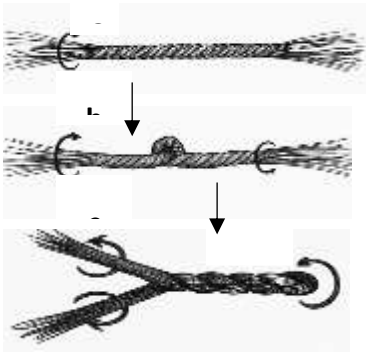

Fig. 5: Steps of hand-twisting rope manufacture a) *Apply clockwise twist (S-twist)*: Each hand applies a clockwise twist to each ply. b) *Position the plies*: Pass the right ply over and the left ply under (counterclockwise or Z-plying). C)*Repeat the process*: Switch hands, twisting both plies in a repeating motion

in patterns. Braiding adds strength and flexibility, and can create cords that are flat, round, or even hollow inside, depending on the technique.[26]

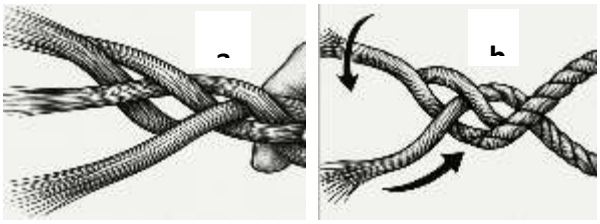

FIG. 6: HAND-BRAIDING TECHNIQUES: A) FROM UNTWISTED FIBERS B) FROM TWISTED FIBERS.

2/5 Artificial Intelligence

Artificial Intelligence (AI) plays a crucial role in improving training efficiency, optimizing rope production, and enhancing market accessibility. AI has transformed handicraft textile design by generating innovative patterns, enhancing artisan skills, and enabling design customization. It streamlines workflows, automates repetitive tasks, and improves precision and quality. AI also supports faster design iterations, reduces errors, and fosters collaboration among designers. Overall, AI empowers artisans to innovate more efficiently and creatively, pushing the boundaries of traditional textile craft Key AI applications include:

- AI-Based Training Modules: Personalized learning experiences tailored to trainees' skill levels.
- Automated Quality Assessment: AI algorithms analyze rope strength, uniformity, and durability.
- Smart Market Analysis: AI tools provide insights on consumer demand and pricing strategies.

- Virtual Assistants: Chatbots and AI tutors guide trainees through technical challenges. [27]

2/5/1 AI Image Generator from Text

Text-to-image generation systems are advanced technologies that interpret textual inputs (prompts) before creating images. These systems are trained on extensive datasets composed of text-image pairs collected from the internet. Although prompts can sometimes produce unexpected outcomes, various models such as Midjourney and OpenAI's DALL-E 2 offer users guidance on how to refine prompts by incorporating specific terms to influence the style or format of the generated images.

By adjusting their inputs, users can progressively gain greater control over the image creation process.[28] Based on the goal of reducing labor costs and time, the pattern evaluation model based on ResNet was used to classify the remaining 5229 pattern samples from the database, resulting in the extraction of 1907 real wickerwork pattern images in one of the studies from the large image dataset; some partial results are shown in Figure (7).[29]

FIG.7: FUNAN WICKERWORK PATTERN DATASET (PARTIAL)

2/5/2Parametric design

The use of parametric design software (Rhino and Grasshopper) to develop products featuring wave-like characteristics, verifying their practical application was studied. By adjusting the number of warp and weft division points and the wave height as shown in figure (8), the designs demonstrate the dynamic possibilities offered by parametric control. Rather than delving into complex design theories, the research focuses on the practical application of parametric design throughout the production process, encouraging designers to explore new creative possibilities. It also examines the compatibility between current digital fabrication methods and parametric techniques, aiming to develop innovative thinking strategies. The study anticipates that future advancements in parametric design will open up broader applications within the field of industrial design.[30]

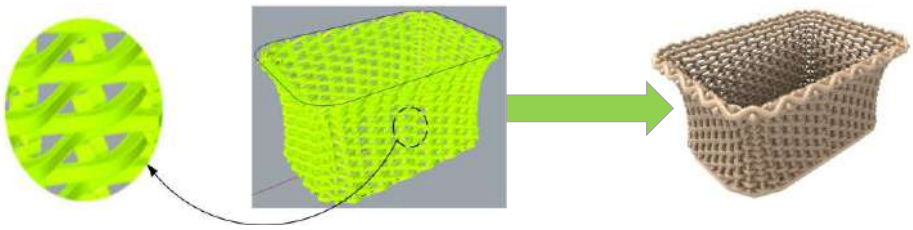

FIG.8: CREATING 3D MODEL WITH WEAVING FEATURES IN BOTH WARP AND WEFT

3/ Experimental work

A comprehensive training system was developed for the handmade production of ropes from rice straw, including three training courses focused on creating decorative and functional products using manual techniques and artificial intelligence. The system covers planning, content development, implementation, and evaluation, emphasizing sustainability and supporting job opportunities in rural communities. The system was evaluated through questionnaires measuring the satisfaction of beneficiaries and craftsmen with the effectiveness of the training and the marketability of the final products.

3/1 Designing a training system

Steps and procedures for designing the training system for the rope industry manually using rice straw and use artificial intelligence:

The design of an effective training system requires a clear methodology that guarantees the achievement of educational and practical goals and form. Figure (9) explains the steps and procedures for preparing this training system .

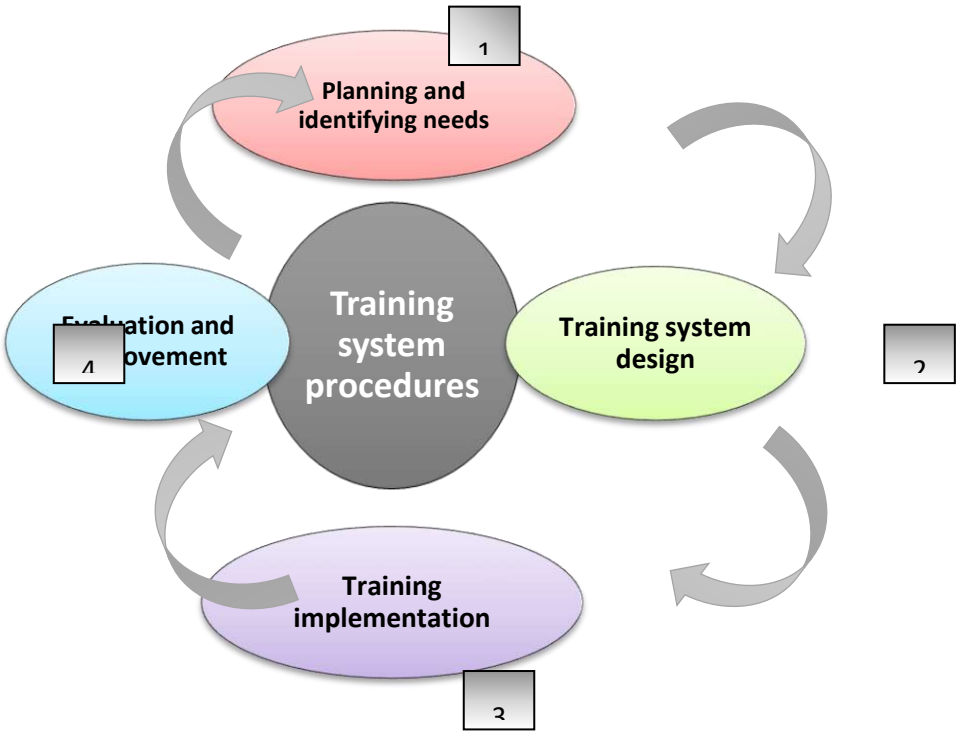

FIG.9: STEPS AND PROCEDURES FOR DESIGNING THE TRAINING SYSTEM FOR THE ROPE INDUSTRY MANUALLY USING RICE STRAW WITH THE USE OF ARTIFICIAL INTELLIGENCE

3/1/1 The first stage: Planning and identifying needs

This stage includes the following two procedures:

a) The feasibility study and the identification of the targeted groups, and this is done through

- Defining targeted groups such as farmers, craftsmen, young people looking for job opportunities, and rural women.
- Analysis of the needs of the trainees in terms of knowledge and skills required for the ropes industry.
- Study the market to determine the demand for ropes made of rice straw and its potential applications.

b) Defining the training goals that include

General goal: Enabling the trainees to master the manufacture of the ropes manually using rice straw in an effective and sustainable way.

Sub -goals:
- Understanding physical properties of rice straw and how to address them.
- Gain handicraft skills for ropes with simple tools.
- Application of quality techniques to ensure the durability of the product.
- Learn ways to market ropes and use them in different applications.
- Using artificial intelligence in improving learning and production processes.

3/1/2 The second stage: training system design

The training covers rope-making from rice straw and includes AI-supported educational tools to enhance learning and production efficiency.

a) Preparing the Training Content

The content should include integrated learning units, as:

Unit 1: Introduction to rice straw recycling and its environmental and economic importance.
Unit 2: Tools and materials used in rope making.
Unit 3: Steps for manual rope manufacturing, from straw processing to forming the final rope.
Unit 4: Quality standards and improving production efficiency.
Unit 5: Marketing and different uses of ropes.
Unit 6: How to use artificial intelligence to support the training process and improve production.

b) Development of educational materials, including

- Booklets and guidebooks containing illustrative images and diagrams.
- Educational videos demonstrating manufacturing steps in detail.
- An interactive application or online platform supported by artificial intelligence offering virtual practical training.
- Smart evaluation systems to analyze trainee performance and suggest improvements and development.

3/1/3 The third stage: Training Implementation

a) Preparing the training environment through the following points:

- Providing workshops equipped with the necessary tools and materials.
- Creating virtual laboratories via an electronic platform for remote learner training.

- Making digital content easily accessible via smartphones and computers.

b) Implementing the training program

- Practical training: Conducting direct training sessions to explain and implement manufacturing steps.
- Interacting with artificial intelligence: Using smart performance analysis systems to provide immediate feedback.
- Interactive workshops: Inviting manufacturing and marketing experts to share their experiences.

3/1/4 The fourth stage: Evaluation and Improvement

a) Performance Evaluation and Impact Measurement

- Use questionnaires to measure trainee satisfaction and the extent to which they benefited from the program.
- Track trainee progress through artificial intelligence and data analysis to identify weaknesses and strengths.
- Compare the quality of manufactured products with the required standards.

b) Continuous Improvement of the System

- Update training content based on feedback from trainees and experts.
- Develop the artificial intelligence technologies used in training to provide a more personalized experience.
- Expand the scope of training to include new communities and support the establishment of small projects in this field.

Training system for Handmade Rope Production from Rice Straw has been developed. Three training courses have been designed and evaluated as part of this system:

a) The art of creating decorative lighting units from rice straw.
b) Design and production of decorative items using rice straw.
c) Recycling rice straw in the production of functional products.

3/2 Adoption of a technique for producing rice straw ropes

The process of rope-making from rice straw begins with selecting high-quality fibers based on color, length, smell, and texture, followed by cleaning, soaking, drying, and optional dyeing for flexibility and aesthetics. Handcrafting involves traditional twisting or braiding techniques to form strong, flexible ropes, ending with finishing steps like trimming and smoothing for a refined appearance.

3/2/1 Selecting good rice straw fibers

When selecting the straw as shown in figure (10) it was important to consider the following:

- **Color:** Preferably golden or light yellow rice straw, as it is more aesthetically appealing and better suited for dyeing or further processing. This coloration also indicates that the straw was properly dried and is free from moisture and mold.
- **Length:** The straw should be long, straight, and free from cracks or breaks.
- **Smell:** Good-quality straw has a mild natural scent and is free from unpleasant odors that could indicate decay or poor storage conditions.
- **Texture and Durability**: The straw should have a relatively smooth texture and be strong without being brittle, demonstrating both strength and flexibility. [21]

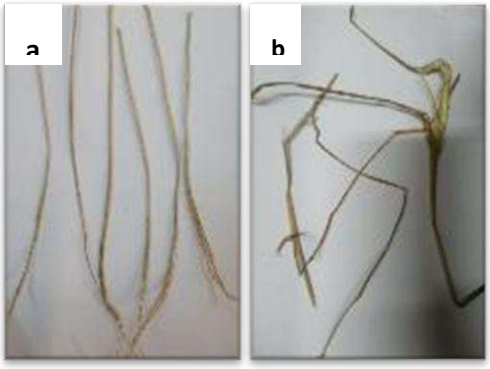

FIG. 10:SELECTING A GOOD RICE STRAW FIBERS: A) HIGH QUALITY FIBERS B) LOW QUALITY FIBERS

3/2/2 Preparing rice straw fibers

The next step after selecting good rice straw fibers is cleaning. The straw should be washed with water to remove dust and impurities. After washing, it should be soaked in lukewarm water with a little salt or natural vinegar for about 4 to 6 hours. This process helps to disinfect the straw, eliminating germs or insect eggs, and also gives the fibers additional flexibility. [22]

After soaking, the straw should be dried in a well-ventilated area for several hours until it reaches a moisture level that allows for shaping without breaking. At this stage, the straw can optionally be dyed using natural or organic dyes, especially if there is a desire to create colorful products. The straw is immersed in dye solutions and then dried again.[23]

3/2/3 Handcrafting of Ropes

As illustrated in Figure (11-a), two distinct techniques were adopted for the hand-manufacturing of ropes using rice straw. The first technique involves a manual twinning process, wherein bundles of rice straw are twisted in opposite directions by hand. This method

FIG. 11: ROPES MANUFACTURING A) TWINNING PROCESS B)

relies on the physical interlocking of fibers to produce a rope with adequate strength, flexibility, and structural integrity. It reflects traditional craftsmanship and emphasizes sustainable material use.The second technique as shown in Figure (11-b) is braiding, where multiple strands of rice straw are interlaced in a structured pattern to form a cohesive rope. This method enhances the tensile strength and aesthetic quality of the final product, while allowing for variations in thickness and design depending on the intended application.

3/2/4 Finishing

Figure 12 shows that the finishing process of the produced handcrafting ropes begins with trimming excess fibers to ensure a clean and uniform surface. In some cases, the ropes are lightly sanded to remove rough edges and improve texture.

3/3 Utilizing AI for the training products designs

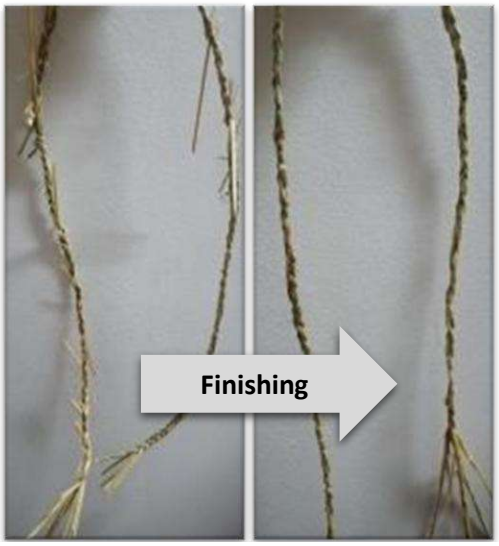

FIG. 12: FINISHING PROCESS OF RICE STRAW ROPES

AI technologies were employed to support the design phase of the training products of the first course training , aiming to demonstrate the potential of artificial intelligence in this field. Advanced design tools and generative AI software were used, enabling the visualization of product prototypes, exploration of various aesthetic and structural possibilities, and optimization of material usage.

Fig. 13: Generated designs of rice straw ropes for: a) the first training course : the art of creating decorative lighting units from rice straw b) for the second training course : Design and production of decorative items using rice straw c) the third training course : Recycling rice straw in the production of functional products.

3/4 Evaluation of Training Courses

The effectiveness of the training courses was assessed through

3/4/1 A survey of the target group's opinions on the anticipated educational effectiveness of the training course

After preparing the three training courses, they were presented to a group of beneficiaries interested in training to gauge their opinion on the content of the three training courses. This is done by providing a questionnaire with nine axes to measure the level of satisfaction, their impressions, and initial perceptions of the training system, as shown in table(1)

Table (1) The questionnaire model used to survey beneficiaries' opinions about the training courses under study

No.	Axes of questionnaire	Respondents opinion		
		Disagree	Agree	Strongly agree
1	The training workshop presentation was organized, clear, and understandable.			
2	There is a real need for this type of training in the community.			
3	Using rice straw in rope making for this idea is applicable.			
4	The product proposed from this training workshop is an innovative idea that achieves sophisticated aesthetic values.			
5	The product proposed from this training workshop achieves the required functional values when used.			
6	Employing artificial intelligence in training increases its effectiveness.			
7	The proposed workshop helps in enhancing sustainable development concepts and increases awareness of the importance of sustainable development.			
8	The proposed training will contribute to creating job or income opportunities for individuals.			
9	I feel enthusiastic about participating in this training when it is implemented.			

3/4/2 A survey of craftsmen's opinions on training system, training outcomes, and their potential marketability

To survey the opinions of artisans, entrepreneurs, and small business owners regarding the training system, training outcomes, and their potential marketability, a questionnaire consisting of 10 axes was prepared, as shown in table (2).

Table (2) The questionnaire model used to survey craftsmen's opinions on training system, training outcomes, and their potential marketability

No.	Axes of questionnaire	Respondents opinion		
		Disagree	Agree	Strongly agree
1	The objectives of the training system are clear and achievable.			
2	The steps and stages of the training system succeeded in achieving the desired objectives.			
3	Applying artificial intelligence helps improve the process of making handmade ropes from rice straw and manufacturing innovative products from them.			
4	The training system contributes to creating new job opportunities for youth and entrepreneurs.			
5	The training system enables the enhancement of entrepreneurship in the field of handicrafts.			
6	Using rice straw as a raw material for rope making is consistent with the context of sustainable development.			
7	The training system helps achieve sustainable development and support the national economy to serve society.			
8	The proposed training courses achieve the practical application of the training system.			
9	The innovative products under study meet the desired aesthetic and functional requirements and can be marketed.			
10	I am interested in participating and supporting this training system.			

4/ Results and disscution

Figure (14) shows the survey results of the target group of people wishing to participate in the training regarding the anticipated educational effectiveness of the three training courses.

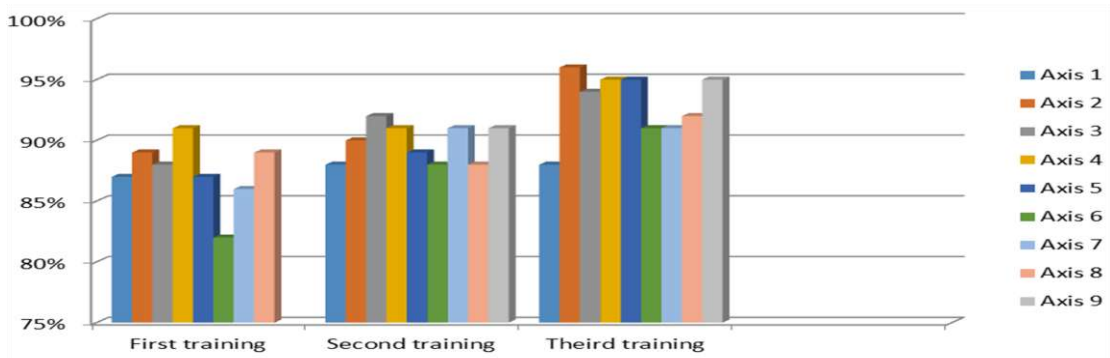

Fig. 14: A survey results of the target group's opinions on the anticipated educational effectiveness of

From this chart and by analyzing its data, we conclude the following:

- All axes achieved a satisfaction rate exceeding 80%.
- Axes 3, 4, and 5 achieved the highest satisfaction rate, indicating that the use of rice straw in rope making is feasible and that the proposed products to be made using these ropes provide sophisticated aesthetic values and achieve the required functional values.
- There was also enthusiasm from the target group to participate in these three training sessions when implemented.
- When comparing the satisfaction rate values achieved by the three training courses, the third training course achieved the highest satisfaction rate, followed by the second training course, and then the first training course, which means that recycling rice straw in the production of functional products has very high acceptance among beneficiaries.

Figure (15) shows the survey results of artisans, entrepreneurs, and small business owners regarding the training system, training outcomes, and their potential marketability.

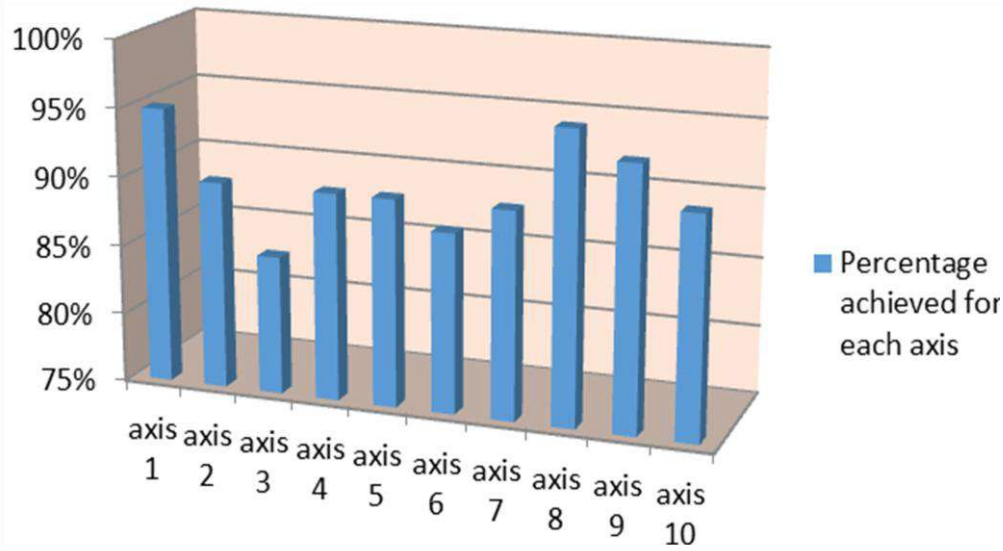

Fig. 15:The survey results of artisans, entrepreneurs, and small business owners regarding the training system, training outcomes, and their potential marketability

From this chart and by analyzing its data, we conclude the following:

- All axes achieved a satisfaction rate exceeding 85%.
- The objectives of the training system are clear and achievable.
- The steps and stages of the training system succeeded in achieving the desired objectives.
- Rice straw can be used to manually manufacture ropes.
- Applying artificial intelligence helps improve the process of making handmade ropes from rice straw and manufacturing innovative products from them.
- The training system contributes to creating new job opportunities for youth and entrepreneurs.

- The training system enables the enhancement of entrepreneurship in the field of handicrafts.
- Using rice straw as a raw material for rope making is consistent with the context of sustainable development.
- The training system helps achieve sustainable development and support the national economy to serve society.
- The proposed training courses achieve the practical application of the training system.
- The innovative products under study meet the desired aesthetic and functional requirements and can be marketed.
- There is significant interest from artisans, entrepreneurs, and small business owners in participating in this training system.

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