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Educational doll design with exploration of the mechanical properties Khombouw bark

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Abstract

The strategy for developing Khombouw bark craft products in Asei Village, Jayapura Regency, has not yet been optimized to become an interactive learning medium for forming early childhood interest in learning and building character education based on local Papuan wisdom. This research explores the mechanical properties by testing the bending strength of Khombouw bark material as a primary material for making character dolls for Papuan children. This research uses a Research and Development (R&D) development approach, including existing, archetype, and experimental studies. The process of assembling the prototype doll from Khombouw bark uses basic patterns with manual sewing techniques and is reinforced with composite materials to give a handmade impression. The results of this research show that natural fiber in the form of bark from the Khombouw tree has a high level of elasticity that can be applied in the design of volumetric product construction. Visualization of educational dolls using natural colors (wood brown or reddish brown) produced from the surface of Khombouw bark material, which is displayed on child figures by adapting the biological characteristics of Papuans (curly hair), as well as traditional clothing such as crowns, noken and tassels to build Papuan cultural identity.

Keywords: *educational dolls, Khombouw bark, mechanical properties, Asei Village*

1. Introduction

The word doll comes from the Portuguese word *boneca*. Dolls are imitation objects of living creatures such as humans, animals, or fictional characters made as toys. However, they can also have a ritual function related to magical or mystical activities. In the community's belief system, dolls are symbols of deceased people or objects that can be used as a medium to communicate with ancestral spirits. Dolls made from wood for ceremonies to convey someone's death can be found in the Sigale-gale dolls in Toba Batak culture (Sitanggang, 2010). In the Joseon dynasty era (1392-1897), Korean people were familiar with mythology through colorful wooden dolls called Kkokdu dolls as a funeral tradition. The Hopi Indian tribe constructs the existence of their ancestral spirits through the medium of Kachina dolls as anthropomorphic ancestral spirit creatures (masked imitators) (Loftin, 2003). Examining the history of the development of dolls in human civilization, they were first used by people who lived in the Ancient Greek and Roman eras, 3000-2000 BC. It is said that every girl is obliged to have a doll to keep until the wedding, which will be placed on the altar of Artemis (Greek) and Diana (Roman). In Ancient Egypt, dolls were still made simply from clay, bones, cloth, and even pieces of wood and became a medium to be used as a substitute for human sacrifice. The shift in the function of dolls from ritual objects to commercial toys was produced in Germany (Nuremberg et al.) by forming trade unions to enforce standard rules in making and marketing dolls. In 1827, Johann Nepomuk Maelzel created a mechanical sound box inserted into the doll's body so that the quality of doll production in the 20th century experienced rapid development using materials made of plastic and vinyl. In 1959, Ruth Handler had the idea to create the Barbie doll after founding the Mattel toy company in her garage in Southern California in 1945. Barbie is an icon of femininity in the lifestyle and behavior of

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the middle class of modern Western society (Rogers, 1999).

Playing is a child's nature, which is spontaneous, process-focused, fun, and flexible. Children need a play tool that can channel feelings and solve problems to fulfill their play needs, namely dolls. Dolls sometimes live in a child's imagination (Musfiroh, 2008). Puppets can be used as storytelling props in the learning process. Puppet shows are a form of story from real life so that children will better understand the storyline (Boueini, 2015). Using dolls as a learning medium is to train oral expression skills (speaking skills), foster and develop good attitudes and behavior, train self-confidence, and develop fantasy and imagination. Dolls are handicraft arts expressed through visual media into two-dimensional and three-dimensional works of art. Dolls, as a function of toy objects, can be categorized as applied fine arts in a hybrid form of various aspects covering art, design, and crafts. Craft is hand work (craft) called craftsmanship, meaning having expertise and skills (Pöllänen, 2016; Kusmadi, 2010). Handicraft arts or handicrafts are artistic activities that focus on hand skills by processing raw materials in the environment into valuable objects with aesthetic value. Craft arts result from human cultivation to solve a problem in meeting artistic needs (Raharjo, 2011; Suyanto, 2004). In designing educational dolls with Papuan characters, organic natural materials are used to explore the ecological wisdom values of local culture through the development of environment-based education. Ecological wisdom is a way of thinking, acting, and behaving in a reciprocal manner of utilizing and processing nature as a living environment and human life (Holilah, 2016). Implementing natural resource-based learning methods can increase students' awareness of the inheritance of local cultural values, intellectual development, character education, and human interaction with the environment.

This research tries to dig deeper into how local materials derived from natural fibers in Khombouw bark are used to create handicraft products in the form of educational dolls. In the tradition of the Sentani tribe, Khombouw bark is used as a material for handicrafts in the form of paintings featuring motifs that contain sacred meaning and significance. Paintings on Khombouw bark are made with three primary colors, namely red in the Sentani language called *hasai*, which comes from clay dye, black (*nogonom*) made from wood charcoal, and white (*keleumong*) from limestone (Manik et al., 2022). The people of Asei village paint tree bark traditionally using young coconut shoots as a substitute for brushes. Paintings created by the hands of these craftsmen include the Iuwga motif, which means the majesty or greatness of an Ondofolo Asei, and *kheykha* as a symbol of the beauty of Sentani women (Rai, 2021). Historically, Khombouw bark in the Sentani language, called *malo*, was first used as clothing for a woman from the Sentani tribe who was about to get married, then also as a wrapper for babies after birth and to wrap corpses in death rituals. Bark, which can be used as raw material for the textile industry, experienced a decline when Indonesian people began to discover weaving techniques. This was because the faster and more practical process of making cloth shifted the tradition of making clothes from bark. Khombouw bark is an endemic tree that grows in the tropical forest area of Asei Village, East Sentani District. In the community's religious and belief system, Khombouw trees can only be cut during the dark moon (night sky without moonlight) or the black moon, the second new moon phase in AD (Manik et al., 2022). The technique of making Khombouw bark is still done manually using traditional equipment and requires a longer time in limited quantities. This research studies the process of making doll concepts and exploring materials from natural fibers to produce an initial prototype of a Papuan child character doll. The material exploration stage aims to discover the physical and structural characteristics of Khombouw bark, which can be applied to hand puppets as educational teaching aids. The process of assembling the doll prototype from Khombouw bark uses basic patterns with manual sewing techniques. It is reinforced with composite materials to give a natural impression and rustic concept as a response to environmental issues in efforts to preserve Khombouw bark.

A study of dolls made from natural materials as a learning medium was carried out by Lili Chrisnawati, Dzul Fithria Mumtazah, and Fadhilah Khairani in *Horticultural Dolls (Horta) as Experiment-Based Learning Media in Efforts to Build Science Process Skills in Elementary School Students* (2020). This research aims to improve students' science process skills and the application of scientific methods in experiment-based learning through dolls made from hydroponic media (wood powder). Research carried out by researchers by presenting elements of local identity that convey messages about the values of character education through puppet designs adapting rare endemic animals in Indonesia was carried out by Muhammad Alhaq & Senja Aprela Agustin in *Designing Stories, Character Puppets and Environment for the Tangkupet Puppet Theater Series with Elevating Elements of Local Indonesian Identity*

(2020). Ilham, M. Zaenul Muttaqin, Akhmad Kadir, Usman Idris, Eka Patmasari in *Khombouw Bark Painting (The Potential of Asei Island Craft Arts as a Tourism Attraction of Sentani Lake, Jayapura Regency)* (2022) analyses the obstacles faced by Khombouw bark painting artisans who experience difficulties in obtaining raw materials for *khombouwbarkas* due to the absence of reforestation practices as a conservation effort against illegal logging, as well as imitations of handicraft products such as *khombouware* which are made into screen prints circulating on the market. The research results show that Asei Besar Island has the potential to be developed as a community-based craft tourism village through

Khombouw bark painting. Research conducted on the phenomenon of the Khombouw bark handicraft business as an effort to maintain local wisdom was also researched by Partini Salomina Rumsarwir in *Khombouw Painting Art: Production Orientation of The Asei Village Community, Jayapura Regency* (2012). The results of this research show that Khombouw bark is a commodity item that is influenced by business orientation because the selling price is relatively high and is in demand by local and foreign tourists, as well as the dominant factor originating from the family's economic orientation but still maintaining the cultural values that have been inherited. To future generations, it will remain well maintained.

Joni Johannes Leonard and Rafiuddin Syam, in *The Analysis of The Tensile and Flexural Strength of Epoxy Composites Reinforced with Khombouw Bark Fibers* (2009), showed that alkali treatment with the orientation of the fibers had a different effect, and the interaction between the two was the same. In the bending test, the treatment and orientation of the fiber direction and the interaction between the two showed different effects. This research uses the lamina method by arranging the fibers in three layers using variations in the direction of -300/00/300, -450/00/450, and -600/00/600, as well as 15% alkali treatment with soaking times (2,4,6 and 8 hours). In contrast, the data analysis method is the two-way ANOVA with the interaction of the two treatments (alkalization and fiber direction). The maximum tensile strength value without alkali treatment is 2.73 MPa (fiber direction -600/00/600), an increase of 7.69%. The maximum tensile strength at varying fiber soaking times was obtained at 11.45 MPa with a soaking time of 4 hours (fiber direction 450/00/450). The maximum flexural strength without alkali treatment is 31.50 MPa (fiber direction 450/00/450). The maximum flexural strength without alkali treatment for 2 hours is 130.50 MPa (fiber direction -300/00/300). Based on the description stated above, the research aims to explore the potential of the mechanical properties of Khombouw bark as a medium for Papuan character dolls in preserving local cultural values, character education for intellectual development, and human interaction with the environment.

2. Research Methods

This research uses qualitative methods with a research and development (R&D) approach. In education, this type of research is very influential in improving the quality of education through the resulting learning media. Development research is a systematic review process for designing, developing, and evaluating programs and learning products, which must meet the criteria of validity, practicality, and effectiveness (Hanafi, 2017). This approach is used to develop learning media using the storytelling method in early childhood education (PAUD) and kindergarten (kindergarten) units using dolls made from natural fibers. Research and development is a process that can be used to develop and validate educational products (Borg & Gall, 2018).

This research was carried out for three months, from July to September 2023, in Asei Besar Village, East Sentani District, Jayapura Regency; the data collection process used interviews, documentation, literature, and material experiments. In-depth interviews were used as a data collection method from informants determined to be two people from the Khombouw bark-making community. Data collection techniques using the library method use review studies of books, literature, notes, or reports relevant to the research being carried out, while documentation studies to complement the research results are in the form of photos or drawings in the prototype-making process.

Material experiment to determine the ability of natural fiber materials from Khombouw bark to withstand friction and tensile strength (flexibility) to become handicraft products in the form of three-dimensional spatial structures. Data analysis in this research uses qualitative descriptive analysis techniques that explain product development results in the form of a learning media doll made from Khombouw bark.

3. Results and Discussion

Existing studies: Characterization potential mechanical properties of Khombouw bark

The existing condition analysis stage is a review activity of data sources to obtain accurate and relevant data. In this stage, a review is carried out to identify the characteristics of the physical condition of Khombouw bark, which can be measured directly from a material without changing its chemical composition. Khombow plants (Ficus spp.) come from the Ficus genus and the Moraceae family, which are ecologically crucial for lowland and highland forest ecosystems (Baskara & Wicaksono, 2013). Two types of Khombouw wood are white Khombow (*Ficus variegata Blume*) and red Khombow (*Ficus nodosa Teijsm & Bin*n). The genus Ficus consists of almost 800 species spread throughout the world in a tropical season, mainly in the Indo-Malesia region (Nur'anini & Arbain, 2013). The Khombouw plant is a type of tree with a tall trunk that can reach 30 meters and buttress roots as high as two meters. The Khombouw tree has single leaves arranged in a spread, oval shape, rounded, heart-shaped base and tapered leaf tips, light green with flat leaf edges, and a secondary leaf vein structure numbering 4-8 pairs. In the forest around Asei village, red Khombouw trees (*Ficus nodosa Teijsm & Binn*) show minimal growth compared to white Khombouw (*Ficus variegata Blume*) as a result of harvesting or logging and taking bark in larger quantities. The Khombouw tree is one of eighteen types of bark from plants in the Moraceae family, which can be used as a bark producer in Indonesia. Good quality Khombouw plants for processing into raw materials for bark crafts come from trees with straight trunks with a diameter of 20-25 cm or more. The technique of stripping bark from tree trunks also pays attention to unique signs which, according to local people, are called watermarks (a kind of indication of the direction of the grain, physical indications of knots, or other indications on the bark in local knowledge) so that the resulting Khombouw bark does not break easily. The direction of the fibers is the general direction of the cells in the wood forming the axis of the tree trunk (Mendis et al., 2019).

The traditional method of making Khombouw bark is similar to the processing of Kapuak bark for craft materials carried out by the Dayak Rimbun tribe through a sacralization process. The technique for making Khombouw bark is done by taking the rough outer layer of the tree trunk to remove it, then pounding the layer using an iron plate to get soft and vast sheets of bark. Pounding the bark takes a long time because it goes through washing to remove the dregs or sawdust, and then the Khombouw bark is dried in the sun for 1-2 days with the help of sunlight. In the religiosity of the Sentani tribal community, there is something magical about prohibiting cutting Khombouw trees during the crescent or full moon. The resulting tree bark will be wrong, break easily, and be thinner, and it is considered not good enough to be made into raw materials for crafts. People who believe in this myth usually cut down Khombouw trees at 6-9 in the morning or 15-16 in the afternoon using axes and machetes (Manik et al., 2019). The community's cultural practice of producing local handicrafts made from natural fibers is still very dependent on the availability of raw materials in the form of bark sourced from Khombouw trees in the forests around villages in the East Sentani District area. The increase in the need for craft materials from Khombouw bark as a commodity that contributes to people's income has not yet been accompanied by tree cultivation business activities. The lack of availability of Khombouw bark for handicrafts or paintings has resulted in local craftsmen preferring to use substitute materials derived from breadfruit trees or importing bark media from Yogyakarta and Kalimantan to meet consumer demand. The process of passing on knowledge regarding traditional practices of preserving Khombouw bark has decreased because the artisans are getting older, so almost no young generation with sufficient educational levels is interested in learning about using Khombouw plants (Manik et al., 2019).

Khombouw bark has a texture that must and can last a long time because it does not rot quickly. Khombouw bark has a high level of elasticity and good quality, as shown by bending or flexibility tests using the tensile test method through heating and immersing the fiber in an epoxy resin matrix (Lasarus, 2018). Khombouw bark fiber is a laminated fiber with mechanical properties because it is solid and weather-resistant (Silka et al., 2019). Wood's mechanical properties are wood's ability to withstand external loads. An external charge is a force outside an object that tends to change the shape and size of the object. The mechanical properties of wood are divided into tensile strength, compressive strength, flexibility, and hardness (Record, 1914; Yoresta, 2015; Dumanauw, 1990). The mechanical talent referred to in materials-based research is an effort to explain the ability of materials to withstand or respond to force, effort, or load, such as hardness, stiffness, elasticity, tensile strength, and material fatigue. Bark consists of macromolecular compounds (polysaccharides and lignin), including organic and non-organic materials

composed of extractive compounds. Extractive compounds have several ingredients, such as stunned compounds, aliphatic acids, and phenolic compounds (Sartika, 2022). The obstacle faced in using materials in the form of bark is the problem of decreasing the mechanical properties of the fibers after being exposed to water, so a method that can be applied to increase the physical resistance of the material by coating is needed. Each piece of wood has naturally different mechanical properties because it is influenced by external factors, such as wood preservation, environmental humidity, loading, and defects by wood-destroying fungi or insects, as well as internal factors, including specific gravity, knots, slanted grain, and so on. The strength or durability of the bark to withstand tensile loads is influenced by the type of wood, the size of the wood cross-section, weight, and span width. Wood has elastic properties and is resistant to loading perpendicular to the grain, so this material cannot be imitated by other materials made by humans, such as steel and concrete. The strength or resistance of wood to two forces acting in opposite directions is called tensile strength. In contrast, the mechanical properties of wood have static bending strength, which helps resist forces that try to bend the wood. This is called the modulus of elasticity (MOE) (Upessy, 2016).

Archetype study: Visual concept for designing Papuan children's character dolls

The stages in creating a NEKAY character design, an abbreviation for Khombouw bark doll, are data collection, analysis, and visualization. Data was collected to analyze early childhood education (PAUD) by observing children's growth and development in preschool (4-6 years). Pre-school age is when children are separated from their parents and begin interacting with their environment. Early childhood is also more complex in cognitive development because children can understand and process visual and verbal information. The development of children at this age also has a curiosity about everything that happens around them, so their sense of interest will encourage them to discover new information or experiences. Evaluation of early childhood learning aims to understand children's behavior, evaluate children's development, and evaluate progress in learning (Wortham, 2004). Based on observations made at preschool institutions such as PAUD and Kindergarten in Jayapura, Papua, to educate children by emphasizing playing while learning. Innovative learning through educational teaching aids (APE) based on local wisdom is not yet optimal to stimulate children's intelligence by instilling local cultural values in students. If viewed from a material perspective, educational teaching aids consist of various types that can develop thinking power (cognition), motor language creation, and children's skills (Ismail, 2007). Observation activities are also carried out continuously by developing a child's sense, namely sensitivity regarding how children, individually and in groups, feel things and react to the environment. Learning effectiveness measures the success of an interaction process between students and between students and teachers in educational situations to achieve learning goals.

This analysis found that characters with these archetypes appear in visual form related to body proportions, faces, clothing, and attributes. Developing dolls in the form of native Papuan children's characters was carried out by observing four aspects of early childhood growth and development: speech and language, gross motor skills, fine motor skills, and socio-emotional. Puppet creation is a skill based on experimentation in forming a creative thinking process consisting of the composition of visual elements and selecting materials or techniques to be used. This research developed a doll prototype to represent the plot of a story with a slice-of-life theme about the daily lives of children learning and playing in their environment. Designing dolls as an interactive learning medium can also play a role in strengthening character education through ways of behaving and acting to live and collaborate as contained in local wisdom values. The process of designing the Khombouw bark doll character using the Three Dimensional Development principle, according to Sheldon (2004), is a design process that looks at three aspects, namely: psychological, physiological, and sociological.

Psychological. Psychology is the basis of the character's personality that connects the creator with the character. The character's traits, habits, strengths, weaknesses, preferences, and intelligence are the creator's imagination, as expressed in the character of the character created. At the character creation stage, the characterization of the Khombouw bark doll presents shapes, strokes, and facial expressions adapted to the local community's cultural traditions. Facial expressions that are enthusiastic and show joy or interest illustrate the nature of Papuans, who are open to other people, friendly, and smiling. The cartoon illustration style used in designing the doll sketch is adapted to the target audience (kindergarten and early childhood education) to convey a cheerful, funny, and enjoyable impression.

Physiological. Physiological is a description of the character's appearance in the form of clothes, accessories, and the color of the character's skin. The appearance of this character shows the nature of the character itself. The stages of designing the Khombouw bark doll character refer to the analysis carried out by observing the physical development of elementary-age children (native Papuan children) anatomically regarding genetic factors. Papuans belong to the Melanesian or Melanesian race, with physical characteristics such as black skin, black and curly hair, slightly thick lips, straight body posture, broad nose, and a prominent jaw. The diversity of characteristics of indigenous Papuans is more clearly visible through phenotypic characteristics, namely hair color and shape (Rumansara, 2015). The costumes used in the Khombouw bark doll characters to build Papuan cultural identity, such as cassowary crown, *noken*, and *wah* (skirt) tassel.

Sociological. The character's relationship with his environment is found in the sociological aspect. Sociological aspects will be seen when the character responds to the environment. The creation of NEKAY character designs is based on experimental practices from natural fibers derived from plants as a form of human interaction with the environment. The representation of environment-based character education in the design of educational dolls made from Khombouw bark aims to bring young children closer to the environment, increase awareness of environmental conservation, and learn to protect the natural environment. Forests and Papuan indigenous people have formed a pattern of mutual need for relationships that has been going on for generations. The relationship between Papuan humans and nature is religio-magical (Soekanto, 1958).

The visualization of the Khombouw bark doll character is simplified so that it is easy to remember and fosters children's love and interest. Drawing anatomy (body proportions) for early childhood or play group children (4-6 years) uses the formula length 5x head height so that the child's body proportions will be smaller than the head's size, which tends to be more significant. It is a circle at the stage of determining the basic shape that will be used to show the characteristics of the Papuan child character doll. The basic shape of a circle tends to be used to show childish, protective, unifying, cheerful, and gentle characteristics. The character design is oriented towards dolls with stylized cartoon visual styles for the needs of stories adapted from native Papuan children. Two characters from native Papuan children were created into Khombouw bark dolls for the scenario of the first episode, consisting of a boy named Dominggus (Domi) and a girl named Yemima (Mima). The visual depiction of the Khombouw bark doll is made in a standing body position, with eyes looking straight. The palms of the hands hang on the sides of the body and face forward, while the soles of the feet also point forward, and the legs are perfectly straight. The sketch was carried out to find the initial form of the anatomy of the Khombouw bark doll, which has body proportions with size from head to foot of only four head units. The doll's head is made with an oval shape that tends to be round, curly black hair with a brownish color, round eyes with bags, and thick eyebrows, while the mouth is curved upwards to show happiness, innocence, purity, and hope. The characters of the boys and girls from the Papuan ethnicity are displayed in short curly and curly hair in two braids. The word Papua itself comes from the Malay language, which means curly hair, which is an image that refers to the physical appearance of the indigenous tribes in Papua. The doll design refers to the biological character and skin color of the Papuan people, which is made with a visual concept using natural colors produced from Khombouw bark material, namely brown wood or reddish brown. The illustration of the Khombouw bark doll character uses a blocking coloring technique with color gradations carried out in rhythm and stages. The coloring process is done by first prioritizing dark colors and transitioning to lighter or lighter colors.

Figure 1. Visual Concept of NEKAY Characters: Yemima (Right) & Dominggus (Left)
(Source: Bayu Aji Suseno, 2023)

Figure 2. The technique of draping doll patterns on Khombouw bark
(Source: Bayu Aji Suseno, 2023)

Figure 3. Doll pattern sewing process
(Source: Bayu Aji Suseno, 2023)

Figure 4. Making doll hair from thread
(Source: Bayu Aji Suseno, 2023)

Figure 5. Dacron filling in dolls
(Source: Bayu Aji Suseno, 2023)

Experimental study: Exploration materials and prototype construction of Khombouw bark dolls

The experimental study was creating a doll concept and exploring the Khombouw bark material to produce a prototype of a Papuan child character doll. The material exploration approach is carried out using the design-by-doing method, which means understanding the characteristics of the material through experiments in the form of treating a material (Masri, 2010). Plant fiber (cellulose) is an alternative synthetic material that has the advantage of being biodegradable and naturally renewable, does not contain toxins, is easily degraded, and is environmentally friendly. Natural biological resources like Khombouw bark can be processed into raw materials for handicrafts because they have a unique texture, motif, and smooth fiber surface. Material exploration is a design approach that aims to obtain novelty value. In the creative process, two things complement each other. They are needed for each other, namely the tangible aspect in the form of material talent and the intangible aspect in the form of aesthetic standards (Guspara, 2017). Meeting these two aspects will lead to usability (utilitarian) and

Figure 6. The final product is a doll made from Khombouw bark (Source: Bayu Aji Suseno, 2023)

aesthetic (decorative) considerations in product manufacture. The tangible aspect of material talent has elements that become references in material treatment, namely mechanical, chemical, and physical (Ashby & Johnson, 2013). Of these three talents, there is manufacturing talent, a material talent that applies to the production process. The doll prototype uses a sound skeletal and joint system to support the show model concept. The Khombouw bark doll characters are human-shaped, measuring 50-70 cm, consisting of the head, body, hands, and feet. Making dolls from Khombouw bark (NEKAY) with Papuan children's characters has three stages, namely detailed planning, product assembly (prototype), and completion (finishing).

Detailed planning

The first stage is preparation, which includes collecting tools and materials for making Papuan children's character dolls. The raw material used is Khombouw bark, which has been processed into thin sheets through a repeated forging process until the thickness meets requirements. Khombouw bark has a firm fiber texture and an attractive natural color (brown or reddish brown). The Khombouw bark processing technique is carried out through the scouring stage to clean the bark from the sap that comes out during the fermentation stage, then continued with the bleaching process to remove substances contained in the bark that cannot be removed by the cooking process, so that the Khombouw bark fibers will cleaner due to the loss of color pigments and dirt levels attached to the bark. Local craftsmen in the Asei area in East Sentani District produce Khombouw bark in sheet form ready to be used. One Papuan child character doll requires approximately three pieces of Khombouw bark with a diameter of 1x1 square meters. At this stage, you also prepare supporting equipment for the doll prototype assembly process, such as wood glue, hot glue gun, needles, thread, scissors, etc. At the detailed planning stage, the final design of the Papuan children's characters was also carried out using digital devices.

Product assembly (prototype)

The initial stage in making a doll prototype is to change or transform a sketch of a Papuan child's character into a basic pattern to create a final product matching the Khombouw bark material design. A medium-sized doll pattern (50-70 cm) will be cut into fifteen pattern components, separated for each part. The doll pattern uses the draping technique because it does not require measurements to be made directly on the Khombouw bark material. The basic pattern is made according to the anatomical shape of the child's body, which will be used for the doll assembly process, starting from the head, body and legs. Cutting the essential pattern components follows the image formed by leaving a distance of 1-2 cm for applying adhesive and sewing manually. The assembly process is carried out by connecting each piece of the doll's frame with filling in the form of dacron material to expand ideally and not shrink when held easily. After cutting the doll pattern components, the next stage is sewing the essential doll pattern components. The process of sewing pattern components uses manual hand-sewing techniques and automatic sewing machines. The pattern components separated from each part begin to be connected using sewing techniques to form the doll's body, then continue sewing on the hands and feet to get the shape of the doll's skeleton. In each part of the pattern component connected through the sewing process, a hole will be left for filling the dacron material.

Final finishing

The finishing process can also take the form of surface coating or coloring to make the product more durable and attractive. The finishing touch technique of the original wood bark material must still be displayed to give a natural impression so that the finishing process stages on the surface of the doll material without using explicit or top-coated materials. Finishing is the final stage in designing the Khombouw bark doll, which aims to provide added value to the product. Finishing work can also be an effort to add accessories or complement traditional

clothing to Papuan children's character dolls, such as crowns, *noken*, and tassels.

4. Conclusion

Khombouw bark has a smooth texture and can last long because it does not rot quickly. It has a high level of elasticity to withstand friction and tensile strength (flexibility) to become a product with a three-dimensional spatial shape. Using educational doll media made from Khombouw bark with an exploratory study of stories and visual characters of native Papuan children is hoped to help stimulate conceptual thinking and experiences using teaching aids to create an interactive learning environment. This research outputs a prototype of a native Papuan child character doll made from Khombouw bark material as an interactive learning medium consisting of one girl and two boys. The characters of the boys and girls from the Papuan ethnicity are displayed in short curly and curly hair in two braids. Prototype The human-shaped Khombouw bark doll character was designed using an excellent skeletal and joint system to support an interactive performance model. The doll pattern uses the draping technique because it does not require measurements to be made directly on the Khombouw bark material. The finishing process can also take the form of surface coating or coloring to make the product more durable and attractive. The finishing touch technique of the original wood bark material must still be displayed to give a natural impression and an ethnic touch so that the finishing process stages on the surface of the doll material without using an explicit or top-coated material.

References

Ashby, M. F., & Johnson, K. (2013). *Materials and Design: The Art and Science of Material Selection in Product Design*. Oxford: Butterworth-Heinemann.

Baskara, M., & Wicaksono, K. P. (2013). Tumbuhan Ficus: Penjaga Keberlanjutan Budaya dan Ekonomi di Lingkungan Karst. *Prosiding Temu Ilmiah IPLBI 2013*. Universitas Hasanudin.

Borg, W. R., & Gall, M. G. (1989). *Educational Research: An Introduction*. New York: Longman.

Boueini, B. A. (2015). I am teaching Social Skills to Children Through Puppetry (Case Study of Institute for the Intellectual Development of Children and Young Adults, Fouman, Iran, 2014). *Indian Journal of Fundamental and Applied Life Sciences, 5*(1), 1696-1702.

Dumanauw, J. F. (1990). *Mengenal Kayu*. Yogyakarta: Kanisius.

Guspara, W. A. (2017). Pendekatan Material Sebagai Alternatif untuk Pengembangan Produk. *INVENSI (Jurnal Penciptaan dan Pengkajian Seni), 2*(2), 33-42. https://doi.org/10.24821/invensi.v2i2.1865.

Hanafi, H. (2017). Konsep Penelitian R&D dalam Bidang Pendidikan. *Jurnal Kajian Keislaman, 4*(2), 133-134. https://jurnal.uinbanten.ac.id/index.php/saintifikaislamica/article/view/1204

Holilah, M. (2016). Kearifan Ekologis Budaya Lokal Masyarakat Adat Cigugur Sebagai Sumber Belajar IPS. *Jurnal Pendidikan Ilmu Sosial, 24*(2), 163-178. https://doi.org/10.17509/jpis.v24i2.1453.

Ismail, A. (2007). *Education Games, menjadi Cerdas dan Ceria dengan Permainan Edukatif*. Yogyakarta: Pilar Media.

Kusmadi. (2010). Seni Kriya dalam Kehidupan Manusia. *Ornamen, 7*(1), 63-71. https://doi.org/10.33153/ornamen.v7i1.939

Lasarus, R. (2018). Analisis Sifat Mekanik Serat Kulit Kayu Khombuow Dan Serbuk Bambu Dengan Metode Uji Tarik. *Neutrino: Jurnal Pendidikan Fisika, 1*(2), 13-17. https://journals.ukitoraja.ac.id/index.php/neo/article/view/482.

Loftin, D. J. (2003). *Religion and Hopi Life.* Bloomington: Indiana University Press.

Manik, A. M., Keiluhu, H. J., Surbakti., S. B., & Yuliana, S. (2022). Etnobotani Kayu Khombow (Ficus spp.) di Kampung Asei, Distrik Sentani Timur, Jayapura. *Jurnal Biologi Papua, 14*(1), 1-10. https://doi.org/10.31957/jbp.1104.

Masri, A. (2010). Penerapan Metoda Design by Doing Melalui Eksplorasi Bahan Non Konvensional Untuk Membangun Industri Kerajinan Kreatif Khas Indonesia. *Prosiding Menuju Pembangunan Berkelanjutan Indonesia: Pemberdayaan Kompetensi Lintas Studi, 16 Juni 2010,* Universitas Paramadina.

Mendis, M. S., Halwatura, R. U., Somadeva, D. R. Jayasinghe., R. A., & Gunawardana, M. (2019). Influence of Timber Grain Distribution on Orientation of Saw Cuts During Application: Reference to Heritage Structures in Sri Lanka. *Case Studies in Construction Materials, 11,* 1-18. https://doi.org/10.1016/j.cscm.2019.e00237.

Musfiroh, T. (2008). *Bercerita untuk Anak Usia Dini*. Jakarta: Depdiknas Dirjen.

Nur'anini, A. S., & Arbain. (2013). Tumbuhan Ficus L. (Moraceae) di hutan Prof. Soemitro Djojohadikusumo, PT. Tidar Kerinci Agung (TKA) Sumatera Barat. *Jurnal Biologi Andalas, 2*(4), 235-241. https://doi.org/10.25077/jbioua.2.4.%25p.2013

Pöllänen, S. (2012). The Meaning of Craft: Craft Makers' Descriptions of Craft as an Occupation. *Scandinavian Journal of Occupational Therapy, 20*(3), 217-227. https://doi.org/10.3109/11038128.2012.725182.

Raharjo, T. (2011). *Seni Kriya dan Kerajinan*. Yogyakarta: Kanisius.

Rai, W. I. (2021). *Penciptaan Karya Seni Berbasis Kearifan Lokal Papua*. Penerbit Aseni: Papua.

Record, S. J. (1914). *The Mechanical Properties of Wood*. India: OKFN.

Rogers, M. F. (1999). *Barbie Culture*. New York: SAGE Publications.

Rumansara, E. H. (2015). Memahami Kebudayaan Lokal Papua: Suatu Pendekatan Pembangunan yang Manusiawi di Tanah Papua. *Ekologi Birokrasi, 1*(1), 47-58. https://doi.org/10.31957/jeb.v1i1.491

Sartika. (2022). Struktur Anatomi Kulit Kayu Pinus (Pinus merkusii Jungh.) dan Mahoni (Swietenia mahagoni Jacq.) serta Gradasi Kadar Taninnya. *Thesis. Universitas Hasanuddin.*

Silka, S., Pasae, N., & Lasarus, R. (2019). Analisis Sifat Mekanik Serat Kulit Kayu Khombouw dan Serbuk Bambu dengan Uji Bending. *Neutrino: Jurnal Pendidikan Fisika, 2*(1), 35-38. https://journals.ukitoraja.ac.id/index.php/neo/article/view/843

Sitanggang, S. R. H. (2010). *Sigalegale Cerita Rakyat dari Tapanuli Utara*. Jakarta: Pusat Bahasa.

Soekanto. (1958). *Meninjau Hukum Adat Indonesia*. Jakarta: Soeroengan.

Suyanto. (2004). Seni Kriya: Teknik dan Kreasi. *Ornamen, 1*(2), 21-31. https://doi.org/10.33153/ornamen.v2i1.775

Upessy, E. K. (2016). Desain Jembatan Kayu dengan Menggunakan Kayu Merbau di Kabupaten. Sorong Provinsi Papua Barat. *Thesis. Universitas Atma Jaya Yogyakarta.*

Wortham, S. (2004). The Interdependence of Social Identification and Learning. *American Educational Research Journal, 41*(3), 715-750. https://doi.org/10.3102/00028312041003715.

Yoresta, F. (2015). Physical and Mechanical Properties of Black Wood (Ebony) as a Construction Material. *Langkau Betang: Jurnal Arsitektur*, *2*(1), 22-28. http://dx.doi.org/10.26418/lantang.v2i1.13837.

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