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Intergenerational Dwindling of Indigenous Astronomical Knowledge in Coastal Communities: Inputs for Curriculum Integration

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Abstract

This study aimed to determine the intergenerational decay of indigenous astronomical knowledge in coastal communities of a Visayan Province. The baseline data was collected through an in-depth interview of 10 fishermen aged 60 and above. The researchers compiled a glossary of indigenous terminologies shared by the informants. Hiligaynon terminologies were provided with English equivalent words and meanings. To gather information from the three generations with the age range of fifteen (15) years, an objective test was developed to assess their indigenous astronomical knowledge. The baseline information is considered 1.00, meaning that the resource generation possesses 100% of this knowledge. The average retention rate and annual rate of change of this knowledge were computed. Notably, the finding reveals a decreasing trend in the annual rate of change (1.81% or approximately 27.15% for every generation) of indigenous astronomical knowledge over successive generations. This finding is quite alarming. The younger generations will continue to thrive in a community where fishing is the primary source of livelihood. They must master indigenous astronomical knowledge as they navigate towards and from the fishing zones. It is recommended that DepEd must consider contextualizing science lessons, especially those related to astronomy. Local Government Units (LGUs) must support DepEd's initiative to retool teachers in integrating indigenous astronomical knowledge into the curriculum. Likewise, the glossary on astronomical knowledge must be utilized as a resource material for teachers in island communities. Efforts must be initiated to unite indigenous and scientific astronomical understanding.

Keywords: *Intergenerational decay, indigenous astronomical knowledge*

INTRODUCTION

Astronomy is a study of objects that lie within and beyond our planet as well as the processes by which these objects interact with one another. As one of the most ancient disciplines of science, astronomy has its cultural roots. As enunciated in Lopez, et al (2021), astronomy's unique features stem from the fact that

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every person in the world, regardless of ethnic group, has a profound relationship with the sky and the stars. This is what Lee, et al (2020) consider as indigenous astronomy. They further emphasized that indigenous people have nurtured critical relationships and knowledge about the stars, from keen observation and sophisticated scientific investigation to place-based ceremony, and celestial navigation for many years. The indigenous relationship and knowledge about the sky is exceptional because they encompass every person's mind, body, heart, and spirit.

However, indigenous astronomical knowledge has been marginalized by western knowledge system. In recent years, the anti-indigenous knowledge myths, such as primitivism; lack of documentation; lack of autonomy; and departing from indigenous knowledge-based life style are some of the factors that challenged the functionality and sustainability of this knowledge (Sirima, 2015; Aderemi, 2017; Ibinarriaga, 2020). This can be a reason why the UNESCO's Declaration on Science and the Use of Scientific Knowledge provides that "*indigenous and local knowledge systems, as dynamic expressions of perceiving and understanding the world, can make and historically have made valuable contributions to science and technology, and that there is a need to preserve, protect, research and promote this cultural heritage and empirical knowledge*."

In the published paper by Sulaiman, et al (2023), they stress that fishermen still use knowledge-based astronomical phenomena on their fishing practices in this modern age. Findings of their study show that fishermen's astronomical knowledge influences their fishery activities based on six elements. Fishermen use indigenous knowledge to: 1) know the best time to expect an abundant catch; 2) know the best location to catch an abundant marine species; 3) assess the maturity of marine species; 4) calendar repeating astronomical phenomena as an aid for fishermen in carrying out fishery activities; 5) guide the estimation time and safety for fishermen at sea; and 6) guide fishermen on the most appropriate technique to use when carrying out fishing activities.

Any researcher who aims to work on indigenous astronomical knowledge must have deeper understanding of the universally agreed-upon concepts and meaning (science), and deeper knowledge of how cultural beliefs differed between indigenous groups (relative experiences), and the significance of these beliefs in shaping our understanding of astronomy and cosmology today (Mardon & Steen, 2021). One of the researchers has grown up in an island community whose childhood years is full of experiences in interacting with the sky and the astronomical objects during night and day time. Moreover, his experience both in fishing and navigating has exponentially enriched his understanding of indigenous astronomical knowledge. Luckily, because of his exposure to modern day scientific education, his early exposure to this indigenous knowledge in the past has deepened his understanding of todays' modern astronomy. Furthermore, this researcher's age belongs to the reference group (60 years old and above).

Current State of Knowledge

The fisherfolks in island communities continually engage in small-scale fishing which doesn't need very sophisticated navigation devices and fishing techniques. Through experiences, they have possessed indigenous astronomical knowledge which have accumulated over time through their observation of and interaction with the natural world. Simpemba (2015) points out that indigenous astronomy in the context of Zambia is the oral astronomy knowledge, culture and beliefs which relate to celestial bodies, astronomy events and related behavior that are held by the elderly persons and passed on to younger generations.

Much about indigenous astronomical knowledge is not written down. It is considered as "a living relationship with nature focused on the sky and celestial phenomena". It is deeply embedded in keen observation and participation, anchored to heritage, but not documented (Lee, et al 2020). With the passing away of its custodians, this knowledge is threatened with extinction. The literature reviewed have highlighted that knowledge of indigenous astronomy is high among the elderly people and declining with age hence, there is a need for documenting and introducing it in the school curriculum and regular public discourse. This information motivates the researchers to determine the indigenous astronomical knowledge in island communities and to examine how robust this knowledge is by generations, and document them for future use.

Theoretical Underpinnings

This research is anchored on the Theory of Conceptual Fields (TCC) by Gérard Vergnaud (1990), cited in Irineu, et al (2022). In this study, the main subject under study is indigenous astronomical knowledge in island communities which, by nature, is a concept. TCC is a cognitivist theory. It seeks to provide a coherent scenario, and some basic principles for the study of the development and learning of complex competences (information and skills), mainly those related to science and techniques. Its main objective is to allow the acquisition of new knowledge by creating estrangement between preexisting concepts during their early and late childhood (schemes) and those of the adolescents (situations). The conflicts of schemes and situations are the roots of cognitive development. Concepts-in-action are essential parts of schemes which lead to the development of a conceptual field that requires children's meeting and being faced with contrasting situations.

The interrelationship between and among disciplines, according to Vergnaud (1990), becomes a teaching aid representing a huge number of concepts. This tool also serves as scaffolding for the study of indigenous astronomical knowledge, since this knowledge is organized into various conceptual fields. Its domains and component parts are observed and analyzed over a long period, through experience, maturity, and learning, through different situations. He has defined *Conceptual Fields* as "an informal and heterogeneous set of problems, situations, concepts, relationships, structures, contents and operations of thought, connected to each other and, probably, intertwined during the acquisition process" (Irineu, et al, 2022).

Objectives of the Study

This research aimed to determine the dwindling pattern of indigenous astronomical knowledge in island communities. The result of this study can provide activities for the revitalization of this knowledge through curricular integration.

Specifically, this research was conducted to provide answers to the following problems:

1. Identify the indigenous astronomical knowledge in island communities.
2. Determine the extent of indigenous astronomical knowledge in the themes of: phases of the moon, tidal dynamics and wind direction, when taken as a whole and categorized according to the following age groups:

2.1. 45 – 59
2.2. 30 – 44

2.3. 15 – 29

3. Determine the dwindling pattern of indigenous astronomical knowledge in the aforementioned themes as shown by the following measures:

3.1. Intergenerational Rate of Retention
3.2. Cumulative Rate of Retention
3.3. Annual Rate of Change

4. What initiatives can be recommended for the revitalization of indigenous astronomical knowledge through curriculum integration.

RESEARCH METHODOLOGY

Research Design

This study was conducted in the island communities in one of the municipalities in Western Visayas. These communities were considered as the locale of the study because of their accessibility to the Visayan Sea where fisherfolks conduct fishing activities. The researchers had utilized a mix of descriptive qualitative and quantitative research methodology. According to Creswell (2009), a mixed method employs aspects of both quantitative methods and qualitative procedures. This research method is more than simply collecting and analyzing both kinds of data; it also involves the use of both approaches in tandem so that the overall strength of a study is greater than either qualitative or quantitative research.

Study Respondents

To gather the indigenous astronomical knowledge, though in-depth interview, the snowball technique of identifying the interviewees was employed. The target respondents were those ageing 60 years old and above (first generation or the reference group), male, and who had engaged in fishing and navigation using indigenous astronomical knowledge. After the interview of the first respondent, the researchers requested him to identify those who meet the inclusion criteria. The data collection proceeded to the next recommended participant until the saturation point was noted. The researchers had interviewed up to ten participants and the last one, revealed iterative responses.

The next study respondents were similarly selected through a snowball technique. The target of the study was to gather information from the seventy-five (7) respondents distributed into: 25 from the second generation (ageing 45-59 years); 25 from the third generation (ageing 30-44 years); and 25 from the fourth generation (ageing 15-29 years). These respondents were subjected to objective multiple-choice test.

Instrument

The research instrument to gather qualitative information, the researchers employed a validated interview guide. This instrument was subjected to validation by 5 university professors through Lawshe's Content Validation method. It contains 7 questions with prepared in-depth follow-up questions.

For the quantitative aspect of the study, the researchers utilized a nineteen (19) item multiple-choice test. The 19 items were distributed into in this manner: six (6) items for Phases of the Moon; seven (7) items for Tidal Dynamics; and six (6) items for Wind Directions. This test was subjected to face, content, and construct validation. Five of the ten baseline informants who know how to read and write, were consulted as to the correctness of contents and accuracy or responses in the constructed multiple-choice test stated in Hiligaynon. All of the validators agreed that the test has very high degree of accuracy. After its validation, the test was conducted to 25 residents (varied age range) of an island barangay which was not included in the sampling frame of participants. Reliability index was determined through Kuder-Richardson (KR_{20}) to test its internal consistency. The reliability coefficient shows high degree of internal consistency.

Data Gathering and Procedure

To gather information essential to answer Problem 1, the researchers utilized an in-depth interview using an interview guide to determine the indigenous astronomical knowledge that exists among the reference group or the knowledge custodians. The interview was conducted to ten fishermen and navigators, as key informants (ageing 60 years old) in the island communities through snow ball sampling technique until the point of saturation was reached. They were chosen because of their expertise in the fields of fishing and navigation using both sail and motorized boats through their indigenous astronomical knowledge. Due to insufficient power supply in the islands voice recording was impossible. The information gathered was recorded in a journal with the assistance of the two secondary school teachers.

From the qualitative information, a multiple-choice test was constructed in order to gather quantitative information essential to answer Problems 2 and 3. The test was conducted to the sample communities and snowball technique for determining 75 participants, twenty-five for every generation; ageing 45-59; 30-44, and 15-29. The researchers were assisted by teachers in community schools to locate qualified participants and conduct the test. When one is done taking the test, he/she recommends another one who is at his age range. Their papers were grouped according to generation. Twenty-five participants per age group were considered as samples. For those who do not know how to read, the questions were read and their answers noted.

The result of the interview was subjected to thematic coding. In the domain of astronomy, three themes had emerged in the analysis. Each knowledge is categorized into the three themes. Phases of the Moon was coded "PM"; Tidal Dynamics, "TD"; and Wind Direction, "WD". Codes were assigned to every Indigenous astronomical knowledge to facilitate groupings. After which, this indigenous knowledge was provided with an English equivalent terminology and meaning in science.

From the glossary of indigenous astronomical knowledge, the researchers constructed a multiple-choice test in Hiligaynon version. Test construction was facilitated because one of the researchers had been a resident of an island community during his childhood years. After the dry run, nineteen (19) items were considered good items, after an item analysis was done. The 19 items test was distributed into in this manner: six (6) items for Phases of the Moon; seven (7) items for Tidal Dynamics; and six (6) items for

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Wind Directions. This test was subjected to face, content, and construct validation. Five of the ten baseline informants who know how to read and write, were consulted as to the correctness of contents and accuracy or responses in the constructed multiple-choice test. All of the validators agreed that the test has very high degree of accuracy. After its validation, the test was conducted to 25 residents (varied age range) of an island barangay which was not included in the sampling of participants. Reliability index was determined through Kuder-Richardson (KR_{20}) to test its internal consistency. The reliability coefficient was 0.79 which shows high degree of internal consistency.

The test papers were scored by item as "0" for wrong and "1" for correct answers. The total score per participant was computed. The mean scores by age groups were determined. The baseline generation is presumed to have the perfect mean of 1.0 (100% knowledge). After which, the generational mean, the indices of intergenerational rates of retention, cumulative rate of retention, and the annual rate of change of indigenous astronomical knowledge were computed.

Data Analysis and Statistical Treatment

The formulae for the computation of the needed indices suggested by Standford Zent & Maffi (2009), are presented below:

(1) Intergenerational Rate of Retention (RG)

The RG indicates the rate of retention between any successive pair of age groups and is calculated as the ratio of the baseline generation's mean to that of the generation immediately preceding it.

This calculation is given by: $RG_t = \frac{\bar{g}_t}{\bar{g}_r}$

Where $\bar{g}_t$ is the mean score of the target age group (i.e. the younger group of the pair), and $\bar{g}_r$ is the mean score of the reference age group (i.e. the next ascending group).

The RG_t of the oldest age group is set at 1 based on the logic that no information about the aptitude level of the preceding generation(s) is available and therefore we cannot assume that any differences or changes have occurred in prior time periods.

(2) Cumulative Rate of Retention (RC)

The *RC* reflects the proportion of the baseline aptitude level retained by each succeeding age group. *RC* is calculated by multiplying the reference *RC* by 10 raised to the power of the logarithm of the target *RG*. As with the *RG* calculation, the *RC* of the oldest target age group is set at 1. The formula is defined as:

$$RC_t = RC_r * 10^{\log(RG_t)}$$

(3) Annual Rate of Change (CA)

The *CA* expresses the average rate and direction of change per year reflected by the target age group and is given by:

$$CA_t = (RC_t - 1)/yg_t$$

where yg_t is the length in years of the target age group interval.

Ethical Consideration

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Ethical principles were employed to guide the researchers in addressing the initial and ongoing concerns arising from qualitative interview and conduct of the test. These principles ensure that the research goals are achieved while protecting the rights and welfare of the participants. The researchers adhered to ethical standards such as anonymity, confidentiality, informed consent, and voluntary participation. To ensure anonymity, the participants were given the option to remain anonymous. Any identifying information will be excluded or coded to prevent linking responses to individuals.

The researchers withheld all identifying information for confidentiality's sake. Only the aggregate data were reported, and raw responses were securely stored. The participants were provided with a detailed explanation of the study's purpose, procedures, benefits, and potential risks before participation. They were informed of their right to withdraw from the study at any time. The researchers acknowledged that participation was entirely voluntary, and there was no coercion. Participants may decline to answer any question or withdraw anytime during the interview.

RESULTS AND DISCUSSION

1. On the indigenous astronomical knowledge in island communities.

Through an in-depth interview, the researchers had gathered qualitative data about folks in island communities. From the ten (10) fishermen and navigators the indigenous astronomical knowledge was recorded and analyzed through thematic coding. There were 108 words were analyzed and coded. Twenty-seven (27) terminologies gathered considered under the domain of astronomy. The Hiligaynon terms were given their corresponding English equivalent terms. This information is presented in the discussion that follows.

a. Astronomical Knowledge on the Phases of the Moon

There are eight (8) Hiligaynon terms about the Phases of the Moon (see column 2 of Table 1). Their equivalent English terms are presented in the third column of the same table. The fisherman's astronomical knowledge on phases of the moon has bearing on the decision he makes as to how and when to go fishing. The kind of fish to catch would also rely upon his traditional knowledge in the domain of Phases of the Moon.

According to Anderson (2017), every fisherman knows that the best fishing times are when the fish are feeding. This tends to be during dawn and dusk, but what often goes unnoticed are the two periods elsewhere in the day--moonrise and moonset. Because the moon has an effect on a variety of factors surrounding the fish--including the live fodder they hunt--these periods, combined with the moon's phase, are what trigger feeding. By understanding this, and choosing times when sunrise/sunset and moonrise/moonset coincide with new or full moon phases, you'll increase your chance of a good fishing catch, assuming that there are fish in the area.

A study of Dio & Onuchukwu (2025) concludes that during "neap tides" which occur during the first and last quarter phases of the moon. This period is associated with less gravitational force, low sea current or slow movement of the water, no flooding, which is good for fishing activities. A good understanding of the effect of moon phases on tidal levels provides tidal information to aid fishing activities in coastal communities. This data is used for tidal prediction, to know when it is convenient for fishing and generally to serve as guide for fishermen of their day-to-day fishing activities. This information implies that the indigenous knowledge of the phases of the moon must be documented, preserved, enriched and validated for future use. Table 1 shows indigenous astronomical knowledge in the domain of phases of the moon.

Table 1. Indigenous Astronomical Knowledge themed as Phases of the Moon

Astronomy - Phases of the Moon		
Code	***Hiligaynon Term***	***English Term***
APM01	Himatayon	Waning Crescent
APM02	Kwarto	First and Last Quarter
APM03	Lati	Crescent
APM04	Ligom-dulom	New Moon
APM05	Pakwartuhon	Waning Gibbous
APM06	Palati-on	Waxing Crescent
APM07	Paugsaron	Waxing Gibbous
APM08	Ugsad	Full Moon

b. Astronomical Knowledge on Tidal Dynamics

The Seven Hiligaynon terms about the Tidal Dynamics are presented on the Table 2. They were provided with English terms. These are presented in the third column of same table. Further explanations are presented in the glossary. The astronomical knowledge, in terms of tidal dynamics, of a fisherman has bearing on the decision he makes as to how and when to go fishing. The kind of fish to catch would also rely upon his traditional knowledge in the movements of water currents.

The study of Eggertsen, et al (2016) reported that tidal currents are important features in reef environments with high tidal range. Such current-influenced areas can be attractive for fish due to transport of nutrients and food items. Twice a day, the mudflats flood and twice a day they lay exposed. The most obvious change is the water level; however, many other things change as well. The oxygen level and the temperature of the tidal bottom are continually changing with the tides. In the summer, the bottom can warm up immensely during low tide, and then cool off as the water rises. Just the opposite happens in the winter. The tides transport nutrients and offer seals a temporary area to haul out. The currents move bottom particles around, thereby continually changing the shape of the bottom. All in all, the tidal zone is very dynamic. And there are not many plants and animals able to handle all of these changes (ECOMARE, 2015). Tidepools which are distinct rocky marine or estuarine habitats are rich areas of fishing activity. It is a rich source of shore species which is highly influenced by tidal dynamics (Mason, et al (2020).

Table 2. Indigenous Astronomical Knowledge themed as Tidal Dynamics

Astronomy - Tidal Dynamics		
Code	***Hiligaynon Term***	***English Term***
ATD01	Ayaay	Neap Tide
ATD02	Kibit	Start of Flood Flow or Ebb Flow
ATD03	Lantong	High Slack or Low Slack
ATD04	Pahunas/Hunas	Ebb Tide
ATD05	Pataob/Taob	Flood Tide
ATD06	Sikla	Spring Tide
ATD07	Sulog	Water Current

c. Astronomical Knowledge on Wind Direction

Wind is also an essential factor for the fishermen to make successful catches. They classify it according to direction: North, South, East, Southeast, Southwest, Northeast and Northwest. There are twelve (12) Hiligaynon terms that were considered as indigenous astronomical knowledge themed as Wind Direction. These terms are listed in column 2 of Table 3. Their English terms are presented in column 3.

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Wind direction is an essential factor that fishermen need to take into consideration to make successful catches. These are classified into North, South, East, Southeast, Southwest, Northeast and North directions.

Arpani, et al (2020) advanced that wind, temperature, and rainfall strongly influence fishermen's catches. In conducting voyages, fishermen pay close attention to weather conditions to catch many fish and not face storms or lousy weather at sea. The relationships between wind intensity, direction, and fishing durations. Major wind directions affecting the island communities, the North, East, Southwest and Northeastern winds are the best ones for fishing. Wind is also an essential factor for the fishermen to make successful catches, and they classify it according to direction: North, South, East, Southeast, Southwest, Northeast and Northwest. The data show that fishermen's knowledge can also be useful in devising plans for management and conservation studies for this estuary.

Weather forecasting using traditional methods in the province of Tawi-Tawi, Philippines, is an important indigenous knowledge and is heavily applied to predict the weather in preparation for fishing and sailing and also for disaster prevention. The study of Tahiluddin, et al (2023) revealed that traditional knowledge/methods using atmospheric (clouds, wind, temperature, and visibility), astronomical (sun and moon) and biological (seagrasses/algae, ants, birds, bees, and earthworms) indicators were used to forecast weather, which generally predicts an incoming rainy season as well as adverse weather (typhoons and floods). This study indicates that traditional weather forecasting is still used by the local people of Tawi-Tawi crucial for fishing and sailing activities.

Table 3. Indigenous Astronomical Knowledge themed as Wind Direction

Astronomy - Wind Directions		
Code	***Hiligaynon Term***	***English Term***
AWD01	Amihan	Northeast Wind
AWD02	Amihan sa Tiyabas	North-North East Wind
AWD03	Dumagsa	Easterly Wind
AWD04	Habagat	South West Wind
AWD05	Habagat Natural	Westerly Wind
AWD06	Habagat sa Canlaon	South-Southwest Wind
AWD07	Habagat sa Lubang	West-northwest wind
AWD08	Kanaway	North-north-west wind
AWD09	Salatan	South-south-east wind
AWD10	Timog	South-East Wind
AWD11	Tulod-batang	Fluky
AWD12	Sungsungon	Upwind direction

2. **On the extent of indigenous astronomical knowledge in the themes of phases of the moon, tidal dynamics, and wind direction in island communities when taken as a whole and grouped according to the following generations:**

   2.1 Second Generation (45 – 59)

   2.2 Third Generation (30 – 44)

   2.3 Fourth Generation (15 – 29)

Table shows that the levels of retention rate of indigenous astronomical knowledge varies from generation to generation. It can be gleaned from the data presented that the rate of retention gradually dwindles up to the youngest generation. While the oldest generation has very high level of retention rate, the youngest age group's retention rate is low.

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Notably, that in the domain of Astronomy, the generation groups have lowest retention rate. This knowledge is of much important because fisherfolks engage in navigation all throughout their fishing activities. Indigenous astronomical traditions are underpinned by a philosophy of knowledge that enables a different view of the place in which humans relate to the natural world. Indigenous knowledge has a strong potential for understanding a range of environments in conjunction with knowledge of the stars and planetary cycles. Low knowledge in astronomy can most probably pose risk to fisherfolks.

Presumably, there might be some causes of this loss of indigenous astronomical knowledge. According to ICSU (2002), when indigenous children are taught in science class that the natural world is ordered as scientists order it, and that it functions as scientists believe it functions, then the validity and authority of their parents' and grandparents' knowledge is denied. While their parents may have possessed an extensive and sophisticated understanding of the local environment, classroom instruction implicitly informs that science is the ultimate authority for interpreting 'reality' and by extension local indigenous knowledge is second rate and obsolete. Schools then, must strengthen their genuine commitments to build an authentic and inclusive collaboration with Indigenous parents by empowering parents to engage in their children's education, building culturally responsive relationships with parents, and supporting the whole family and student's development (Sianturi, et al, 2022).

Table 4. Extent of Indigenous Astronomical Knowledge by Age Group (Generation Group)

Intergenerational Level of Retention of Indigenous Astronomical Knowledge							
Domain	***Code***	***2nd Gen (45-59)***		***3rd Gen (30-44)***		***4th Gen (15-29)***	
		RG	***Int***	***RG***	***Int***	***RG***	***Int***
Phases of the Moon (6)	PM	0.83	VH	0.59	M	0.35	L
Tidal Dynamics (7)	TD	0.87	VH	0.62	H	0.37	L
Wind Direction (6)	WD	0.86	VH	0.61	H	0.36	L
Total (19)	**Total**	**0.85**	**VH**	**0.61**	**H**	**0.36**	**L**

Note: 0.81-1.00, Very High; 0.61-0.80, High; 0.41-0.60, Moderate; 0.21-0.40, Low; 0.00-0.20, Very Low

3. **On the dwindling pattern of indigenous astronomical knowledge as in terms the following measures:**
   - *3.1 Intergenerational Rate of Retention*
   - *3.2 Cumulative Rate of Retention*
   - *3.3 Annual Rate of Change*

The domains of indigenous astronomical knowledge are, Phases of the Moon, Tidal Dynamics, and Wind Directions. To measure the patterns of change, the following measures were computed, such as: a) the intergenerational rate of retention (*RG*), b) the cumulative rate of retention (*RC*), and c) the annual rate of change (*CA*). All of these rely on very simple statistical calculations and can be done by hand or with a pocket calculator.

Table 5 shows the Intergenerational dwindling of indigenous knowledge in the domain of Astronomy. It can be gleaned from the data in this table that there is marked loss of this knowledge by generation. The cumulative rate of retention by age group shows decreases from 0.85 (85%) to 0.36 (36%). For age group 45-59, the annual rate of change is 0.010 (1%); for 30-44, 0.032 (3.2%); while for the youngest generation

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(15-29) marks the highest rate of change of 0.054 (5.4%). The average annual rate of change for the whole generation is 0.0181 (1.81%). That means every year, TEK in the domain of Astronomy decreases by almost 2%.

This finding is corollary to the view that despite of the many virtues and benefits of indigenous astronomical knowledge, there is growing concern that it is being lost or eroded in many places due to modernization influences. The impending loss of a valuable resource has stimulated the search for policies aimed at preserving, reinforcing, recording or adapting unique cultural knowledge. The diversity of human knowledge of the skies, the utilization of this knowledge by different societies, and the advances of knowledge that comes from scientific endeavor and inquiry will help build a more complete picture of human engagement with the meaning of the stars, which have been on view since time immemorial (Malapane, et. al, 2024).

Indigenous knowledge system in astronomy seeks to understand, explain, and predict nature. This system is passed on to successive generations through oral tradition. However, due to the dominance of western science education, this knowledge system is extremely marginalized. This is supported by Simpemba's (2015) study which shows that knowledge of traditional astronomy is high among the elderly people and declining with age hence the need for documenting and introducing it in the school curriculum and regular public discourse.

Indigenous knowledge is an essential body of knowledge that can be integrated in the school curriculum. This answers to the recent trend of make teaching and learning contextualized to meet dynamic needs of the society. In island communities, this knowledge can be differently classified ranging from technological, science, cultural environmental. Choosing indigenous knowledge to be integrated into the mainstream curriculum may be challenging for educators; however, by focusing on the extent to which the current curriculum reflects the changing needs of the society in this millennium, one can make wiser decision.

Table 5. The Intergenerational Dwindling Pattern of Indigenous Astronomical Knowledge

Intergenerational Rates of Change (Vitality Indices)					
Astronomy (19 items)					
Age Group	***Mean Score***	***RG***	***RC***	***CA***	***CAa***
Baseline Generation (60-74)	19.00	1.00	1.00	0.00	-0.0181
Second Generation (45-59)	16.15	0.85	0.85	-0.01	
Third Generation (30-44)	11.51	0.61	0.52	-0.032	
Fourth Generation (15-29)	6.90	0.36	0.19	-0.054	

Conclusion and Recommendation

The researchers have recorded twenty-seven (27) indigenous astronomical knowledge through an in-depth interview of ten fishermen and navigators with ages ranging from 60-74. This knowledge was grouped into three sub-domains of astronomy (phases of the moon, tidal dynamics and wind direction). Notably, due to introduction of scientific and modern methods of fishing, this knowledge is threatened with extinction.

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When the level of intergenerational rates of retention of indigenous astronomical knowledge was compared, there is a marked decreasing rate from the oldest to the youngest generations. This goes to show that this knowledge decreases as years pass by. This is alarming because when fisherfolks who go for survival fishing do not have sophisticated weather forecasting instrument, they are exposed to disaster such as abrupt weather changes, storms, gale, wind gustiness, and other inclement weather. High level of astronomical consciousness can reduce the many challenges for disaster mitigation. Decline in traditional environmental knowledge can lead to adverse impact on the lives of fisherfolks.

The indigenous astronomical knowledge dwindles by almost two percent per year. The pattern of progressive decline of this knowledge by generation confirms the notion that this knowledge is threatened with extinction. The indigenous astronomical knowledge is anchored on the belief that fisherfolks must acquire knowledge that equips them with varied views as they relate to the natural world. However, the reviewed literature has shown that due to the introduction of solar energy in island communities, there is one phenomenon that hinders people's interaction with the objects in the sky. This is known as "light pollution". Because of the exposure of the younger generation to solar lights at night, the are deprived of the opportunity to see the beauty of the sky.

The information about the intergenerational dwindling of indigenous astronomical knowledge which points to the fact that initiatives must be instituted for its preservation. Therefore, the researchers present the following recommendations:

a) There must have training programs to develop higher level of indigenous astronomical consciousness and respect for this knowledge to face challenges and economic pressures among the fisherfolks;

b) There must have high stakes researches conducted to develop new astronomical and ecological insights. These insights can be obtained from in-depth investigations of indigenous knowledge systems from the fisherfolks.

c) There must be efficient fishery resource management system. Much traditional knowledge is relevant for contemporary natural resource management to actualize efforts of unifying it with scientific knowledge.

d) There must be continuous education for the development and conservation of protected marine resources. Indigenous astronomical knowledge may be used for the contextualization of modern science contents and show their implication to marine environmental protection and disaster risk reduction.

e) There must be unified development planning. Development agencies may benefit from traditional knowledge which can provide them with more realistic evaluations of production systems, marine resources and environment.

f) There must be comprehensive environmental assessment. Environment advocates must assess the time-tested and in-depth knowledge of fisherfolks about marine habitats. This can be a valuable resource in assessing the social and environmental impacts of proposed development projects.

g) There must be concerted efforts of the local government units and non-government organization for the development of tourism activities to provide alternative sources of income to the people in island communities.

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