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# Indigenous Knowledge Content & Mathematics Curriculum:
## Some evidence from a Namibian perspective

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**Abstract**
Cultural practices present opportunities for Mathematics Education to be more relevant, and effective, especially in post-colonial contexts. Despite national policies emphasising integration of Indigenous Knowledge (IK) into school curricula, there has been limited success in incorporating ethnomathematics into Mathematics teaching. We explored geometrical concepts inherent in traditional baskets produced by Aawambo women, an ethnic group in northern Namibia. We identified specific geometrical concepts that can be linked to the junior secondary school Mathematics syllabus. We employed ethnographic observations, interviews with local basket makers and focus group discussions with Mathematics junior secondary school teachers for triangulation. Furthermore, we adopted an interpretive paradigm using a multi-modal method to source empirical data that demonstrated relevance to the curriculum. We explored socio-cultural perspectives of women and artefacts (baskets) to compare the subject matter from literature. The findings revealed common concepts as well as the ethnomathematical content not yet incorporated in the junior secondary school Mathematics curriculum comprising of symmetry (axial symmetry) and geometrical transformation (shear and translation). The study has implications for decolonizing western Mathematical practices through adoption ethnomathematics approaches across Africa.

**Keywords:** Indigenous knowledge, Mathematics curriculum**,** basket-making, Aawambo, Namibia

## Introduction
Namibia has a wealth of untapped indigenous knowledge (IK) produced by communities. However, the content produced by the knowledgeable communities has not been mapped nor widely explored to construct culture-based Mathematics teaching materials (Ferreira, 2015; Kulago, Wapeemukwa, Guernsey & Black, 2021; Shimwandi, 2024; Utete, Ilukena &

Sindano, 2019). Tohirin, et al. (2021) stress that local communities possess the uniqueness of local wisdom that can be expressed in Mathematics learning, and often referred to as *Ethnomathematics*. This approach proved efficacious through curriculum reforms and the transformation of western based educational discourse currently practiced in most African countries (Higgs & Makoni, 2016; Machaba & Dhlamini, 2021). This approach deals with both content and the process of curriculum, classroom, teacher expectations, professional development and relationships among teachers and community among other expectations (Aikpitanyi & Eraikhuemen, 2017). More importantly, D'Ambrosio and D'Ambrosio (2013) opine that curriculum should pursue educational goals created and accepted by society. As a result, the curriculum should pursue goals created, negotiated, and accepted by society. Furthermore, the curriculum should consider social systems, identify contents that may help to reach the goals, and develop methods to transmit those contents.

Numerous researchers call for focused content on different types of calculations in Geometry collected over time that forms part of the cultural anthropological definition of Mathematics that relate to any culture, including present-day school Mathematics (Biraimah, 2016; Josua, et al., 2022; Guus, et al., 2016; Mosimege, 2000; Zaslavsky, 1999). In this paper, we used basket weaving by local *Aawambo* women to address the issue of lack of content required to end the Western disposition that imposes irrelevant curriculum practices. Constructing a basket is a small bio-engineering project that requires mathematical thinking, and related skills through observing, discussing, and interpreting the activity conducted within an area where teachers could be located (Demmert Jr, 2001; Jungic, 2019). In addition, a variety of limited mathematical aspects that are involved in basket making are not utilized in the Mathematics classroom (Onstad, et al., 2003; Ezeanya-Esiobu, 2019; Mawere, 2015; Ronoh, 2017). Therefore, teachers need the availability of content to be able to integrate ethnomathematics in the classroom (Ministry of Basic Education, Sport, and Culture (MBESC), 2002; Nur, et al., 2022; Onstad et al., 2003). In this paper, we claim that the Namibian educational system is to a greater extent negating IK integration in the school curriculum and little literature exists. This paper, therefore, explored the Mathematics embedded in basket making, a cultural activity by the *Aawambo* people, a subgroup of the Bantu people of northern Namibia who have retained their cultural practices of basket making. This paper was guided by the following main question: *What type of Mathematics is found in basket making of the Aawambo ethnic group in Oshana region?* The study's findings aimed to map and construct culture-based Mathematics teaching materials through ethnomathematical studies. This paper is significant in that, it stands out as the first attempt to categorise patterns by reference to the *Aawambo* culture and its relevance to the local Mathematics curriculum.

**Literature Review**

Historical arcs of the evolution of Mathematics can be traced from ancient times to the present, illustrating the plurality of mathematical systems (Burton, 2011; Gerdes, 1994; Huylebrouck, 2006; Meyer & Aikenhead, 2021). Attempts have been made to connect geometric elements of traditional embroidery and ethnomathematics (Maxwell & Chahine, 2013). For instance, a study conducted by Fouze and Amit (2019) on geometrical shapes in Bedouin women's traditional dresses from the Negev area in the south of Israel showed symmetrical designs that indicated a complex and precise spatial perception, and a high level of skill developed over generations. Similarly, Nurbaeti, et al. (2019) analysed geometric motifs and symbols of woven fabric (*Tembe Nggoli*) of the Mbojo tribe society. These studies (Fouze & Amit, 2019, Maxwell & Chahine, 2013, Nurbaeti, et al., 2019) contributed to the emergence of mathematical concepts such as translation, reflection, and dilatation, as well as the rotation in patterns of triangles, rectangles, parallelograms, and octagons. These mathematical concepts were sourced from the communities on the relationship between their cultures and Mathematics (Nurbaeti, et al., 2019).

Empirically, Nur, et al. (2022) used observation sheets, interview guides, voice recorders, and field notes to collect data on mathematical ideas used in various activities and cultures of society. Mathematical concepts are connected with various cultural objects such as numerical systems, lines and angles, plane figures, spatial figures, statistics, sequences and series, social arithmetic, and algebra. Furthermore, they developed the ethnomathematical learning model to enhance the teaching of Mathematics using innovative tools like activity-based task sheets, project assignments, modules, and field observation reports.

Ethnomathematics requires authenticity of the content presented thereunder. Bistrow (2022) stresses that knowledge that involves both societal norms and tacit knowledge is gained through experience from community members. Tacit knowledge in this context allows for a mastery that is holistic and egalitarian, directing own and self-learning whereas mastering of skills requires application of concepts within the community's norms. Furthermore, Bistrow (2022) opines that tacit knowledge produced by the community members is valued knowledge and sustainable as it communicates expectations of that community. Presumably, this could translate into educational expectations, including ethnomathematics produced by individuals within a respective community. Hence, teaching draws on multicultural artefacts and calls for culturally responsive pedagogies and use of resources available in their immediate vicinity (Jegede & Aikenhead; 1999; Mhakure & Otulaja, 2017).

Many scholars have encouraged the integration of ethnomathematics in the school curriculum as it has the potential to promote participation, increase interest in Mathematics, and help in the development of mathematical concepts (Kibirige & Van Rooyen, 2018; Mapara, 2009; Seehawer, 2018). Emeagwali (2003) recommends striking a balance between Western and indigenous knowledge systems whilst Agrawal (2014) and Drew (2005) believe that knowledge can be tapped from the community and not only from laboratories as in Western systems. Dominikus, et al. (2023) explored mathematical concepts that exist among the West Amarasi society from Merbaun Village, West Timor, in East Nusa Tenggara Province, Indonesia. The results showed mathematical concepts including geometrical shapes, reflection, rotation as well as reflection; and ways of thinking in the socio-cultural context of that community. However, we note that ethnomathematics as a practice has been excluded from Namibian Mathematics engagements at policy and pedagogical knowledge. Dominikus, et al. (2023) stress the importance of the weaving content outcomes to be included in the curriculum so to serve as a teaching resource to communities and context for learning Mathematics.

Pradhan (2023) emphasises the importance of the evidence of ethnomathematics beyond the classroom and textbook as observed through cultural artefacts to serve as resources for teaching. The evidence for artefacts simply broadens the scope of academic knowledge. By incorporating a diversity of ideas, academia develops a more cohesive body of knowledge, regarded by Jegede and Aikenhead (1999) as harmony between universalism and multiculturalism in the formal school curriculum and syllabus. In turn, teachers will be able to connect to their immediate environment and broaden opportunities to view Mathematics teaching differently and consequently enhance learning (Achimugu & Adib, 2014; Chauraya, 2015; Cobern & Loving, 2016; Hewson, 2013). Together with other researchers (Ali & Davis, 2018; D’ambrosio, 2020; Gerdes, 2012; Gould, 2014; Mosimege, 2012; Peñas, et al., 2021), we believe that the mathematical thinking and Mathematics-related skills involved in the construction of baskets can be transferred from community members and integrated in the Mathematics curriculum, a process of knowledge transfer that has hitherto been ignored.

## Methodology

We used an ethnographic research design to explore the ethnomathematical ideas embedded in the *Aawambo* cultural artefacts and examined the possibility of matching the identified content to the junior secondary school geometry. We chose ethnography as a research method to source Geometrical shapes and practices of people as a socio-cultural process. We conducted document analysis to source other geometrical concepts embedded in basket weaving in other cultures. We argue that the extent of consistency between our findings and that of other knowledge has confirmatory significance (Patton, 2002). We established commonalities and variations of content to prove the existence of Mathematics in basket-making that could be linked to the Mathematics curriculum at the junior secondary school level in Namibia. We conducted interviews with basket weavers, observations and took field. In addition, we recorded voice data and captured photographs of artefacts, after which, we had a focus group discussion with four teachers during the workshop for classification of geometrical concepts and validation of data. The basket weavers were deemed competent in designing complex patterns to portray the multiple decorations that were later used by teachers to identify the Geometrical shapes. Interviews results were pseudonymised. Using an interpretive multi-method as an analytical lens, common concepts were identified and grouped to establish robust evidence and practices of ethnomathematics in the Namibian Mathematics curriculum at the junior secondary school level.

## Findings

The findings revealed the geometrical concepts that emerged from basket weaving, themed geometrical shapes, symmetry, geometrical terms and relationships, and geometrical construction. We present a collection of geometrical concepts found among the Aawambo basket weavers with a view to add onto the limited teaching resources in teaching geometry and contribute to the list of ethnomathematics related content on the continent. Furthermore, we present results on the outcome of the identification and consolidation of the geometrical concepts with mathematics teachers.

## Geometrical shapes

### *Circle*

**Figure 1** The circle shape found in basket making

Evidently, basket weaving activities reflect the mathematical concepts of circular geometrical shapes carefully woven out of strands of fibre over and under each other to create a round shape (Figure 1).

Mr. David and Mr. Matheus confirmed the circular shape by stating the methods they used to identify it:
"*The basket weaving products depicts the mathematical concepts of circle geometrical shapes*" (Mr. David, 2021, Teacher).
"*I used the circular tray of woven basket methodology to identify that the shape is a circle*" (Mr. Matheus, 2021, Teacher).

Additionally, in Figure 1, the centre of the basket shows that the woven basket reflected square shapes. The square shape is also depicted in Figure 2 (marked ABCD).

### *Square*

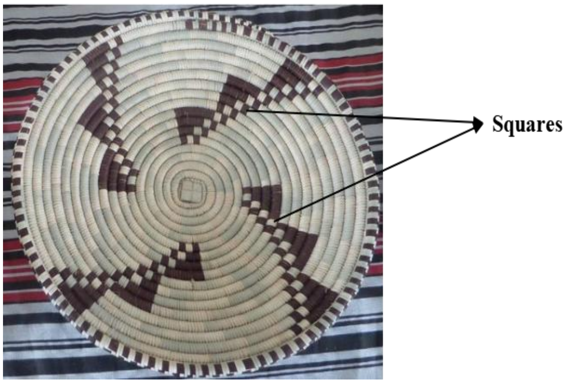


**Figure 2**: The square shape found in basket product

In confirmation, Ms Elizabeth and Mr Angula said:
"*I looked at the four corresponding straight line of the same size or length on the basket, it reflects a square shape*"
(Ms. Elizabeth, 2021, Teacher).
"*I used the plain weaving technique and decorated patterns as an approach to identify a square*" (Mr. Angula, 2021, Teacher).

### *Triangle*

Results from junior secondary school Mathematics teachers reflected the mathematical concept of the triangular shape, as visible on the artefacts produced by the weavers. This is also evident in Figure 2. Ms Elizabeth and Mr Angula depicted the three lines on the baskets that meet to form the triangles:

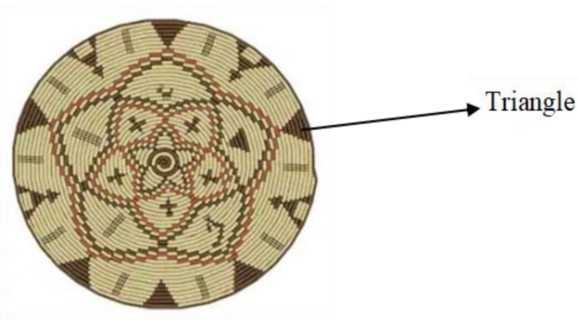


**Figure 3:** The Triangular shape found in

"*I used the plane structure decorative pattern to depict the Mathematics concepts of triangle shape" (*Ms. Elizabeth, 2021, Teacher).
*"The basket weaving activities reflect triangle mathematical shapes and I used the corresponding point of the three lines with vertices point used to identify a triangle shape on woven baskets"*
*(*Mr. Angula, 2021, Teacher*).*

In support, results from observations and field notes revealed that the decorative pattern depicts triangular geometrical shapes and was evident in the photographs in Figure 2 and 3.

***Rectangle***

The results of the study revealed that rectangles were one of the geometrical shapes found in woven baskets.


**Figure 4:** Long horizontal straight lines and short vertical lines shows a rectangle shape

Mr Matheus and Mr David explained that:

"*The basket weaving activities portrays a rectangle shape which is found at the centre of the basket and from the decorated patterns*" (Mr. Matheus, 2021, Teacher).

"*In order to ascertain that this is a rectangle, I employed the intersection of long horizontal straight lines and short vertical lines were used to identify the rectangle shape*" (Mr. David, 2021, Teacher).

The results from observations and field notes validated the rectangle geometrical shapes, which are noticeable in the photograph (Figure 4).

***Kite***

**Figure 5:** Decoration meeting at vertices point reflects the mathematical concepts of kite shape

A kite was highlighted as one of the geometrical shapes found in the woven basket.

Mr David and Mr Angula explained the methodology:

"*The basket weaving products depicts the kite shapes and the decoration's patterns of the basket to identify the sides of shape that has two pairs of equal length sides and the sides that are adjacent to each other*" (Mr. David, 2021, Teacher).

"*I also used the intersection of oblique line which is formed as a result of decoration meeting at vertices point to reflect the mathematical concepts of kite shape*" (Mr. Angula, 2021, Teacher).

The data set from observations and field notes revealed that the kite shape found in basket making (Figure 5).

**Geometrical Symmetry**

The findings from geometrical symmetry were presented under the following sub-themes:

***Axial symmetry***

**Figure 6:** Depiction of axial symmetry by the crossing of line that runs from the centre of the basket to the circumference

Results indicate that basket weaving activities depict the mathematical concepts of symmetry which comprises axial symmetry.

Mr Matheus expressed that

"*I used the crossing of line that runs from the centre of the basket to the circumference of woven basket to identify axial symmetry on the woven basket products*" (Mr. Matheus, 2021, Teacher).

To validate the results, the axial symmetry was observed as in Figure 6.

***Rotational symmetry***

Results indicated that the basket weaving activities reflected the mathematical concept of rotational symmetry (Figure 7).

**Figure 7:** *Depiction of rotational symmetry*

Ms Elizabeth remarked that

"*I used the rotation of an object until the decorated patterns goes back to its original position to identify the mathematical concepts of rotational symmetry*" (Ms. Elizabeth, 2021, Teacher).

To authenticate the findings, a data set from observations showed that rotational symmetry is made by the crossing of a line that runs from the centre of the basket to the circumference which is also used to identify axial symmetry on the baskets.

**Geometrical terms and relationships**

The geometrical terms and relationships in this study are presented under the following sub-themes.

***Lines***

The results indicated that the basket weaving activities reflected a geometrical line (Figure 8).

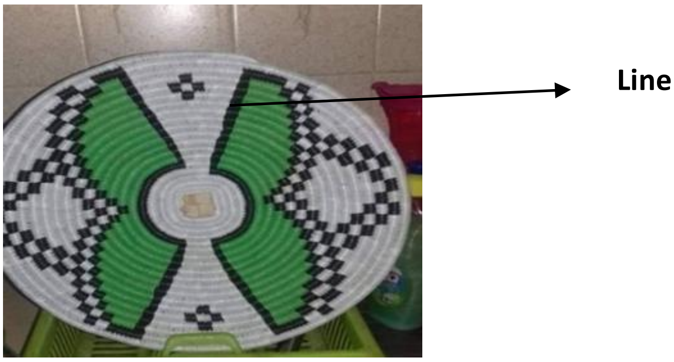


**Figure 8:** *Geometrical line*

Mr David identified those on baskets by "*employing the weaving morphology of the decorated patterns of lines, that runs straight across the woven basket, the geometrical concepts of line*" (Mr. David, 2021, Teacher).

**Parallel and intersecting lines**

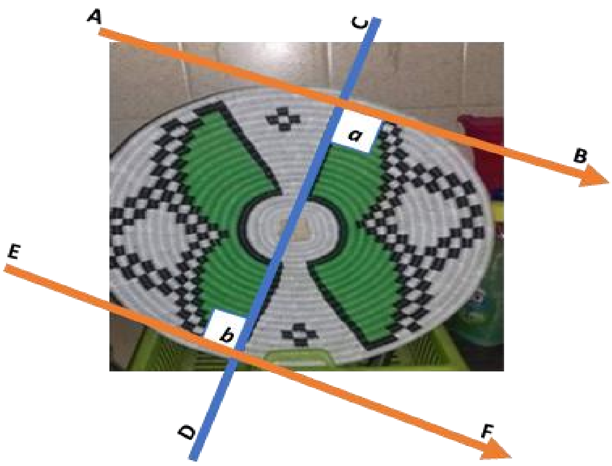


**Figure 9:** *Illustration of the parallel lines cut by a line to produce same angle*

The strips found at the rim of the basket depicted the geometrical terms of parallel (Figure 9). Thus, for example, decoration made up of line AB is parallel to the decorations of line EF. The transversal decorations of line CD intersect and meet lines AB and EF. As a result, angles labelled *a* and *b* are equal as they are alternate angles.

Explicitly the weavers stated:

"*I used the straight line that goes in same direction to identify parallel and lines that lie in the same plane and never meet*" (Mr. Matheus, 2021, Teacher).

In addition,

"*I also used the plaited straight line formed by weaving fibre met a point to form the mathematical concepts of intersection*" (Ms. Elizabeth, 2021, Teacher, 2021).

"*I also used the two decorated lines that cross each other to identify an intersecting line*" (Ms. Elizabeth, 2021, Teacher, 2021).

The decorations (Figure 9) showed parallel lines on the woven basket that cut across a decorative pattern to produce two angles of the same size, labelled *a,* and *b*.

***Geometrical similarities and congruence***

Figure 10 indicates mathematical concepts of geometrical similarities and congruence. Thus, Shape JKLMN is similar to PQRST. The artefacts labelled A and B on the basket shows geometrical properties of congruent shapes; with B being congruent to C, and A congruent to D.

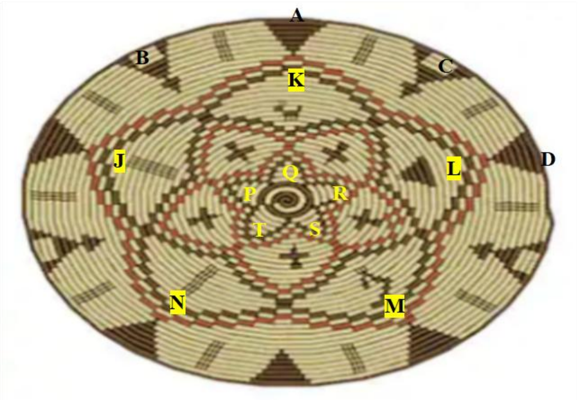


**Figure 10:** *Geometrical similarities and congruence*

Based on the interview, Mr David states that

"*I used the decoration pattern, strip pattern on the basket weaving products which are of the same size and shape to identify congruence and same shape and different sizes to identify similarities of decoration structures on woven basket*"

***Point***

A point is one of the geometrical concepts found in woven baskets (Figure 11). A point can be identified as stated as follows:

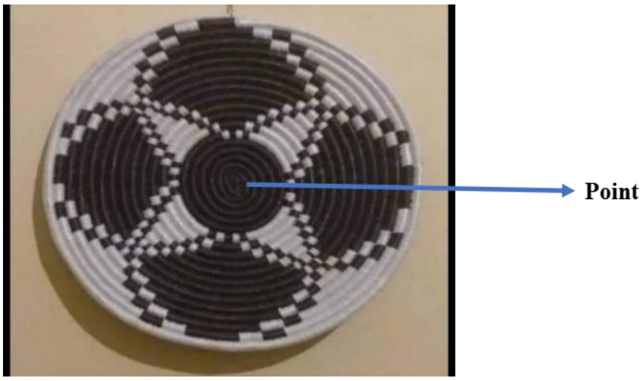


**Figure 11:** *Depiction of a Geometrical point*

"*I used a dot found on the basket woven product that does not have length, width or height*" (Ms. Elizabeth, 2021, Teacher, 2021).

"*I used a decorated small dot on the basket that has no dimension*" (Mr. Angula, 2021, Teacher).

***Round Angles***

The basket weaving activities reflected the geometrical terms of angle (Figure 12), as teachers expressed:

"*An angle on woven basket is portrayed by the turn or bend between two intersecting lines that have a common endpoint called the vertex of the angle*" (Mr. Matheus, 2021, Teacher).

"*In simpler, an angle is formed as a vertex with two arms*" (Mr. Matheus, 2021, Teacher).

Further, round angle is formed by

"*A round structure of a decorated pattern or basket artefacts shows a complete revolution which adds up to three hundred and sixty degrees*" (Mr. David, 2021, Teacher).

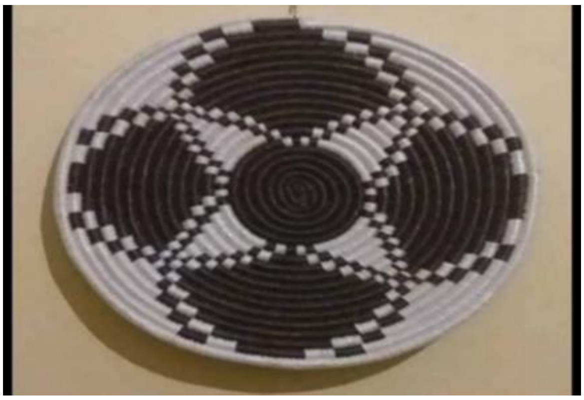

**Figure 12:** *Round angle (360 degree angles) formed at the centre on the woven basket*

***Straight angles***

Based on the participant views the results revealed that the basket weaving activities mirror straight line angles. Evidently, teachers pointed out that:

"*The basket weaving products reflects the straight geometrical angles. I used the morphology or structure of strip of line to identify the straight angle on basket woven products*" (Mr. David, 2021, Teacher).

From the observation, the straight angle is evident in the photograph (Figure 13). Thus, one of the straight-line angles formed on a woven basket is marked X on Figure 13.


**Figure 13:** *An example of straight-line angle, Marked X formed on the woven basket*

***Right angles***

Right angles were also identified as one of the geometrical terms found in woven baskets. Teachers identified these angles and remarked:

"*I used the horizontal and vertical lines that cross each other or horizontal and vertical lines that intersect forms right angles*" (Ms. Elizabeth, 2021, Teacher, 2021).

From Ms Elizabeth views and illustration in Figure 14 right angles is marked Y.


**Figure 14:** *An example of Right angle, Marked Y formed on the basket*

It can therefore be deduced that the weaving morphology of the decorated patterns of lines running straight across the woven baskets have geometrical concepts of line. Additionally, two straight lines that go in the same direction were used to identify parallel lines. Further, decorative patterns of the same size and shape depicted similarities and congruence. The dot found on the woven product depicted a point and use of the morphology or structure of strip of line used to identify the straight angle. The use of horizontal and vertical lines that crossed each other, or horizontal and vertical lines that intersect formed right angles.

**Geometrical transformation**

Results on geometrical transformations are presented under the following sub-themes:

***Rotational transformations***

The results show that the basket weaving activities of the *Aawambo* people of Northern Namibia depicted the mathematical concepts of rotational transformations as explained:

"*The decorative pattern methodology was used to identify rotational transformation in basket weaving*" (Mr. Matheus, 2021, Teacher).

**Figure 15:** *Illustration of V-shaped rotational transformation on the basket*

He further added that

"*I used the circulation of decorated pattern around a fixed point and turning a figure about a point*" (Mr. Matheus, 2021, Teacher).

The description of Mr. Matheus is also evident in Figure 15.

***Reflection transformation***

Ms. Elizabeth, 2021, Teacher stated that Basket weaving depicted reflection transformation.


**Figure 16:** *Reflection transformation formed by drawing a line of symmetry through point A and C or B and D on the basket*

Explicitly Elizabeth explained that:

"*As a Mathematics teacher I used my subject knowledge to find reflection transformation through the decorative patterns which are found on the opposite position of the first decoration and upside of the same size*" (Ms. Elizabeth, 2021, Teacher, 2021).

The reflection transformation is evident from Figure 16, by drawing a line of symmetry connecting either point A and C or B and D.

***Enlargement geometrical transformation***

Enlargement transformation (Figure 17) was also identified as one of the geometrical concepts found in woven baskets.


**Figure 17:** *Enlargement geometrical transformation of decorations labelled A in relation to A' on the basket*

Mr David explained that:

"*When identifying enlargement transformation, I looked at the increase in size or dilation of decorated patterns*"
(Mr. David, 2021, Teacher).

**Figure 18:** *Decoration patterns depicting Translation geometrical transformation*

***Translation geometrical transformation***

In support, Figure 18 showed that basket weaving activities depicted translation transformation.

Mr Angula stated that the basket weaving activities showed geometric transformation of translation:

**"***I have observed a regular repetition of decorative patterns, and the elements of these patterns are parallel to each other with equal spacing between them.*"
(Mr. Angula, 2021, Teacher).

***Shear transformation***

As also evident in Figure 19, basket weaving activities indicated shear geometrical transformation.

**Figure 19:** *Shear geometrical transformation on the basket*

Mr Matheus said that:

"*The shrinking or stretching the figure of shape from the decorated pattern results in the formation of shear transformation*"
(Mr. Matheus, 2021, Teacher).

In summary, the circulation of the woven basket showed the rotational reflection. Decorative patterns of similar size which were opposite each other depicted reflection transformation. Evidently, the sliding decorated patterns exhibited translation and the increase in size of decorative patterns depicts enlargement transformation. The stretching showed a shear transformation.

**Geometrical Construction**

This section presents, data on geometrical construction under sub-themes.

***Angle bisector***

The results from this study revealed concept of angle bisector (Figure 20).


**Figure 20:** *Construction of angle bisector in the b*

Mr David expresses that:

"*In order to determine that there is angle of bisector on a woven basket I used the parallel lines on the woven basket that cut across a certain decoration pattern to produce two angles of the same size*" (Mr. David, 2021, Teacher).

Consequently, Figure 20, showed that angle ABC is bisected by line BD.

***Perpendicular bisectors***

The results revealed that the basket weavers' activities reflected the mathematical concepts of perpendicular bisectors (Figure 21). After probing for explanation on how perpendicular bisectors could be identified on woven basket products, a teacher yielded the following statements:

"*The straight line that the oblique lines meet at a vertex point results in the formation of perpendicular bisector*" (Ms. Elizabeth, 2021, Teacher, 2021).


**Figure 21:** *Illustration of the perpendicular bisector*

The decorations (Figure 21) showed that the use of parallel lines on the woven basket cut across a certain decorative pattern to produce two angles of the same size. Additionally, the straight lines meeting the oblique lines at a vertex point result in the formation of a perpendicular bisector. Further, the illustration on Figure 21 of line AB (formed by the coils and decorations) is bisected by the straight line that the oblique lines meet at a vertex point, X.

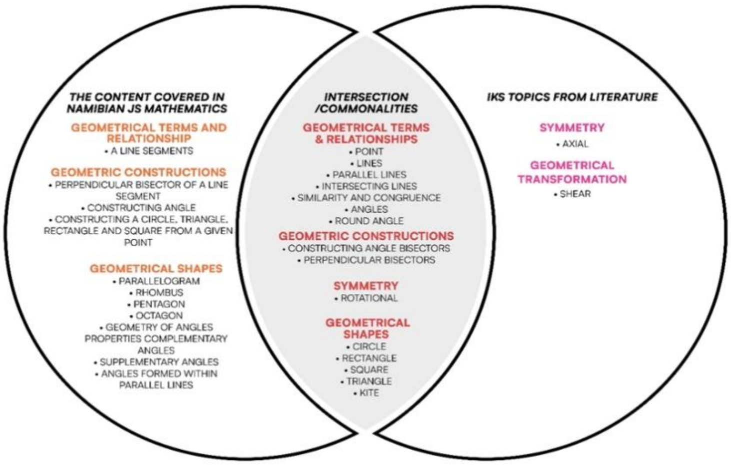


**Figure 22:** *Geometry depicted in the baskets and matched to the literature*

Based on the findings, we developed a Venn diagram (Figure 22) to illustrate common concepts, shown by the intersection between the content covered in the Namibian junior secondary (JS) Mathematics curriculum and geometry related topics from the literature.

Figure 22 depicts how the Mathematics concepts found at the point of intersection were related to junior secondary Mathematics curriculum in Namibia. Subsequently, a dialectical relationship was detected between geometrical concepts found in junior secondary school mathematics curriculum and in the literature. The geometrical concepts relevant to the junior mathematics curriculum include the following (Figure 22):

(a) the geometrical terms and relationships (point, lines, parallel lines, intersecting lines, similarity and congruence, and angles);
(b) geometrical constructions (constructing angle bisector and perpendicular bisectors);
(c) geometrical shapes (circle, triangle, rectangles, hexagon, kite and square);
(d) geometrical symmetry (rotational) and geometrical transformation (reflection, enlargement and rotation);
(e) geometrical angle and properties (right angle and straight angle).

Furthermore, the results show that geometry (IKS topics) not yet incorporated in the junior secondary Mathematics curriculum comprised symmetry (axial symmetry) and geometrical transformation (shear and translation). In addition, the content not found under the geometrical concepts consisted of:

(a) geometrical terms and relationship (a line segments);
(b) geometric constructions (perpendicular bisector of a line segment**,** constructing angle and constructing a circle, triangle, rectangle and square from a given point);
(c) geometrical shapes (parallelogram, rhombus, pentagon and octagon);
(d) geometry of angles properties (complementary angles, supplementary angles and angles formed within parallel lines).

The results in this study generated a list of topics on geometrical content deduced from the artefacts by Aawambo women. Although the artefacts contained relevant content, the list was not exhaustive but limited to the group of women that participated as knowledge holders in the selected community. However, the content produced was found to be relevant to the junior secondary Mathematics curriculum.

**Discussions**

Namibia has policies in place that stipulate the importance of IK and the values it may add to education. However, evidence of IK content in the curriculum has been negated in the Mathematics school curriculum. This finding is in line with that of Chinsembu and Hamunyela (2015) that the challenge lies in identifying the knowledge that could be included in Mathematics, documentation and the locality of IK. Comparatively, the importance of IK content is emphasised in progressive curricula in neighbouring countries of Zimbabwe and South Africa while in Namibia, little guidance is provided to the teachers on how this should be accomplished (De Beer & Mothwa, 2013; Risiro, 2019). This study collected evidence of geometrical concepts from well vested members of a local community considering the importance of IK characteristics such as shared knowledge by many ethnic groups, variances based on natural settings and social histories in present communities. In this study cultural artefacts presented rich geometrical ideas from community members and in turn the ideas were certified using a classification system by Mathematics teachers. With the same objective, researchers found rich geometrical facts and principles as sources for mathematical concepts embedded in cultural artefacts. The weaving of cultural artefacts helped to create ample opportunity to develop ethnomathematical knowledge beyond the classroom, involving community members (Agrawal, 2014; Drew, 2005; Chikunda & Ngcoza, 2017; Nurbaeti, et al., 2019; Pradhan, 2021).

For this study, the skills, knowledge, methodologies, eye-catching and flamboyant-looking artefacts involving the designs, patterns and structures were presented as evidence of knowledge that formed part of ethnomathematics. Similarly, evidence of ethnomathematics was sourced through cultural artefacts as teaching resources (Hewson, 2013; Pradhan, 2023). The content presented in the Venn diagram (Figure 22) were identified and categorised and matched to the Namibian Junior Secondary School Mathematics curriculum. The fact that evidence was reflected in the Namibian curriculum, showed a positive trend towards increased content creation in the ethnomathematics domain, widening opportunities for local communities to make meaningful contribution to Mathematics offered in schools. More geometrical concepts were identified in this study and were matched to the Namibian Junior Secondary School Curriculum, excluding symmetry (axial symmetry) and geometrical transformation (shear and translation). This finding could be attributed to the fact that ethnomathematics was not prioritised by curriculum developers and mathematics teachers possibly due to lack of knowledge, skills and understanding of the value of IK. However, this is not surprising as fewer communities value the importance of basket weaving and its benefit to the Mathematics curriculum (Dominikus, et al., 2023).

It is significant that the geometrical concepts found in this study could be integrated in the Mathematics curriculum as stipulated in policies and national agendas that recognize IK. This finding is in line with Deda and Amsikan (2019) who stress that communities possess local wisdom that could potentially be used to convey geometry concepts in Mathematics at junior high school. However, studies have revealed that the implementation strategies remain a challenge (Chinsembu & Hamunyela, 2015; Jauhiainen & Hooli, 2017; Onstad, et al., 2003).

## Conclusions

While integrating localized examples can make Mathematics more engaging through socio-cultural practices, we reclaimed indigenous knowledge subdued by colonial education models. The list of geometrical concepts identified indicated a positive trend towards the adoption of ethnomathematics in the junior secondary school Mathematics curriculum. More so, we stress the importance of content co-creation, involving the knowledge holders to generate ideas that were mirrored in artefacts; and teachers for content validation, necessary to expand the list of geometrical concepts. By articulating the geometrical concepts by *Aawambo* women, this research provides a foundation for developing culturally relevant pedagogy and curricula for Mathematics teaching in Namibia.

## Recommendations

The study revealed a need for research that focuses on the documentation of cultural artefacts that could be used to complement teaching resources for geometry. Future researchers should explore ethnomathematics to broaden cultural values and the mathematical ideas embedded in locally produced baskets. In addition, curriculum developers and the Ministry of Education should record the Mathematics concepts that are found in basket weaving from other communities to add to the list of topics made available through this study. This would allow teachers to obtain adequate resources required to integrate IK in Mathematics teaching.

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