Exploring Indigenous Materials for Creative Drawing as an Alternative Resource for Sustainable Development in Least Developed Countries

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ABSTRACT

The fourth Sustainable Development Goal of quality education for all is one of the most powerful and proven vehicles for sustainable development. To achieve this goal through Art and Design Education, there is need for innovation and improvisation of materials to encourage and motivate learners who can't afford the compulsory manufactured materials required for drawing. Much as there are plenty of indigenous materials to provide stain/pigment for drawing very few artists and facilitators have taken time to explore and experiment on different alternatives for creative drawing. In a bid to discover the potential of indigenous materials for drawing, the survey was conducted on different plants and rock substances, through different processes of extraction like grinding, smashing, blending among others, different colour stains such as green, yellow, red, blue and purple was extracted from these inorganic and organic materials. The findings found out there are plenty materials readily available around our surroundings from which colour pigments can be extracted and used for creative drawing. The study is expected to promote the use of indigenous natural materials for quality Drawing and make learning and teaching art economically viable across all levels of education.

Key words*:* Indigenous Materials, Creative Drawing (Fine Art), Colour Stain, Sustainable Development Goals (SDGs)

INTRODUCTION

Uganda is a country blessed by nature and our environment makes infinite the possibility of discovering new colours and materials that could be substituted for imported colours and materials which have the potential to produce equally or much better quality drawings. Colour pigment for drawing can be extracted from plants, soils, rocks and other organic and inorganic components which are readily available at our disposal. The notion that improvised materials from plants and rock elements can make better art work could largely depend on the skills and understanding of usage by the Artist.

Many institutions and artists have failed to utilize natural materials for drawing purposes and continue to rely on manufactured and processed materials. Such monotony in the use of materials makes drawing conventional and yet artists need to exercise creativity at all times. Artists can obtain colour stain such as red, blue, green and yellow from indigenous materials readily available within our surroundings. According to Danielle (2005), Indigenous materials are materials that are naturally and locally found in a specific place such as timbers, grass, rock and soil, palms, and rattan.

These indigenous materials can produce colorants which may be may be natural or synthetic. According to Danielle (2005) Plants are a major source of natural colorants which are described as substances with intense colours. Colorants from natural materials may be used with textiles, food, inks, paints and cosmetics. Colorants used in textiles are called dyes while those in making ink paint and cosmetics are called pigments also known as colour stain. According to Davis (2005), Stain is a mark or discolours with anything that is difficult to remove. Extraction of stain from plant material involves many steps using solvents such as petroleum ether and propanone. Stain can be made more effective for drawing if some mordants are added such as water, wood glue, salt, sugar, dye, soda, soda water and other different substances. (Tanaka, 2006). According to Folgarait (1998), these chemicals or mordants are intended to bind the stain/pigment to the Drawing/drawing surface.

According to Davis (2005), Drawing is a form of visual art where a person makes use of various drawing instruments to mark on paper or any other two dimensional medium. Drawing is one of the oldest forms of human communication and expression; there is evidence that Drawing existed before written language and communication. This can be confirmed by the creation of cave and rock paintings around 30,000 years ago. (Tom, 1992). Drawing Instruments include graphite pencils, pen and ink, inked brushes, wax colour pencils, crayons, charcoal, chalk, pastels, various kinds of erasers, markers, styluses, various metals (such as silverpoint) and electronic drawing (Todts, 2008)

It is important to note that majority of students across all levels of education rely on the use of manufactured/imported or readymade materials and instruments for drawing; these materials are expensive and yet compulsory in most art and design education institutions across Uganda and most Least Developed

Countries; this forces some students to withdraw from courses and prospective students to opt for other courses that don't have additional and or compulsory requirements besides tuition fees; this has crippled the country's ability to nurture talent in art and design especially for poor students who end up in the informal sector making drawings that have demand.
SDG 4 declares that, by 2030, the world ought to ensure inclusive and quality education for all and promote lifelong learning. All its targets dictate that all persons, at every stage of their lives should have opportunities to acquire the knowledge and skills they need to fulfil their aspirations and contribute to their societies (UNESCO, 2015). It entails commitments with students' diversity, quality learning and education along the life course.

Most public education institutions in low-income countries lack adequate financing to transform learning environments and practices towards achieving the sustainable development goal of education. They face cumulative problems blend education together with economic and health related deprivations caused by poverty. The possibility of the natural environment utilizing indigenous materials for drawing has a possibility of furthering the achievement of the SDGs number 4 of quality education for all; it can be assisted by using local indigenous materials to facilitate learning. Counting can be done using sticks and stones, surfaces for drawing and writing can be improvised by use of dry leaves and bare ground, drawing can be done by using stain from plants and rock materials.

The study is expected to benefit students by enhancing their creativity as well as reducing the high costs associated with the purchasing of manufactured or imported materials. It is also likely going to benefit government by substituting some of the already made imported materials colours by promoting the manufacture of these drawing materials locally.

Purpose of the Study
To explore indigenous materials for creative drawing as an alternative resource for sustainable development in Least Developed Countries.

Objectives of the Study
The study was guided by the following objectives.

1. To find out whether creative drawing can be done using stain extracted from different plants and rock materials.
2. To examine whether the use of indigenous materials in art and design can further achievement of the Sustainable Development Goals.

METHODOLOGY

The research used a survey design. Organic and inorganic materials were obtained randomly from the surroundings of Kyambogo University; the researcher used research assistants (students) who obtained different organic and inorganic samples from plants and rock (soil) materials, chalk, charcoal and plants. Soil samples included loam soil, clay soil, ant hill soil, and plaster of Paris; plants included purple flowers, yellow flowers, lantana fruits, passion fruit juice, Vernonia Amygodaline (muluuza), cassava leaves, sweet potato leaves and beet root.

The materials were weighed, then the processes of extraction begun using different methods like grinding, squeezing, pounding, crushing, blending, smashing and boiling to extract the fluid. The colour pigments/stains were obtained by removing the residues and weighing the remaining pigment. The extracted colour pigments/stains where mixed with measured additional substances which included water, sugar and salt, paraffin, natural dyes to strengthen the colour, other colour pigments were subjected to rating where the stains were stored under temperature variations then tested on the different types of paper to establish their suitability for Drawings.

Testing was done by research assistants using different drawing techniques such as sprinkling with soft bristle brushes, dripping, smudging, splashing, dropping, dipping with the use of a pencil, hatching method with cloth, cross hatching using brushes; these techniques clearly affirmed indigenous materials as possible alternatives for drawing.

These material components were tested five (5) times with specific weights and measurements of both material and residue to come up with scientific results (which present colour pigments) that are predictable, repetitive, consistent and standardised to be used for drawing. The data was collected by testing, and recording extracted pigments from the samples; the samples were measured on a weighing scale to ensure that the right quantity of materials matched the right number of additional components to create colour pigments that could be tried on different types of paper which included bond papers, newspaper, sugar paper and card board paper.

Tables and Figures

Table 1: Showing Organic Materials and their Characteristics.

SPECIMENS/MATERIALS	CHARACTERISTICS/FEATURES
Specimen A: Vernonia Amygdalina (Bitter leaf) 	It's a small tree that grows in tropics under a range of ecological zones in Africa and produces a large mass of forage and is drought tolerant. (Hutchioson and Dalziel, 1963). It doesn't produce seed therefore the trees are distributed through cutting. It's a member of the Daisy family, in the order of Asterales; the leaves are green with a characteristic odour and bitter taste. It's a shrub that grows and elevates between 2-5 meters long (6.6 -16.4 ft.) with a petiolate leaf of about 6 mm diameter and has an elliptic shape. Its bark is rough (Bonsi, 1995). It has chemical components that are extracted for their potential pharmacological uses and has mineral components like zinc, magnesium, carbon and copper, in African countries they are used as local medicine against leech. The leaves are also used for human consumption.
Specimen B: Beta Vulgaris (Beetroot) 	It's a taproot also known as beet, table beet, garden beet, red beet or golden beet, it has deep purple roots which are usually boiled and eaten. Its leaves, stalks and roots are also edible. It contains high amounts of biologically active substances including betalins and inorganic nitrate. It has compounds such as minerals, betalains, oxalic acid, phenolic acids and sugars. (Kakhia,2010). It is a well-known potent anticancerous food, a virtue that derives from its wealth in flavonoids, mainly because of the red pigment. It contains the dominant antioxidant betacyanin which gives it the deep red hue.
Specimen C: Anthill soil/Termite soil 	Anthill soil is a reddish brown soil that has fairly refined soil particles. It is the natural geotechnical structure that surprisingly survives natural hazards. It is classified as low plasticity silt. It is common in areas of the savannah region especially in arid, acid or cold environments where earthworms are scarce or absent (Folgarait, 1998). Termites usually repair their anthills very swiftly and this possibly explains the good condition of anthills which keep on growing until they are trimmed down by humans through their activities.

Specimen D: Clay soil 	Has the smallest particle size of any soil type, they are so small and can only be viewed under an electron microscope which makes them have a smooth texture. This permits large volumes of particles to exist in a relatively small space. Structure of the soil is very dense and the particles typically bond together making hard it for root penetration. It has very little organic material, it lacks nutrients and micronutrients essential for plant growth. The density is thicker and heavier than other types of soil. Density also makes it more resistant to erosion. It has slow permeability which results in a high water holding capacity, when wet it becomes slick and sticky
Specimen E: Loam soil 	Its dark brown in colour. It's found in a majority of agricultural areas in regions around the world. It's Considered ideal for farming because it retains nutrients and has a high water retention capacity while still allowing excess water to drain. It Generally contains more nutrients, moisture and humus. It is usually used to facilitate construction. Loam soil is used for making bricks, loam posts and beam construction.
Specimen F: Bougainvillea (Purple flowers) 	These flowers have an attractive bright colour. They are purple with a clear scent, they have small leaves and they usually grow in shrubs, they are able to withstand dry seasons, they are at times used for fencing.

Specimen G:Tithoniadiversifolia (Mexican sunflower) 	They look like sunflower but have faded green leaves. These are bright coloured yellow flowers with clear scent; they are fragile to extreme weather conditions and dry up during dry seasons.
Specimen H: Lantana camara (fruit) 	They are a small spherical fruit, they are green when raw and black when ripe, and they have rough thorny leaves. These plants have the ability to survive and withstand dry conditions. Lantana Camara issued as herbal medicine for the treatment; as antiseptic for wounds (Kakhia, 2010)

Other organic materials that were used for this research included, cassava leaves, potato leaves, yellow flowers, red flowers, purple flowers, passion fruits, blue flowers. Inorganic materials included charcoal, Plaster of Paris among others. It's important to note that additional components were added to the stain extracted from these materials and tested individually to ensure that they provided colour that could be used for drawing. These additional components included water, wood glue, salt, sugar, dye, soda, soda water and other different substances. According to Folgarait (1998) these chemicals or substances are called mordants and were intended to bind the stain/pigment to the drawing surface (medium).

Table 2: showing extraction and testing

EXTRACTION	TECHNIQUES OF DRAWING AND TESTING
Specimen A: Vernonia Amygodaline(muluuza) Leaves weighing 1.5 kgs was smashed, ground, and pounded in a container with a stick as an improvised mortar and pestle. The substance was then squeezed with hands to obtain stain which weighed 0.15 kgs. The residue of 0.35 kgs was disposed of.	Testing was done on bond paper, newspapers and manila paper using testing the pigment using different drawing techniques like splashing, dropping and brushing The stain/pigment was then diluted with additional components such as salt, sugar, water and paraffin separately to examine their reliability and fitness for drawing before testing on different types of paper.

Specimen B: Beta Vulgaris L .(Beetroot) The specimen of weight 0.1 kgs was smashed, ground, and pounded in a container with a stick as an improvised mortar and pestle and weighed to get 0.08 kgs The substance was then squeezed with hands to obtain stain which weighed 0.03 kgs. The residue of 0.05 was disposed of.	Testing was done on Bond paper, newspapers sugar and manila paper using testing the pigment using different drawing techniques like smearing, splashing, dropping and brushing. The stain/pigment was then diluted with additional components such as salt, sugar, water and paraffin separately to examine their reliability and fitness for drawing before testing on different types of paper
Specimen C: Anthill soil/Termite soil 0.8 kgs was grinded with a stone to obtain fine particles which weighed 0.75 kgs. It was then mixed with 90 mls of water.	The techniques of drawing used to test the stain on paper included sprinkling, brushing and blowing. The stain was then tested on different types of paper separately after adding additional components like wood glue, vanish, green dye, sugar, salt, paraffin. The paper types included bond paper, newspapers and manila paper to check their fitness for drawing.
Specimen D: Clay soil 1.05 kgs was grinded with a stone to obtain fine particles which weighed 0.85 kgs. It was then mixed with 90 mls of water.	The techniques of drawing used to test the stain on paper included sprinkling, brushing and blowing. The stain was then tested on different types of paper separately after adding additional components separately with substances like wood glue, vanish, green dye, sugar, salt, paraffin. The paper types included bond paper, newspapers and manila paper to check their fitness for drawing.
Specimen F: Purple flowers Flowers weighing 0.3kgs were smashed, ground, and pounded in a container with a stick as an improvised mortar and pestle and weighed 0.28 kgs after pounding. The substance was then squeezed with hands to obtain stain which weighed 0.1 kgs. The residue of 0.18 Kgs was disposed of.	The techniques of drawing used included sprinkling, brushing and blowing, dropping. The stain/pigment was then diluted with additional components such as salt, sugar, water and paraffin Then separately with additional components and tested on different paper types including bond paper, newspapers and manila paper to check their fitness for drawing.
Specimen E: Yellow flower Flowers weighing 0.7 kgs was smashed, ground, and pounded in a container with a stick as an improvised mortar and pestle and weighed to get 0.67 kgs. The substance was then squeezed with hands to obtain stain which weighed 0.1 kgs.	Testing was done on Bond paper, newspapers and manila paper using different drawing techniques like splashing, dropping and brushing The stain/pigment was then diluted with additional components such as salt, sugar, water and paraffin separately to examine their reliability and fitness for drawing before testing on different types of paper.
Specimen H: Lantana fruit The specimen of weight 0.1 kgs was smashed, ground, and pounded in a container with a stick as an improvised mortar and pestle and weighed to get 0.08 kgs The substance was then squeezed with hands to obtain stain which weighed 0.03 kgs. The residue of 0.05 was disposed of.	Testing was done on Bond paper, newspapers sugar and manila paper using different drawing techniques like smearing, splashing, dropping and brushing The stain/pigment was then diluted with additional components such as salt, sugar, water and paraffin separately to examine their reliability and fitness for drawing before testing on different types of paper.

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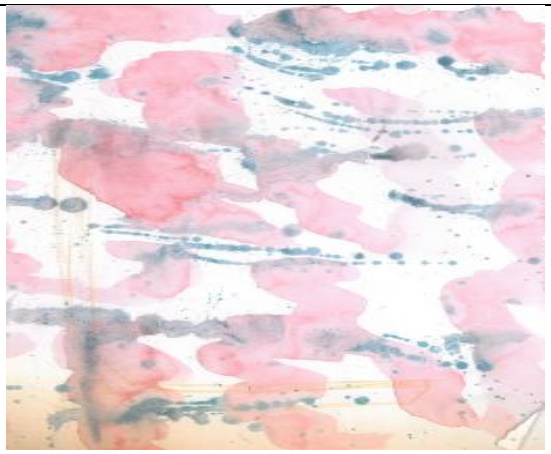
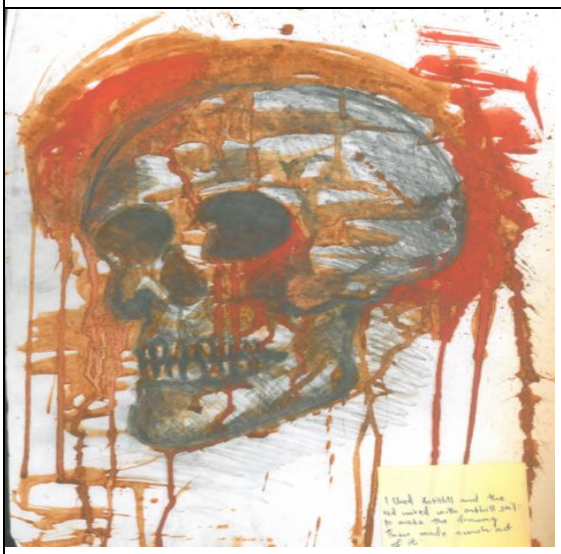
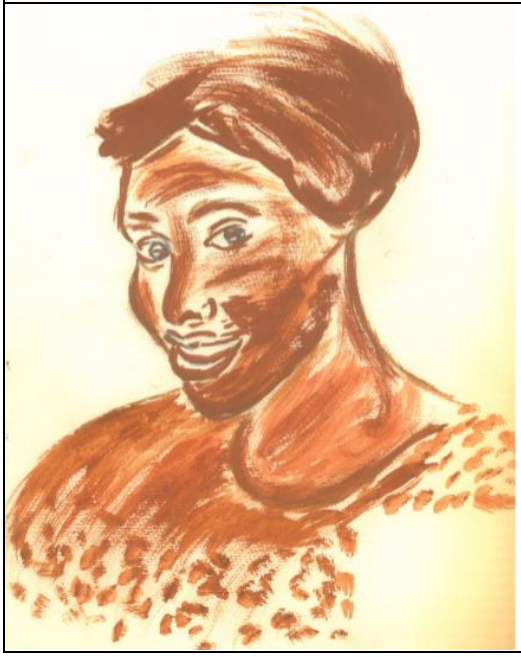
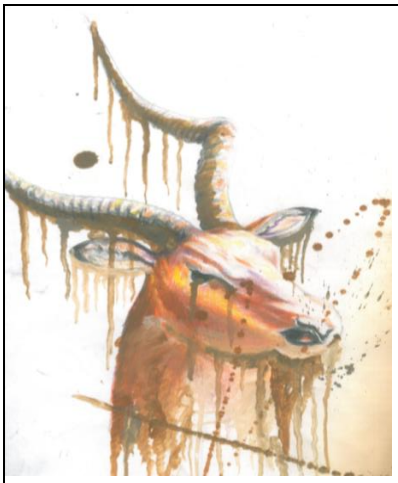
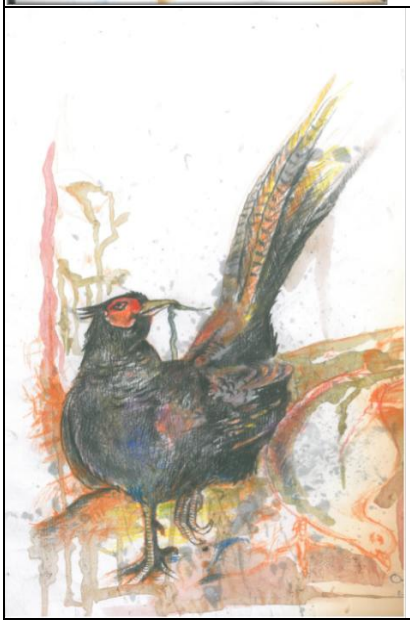
RESULTS

The research found out that organic and inorganic materials could extract pigment/stain that could be used for drawing, after the process of extraction was done, stain was then used to draw artwork and the results are presented below.

Table 3: showing final artwork and its properties.

FINAL ARTWORK	DISCUSSION
	**Description:** Free Expressive Drawing. **Pigment/Stain:** Beet Root and Blue Flower pigments. **Technique:** Drawing. **Media**: Pigment/stain with brush on Bond Paper. **Size:** A3 Bond Paper.
	**Description:** Free Expressive Drawing of a Human Skull. **Pigment/Stain:** Anthill soil and water colour pigments. **Technique:** Drawing/painting on vertically placed paper. **Media**: Pigment/stain with brush and soft lead pencil drawing on Bond Paper. **Size:** A3 Bond Paper.
	**Description:** Free Expressive Drawing of a female Portrait. **Pigment/Stain:** Anthill soil pigment. **Technique:** Drawing/painting. **Media**: Pigment/stain with brush and soft lead on Bond Paper. **Size:** A3 Bond Paper.

	**Description:** Nature Drawing. (Antelope) **Pigment/Stain:** Loam soil pigment. **Technique:** Drawing/painting on vertically placed paper. **Media**: Pigment/stain with brush and soft lead pencil on Bond Paper. **Size:** A3 Bond Paper.
	**Description:** Still Life Drawing. **Pigment/Stain:** Vernonia Amygdalina (Bitter leaf) pigment with crushed charcoal. **Technique:** Drawing on Bond paper. **Media**: Pigment/stain with brush and soft lead pencil on Bond Paper. **Size:** A3 Bond Paper.
	**Description:** Free Expressive Drawing. **Pigment/Stain:** Sweet Potato leaves and Beet Root pigments. **Technique:** Drawing on Bond paper. **Media**: Pigment/stain with brush and soft lead pencil on Bond Paper. **Size:** A3 Bond Paper.
	Description: Free Expressive Drawing. **Pigment/Stain:** Beet Root and Charcoal. **Technique:** Drawing/splashing pigment on Bond paper. **Media**: Pigment/stain and charcoal on Bond Paper. **Size:** A3 Bond Paper.

	**Description:** Still Life Drawing. **Pigment/Stain:** Beet Root and Vernonia Amygdalina (Bitter leaf) pigments. **Technique:** Drawing on Bond paper. **Media**: Pigment/stain and soft lead pencil on Bond Paper. **Size:** A3 Bond Paper.
	**Description:** Free Expressive Drawing. **Pigment/Stain:** Loam Soil pigment. **Technique:** Drawing on Bond paper. **Media**: Pigment/stain and soft lead and colour pencil on Bond Paper. **Size:** A3 Bond Paper.
	**Description**: Free Expressive Drawing. **Pigment/Stain**: Beet Root, Vernonia Amygdalina, and Passion Fruit pigments. **Technique**: Drawing on Bond paper. **Media**: Pigment/stain and soft lead and colour pencils on Bond Paper. **Size**: A3 Bond Paper.

DISCUSSION

According to Vander *etal*, (2008),The majority of colour stain colorants are extracted from plants .i.e. roots, berries, bark, leaves, and wood and other organic sources such as fungi and lichens. Inorganic materials include rock substances. These organic and inorganic materials can be utilized for creative drawing after stain has been extracted and mordants have been added to bind the dye to the drawing surface.

The Still Life and free expressive drawings shown in table 3 provides evidence that indigenous materials from plant and rock substances can provide pigment/stain for drawing purposes. This shows that art students especially those from poor backgrounds have an opportunity to learn creative drawing using pigment from their immediate environment, the use of improvised materials can help facilitate the achievement of SDGs of education for all. The major colours pigments extracted from the materials were red, brown, green, purple and yellow and the pictures above show that these colours can be used for drawing.

According to Kakhia (2010) a variety of plants can be used to create red and pink colour pigments. In our studies our red colours were extracted from beet root but a number of lichens, henna, alkanet or dyer's bugloss

(*Alkanna tinctoria*), asafoetida and madder can produce red colour pigment as well. Madder (*rubia tinctoria*) and associated plants of the *Rubia* family are indigenous to many moderate zones across the globe. (Beale, 2003)

Yellow stain was also extracted and used in the drawings. Yellow pigment is also common and materials that produce yellow are almost as many as the red ones (Griesbach, 2005). In our study respondents extracted yellow pigment from Tithoniadiversifolia (Mexican sunflower) and concentrated passion fruit juice however yellow stain can be produced from saffron, pomegranate rind, turmeric, sunflower, onion skins, and a number of weedy flowering plants available around our environment (Tanaka, 2006).

In study the purple pigment was obtained from Bougainvillea (Purple flowers) but Purples can also be derived from lichens, and from the berries of White Bryony and from some Rocky substances and mulberry (*morus nigra*) when an acid mordant is used to stabilize it (Beale, 2003). The browns used in the study were also collected from anthill soil and loam soil, these materials provide a deep brown which can be diluted or concentrated with additional substances like water, oil, and paraffin among other mordants.

Colour green was extracted from lantana camara, Vernonia Amygdalina (Bitter leaf), potato leaves, cassava leaves, these plants grow in tropics under a range of ecological zones in Africa and many other region across the globe. (Hutchioson and Dalziel, 1963). Green is extracted from plats that have chlorophyll, plants that grow under shades or contain less chlorophyll than those growing in open atmospheres. (Dżugan, 2006). For those green plants growing under shades, Mg with Fe ions gives a grey-brown chlorophyll product; the presence of Zn and Cu ions increases the stability of the natural green colour (Nishio, 2000).

Many pigments extracted from materials require the use of additional substances to bind the stain to the drawing surface or fibre, common materials used are tannin from oak galls, and salt, natural alum, vinegar, and ammonia from stale urine were used by early dyers. (Bonsi, 1995). The evidence provided from the drawings shows that indigenous materials can be used as an alternative resource for sustainable development in LDCs. Opportunities of achieving the 4th SDG goal of quality education can be done by innovation and improvisation of materials for art and design education that is likely to encourage and motivate learners especially from poor backgrounds who can't afford buying manufactured products/materials.

CONCLUSIONS

The study found out that there are plenty plants and rock indigenous materials that can be improvised to provide stain for drawing. These materials include plants, roots, rocks, soil and other materials organic or inorganic that stain can be extracted from; these materials are readily available within the environment. Using these materials for drawing course units in schools and universities would help students and facilitators reduce the monotony of using manufactured materials and offset the high costs of buying that some students especially the poor ones find difficult to afford.

RECOMMENDATIONS

Schools, universities and art institutions need to find ways of incorporating course units that allow student exercise their creativity, especially when it comes to materials for drawing, they should reduce the reliance of manufactured materials for art, because in LDCS like Uganda a lot of dreams have perished because the majority of people especially in the rural areas are too poor to afford these materials and yet have the interest in furthering education in art and design.

There is need to conduct further research aimed at stabilizing the pigments and ensuring that they have consistent; much as the stain was used to create drawings, it's difficult to establish whether these drawing can stand the test of time, it's not clear whether drawings using some stain or pigments could withstand different conditions and remain unswerving.

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