

Development of Indigenous Physics as Solution to Socio-economic Problems: Insights from Physics Teachers and Elders

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Abstract: The limited application of Indigenous Physics in the development programs of many nations has resulted in the emergence and reoccurrence of many socio-economic problems. This study argues that, if Indigenous physics including its teaching, learning and practice are demystified and developed people's socio-economic problems can be solved. Indigenous physics is a reservoir of critical scientific knowledge, skills, technology and practices that are compatible with the people's socio-economic contexts hence can offer solutions to problems such as energy crisis and those associated with climatic change as well as environmental degradation. Electricity shortages may be minimized by increasing its generation using Indigenous Physics Knowledge of electrostatics applied in creating of lightning that requires neither large dams, foreign currency nor large workforce. This qualitative study adopted Post-colonial theory ideas grounded in indigenous research paradigm. The participants were selected purposively, and interviewed. Teachers formed focus groups while Elders engaged in cultural talks at cultural meetings. Thematic data analysis revealed findings indicating that development of IP is possible and necessary as it can provide solutions to people's problems. The study stimulates new thoughts and generates discussion on the wealth of Indigenous Physics Knowledge that can be used to solve socio-economic problems .

Keywords: Development, Stigmatization, Indigenous Physics (IP), Western Physics (WP), Indigenous Physics Knowledge (IPK)

I. INTRODUCTION

It is well known that indigenous knowledge systems (IKS) in different nations is being despised and underdeveloped.

This has resulted in limited application of Indigenous Physics in the development programs of many nations resulting in the emergence, persistence and reoccurrence of many socio-economic problems. This paper argues that, if Indigenous physics (IP) including its teaching, learning, and practice are revived, demystified, and developed some socio-economic and environmental problems in Africa can be solved. This research is based on the realization that IP like Western Physics (WP) provides valuable knowledge and technology resource base that has immense potential to alleviate many socio-economic problems in indigenous communities in Africa and even beyond [1], [2]. The knowledge of IP empowers members of indigenous societies with abilities and capabilities to deploy and employ practical techniques and skills to manage their environment and to find solutions to

their problems [2]. Examples may include electricity shortages which may be minimized by increasing its generation using IPK of electrostatics applied when creating and using traditionally man made lightning (Mheni). Mheni is a sudden illumination of the heavens caused by the discharge of atmospheric electricity from one cloud to another or from a cloud to the earth; a flash of light due to electricity in the atmosphere[3]. Indigenous Physics Knowledge of atmospheric physics associated with rainmaking (Mukwerere) may also be applied to minimize instances of droughts in Africa in place of State-of-the-art cloud-seeding methods which are costly and causes acidic rainfall [4] amongst other problems.

This paper hopes to provide highlights of the socio-economic problems that can be solved by application of IP with examples from some African society. The paper implies the need to create not competing but complementary frameworks between WP and IP particularly in solving socio-economic problems. It challenges and interrogates the dilemma of exclusively introducing western-based scientific knowledge in cultural contexts based on indigenous epistemology. The paper also highlights ways IP can be developed according to Advanced level Physics teachers and community elders. A background to the study is going to be discussed first and key terms are defined in context. Research questions that guided the study are cited and findings are also discussed. The paper finally proposes some recommendations for the development of IP and its practices.

II. BACKGROUND OF THE STUDY

The term IP denotes the study of knowledge of matter, energy, forces, skills and philosophies developed by societies during interaction with their natural surroundings [5]. Indigenous physics or science used interchangeably by Sithole [5] is experiential knowledge based on a worldview and culture that is basically relational. Indigenous physics is a reservoir of critical scientific knowledge, skills, technology, and practices that are compatible with African contexts. It can offer effective solutions to social and economic problems in Africa such as droughts, energy crisis, environmental degradation, pollution, and global warming. Indigenous physics is part of IK known for its resilience and ability to

describe, explain, predict, and negotiate nature [6]. It has always been generated in order to solve, societal and natural challenges like weather changes, shelter, communication, food, wars and diseases[7],[5].

Indigenous physics is underdeveloped in Africa because of the advent of colonialism, modern religion, western scientism, continuing colonial modernity and associated urbanization. Africans have not developed their IK for centuries [8]. Indigenous Physics is underdeveloped as it is seen to be at odds with scientific knowledge [9] and unsystematic [10]. Indigenous Physics is also seen as dangerous to non-indigenous people if freely shared [8]. Currently IK including IP is less widely known and valued in Africa and is in the danger of being lost [7], [9], [10]. The norms and practices regulating the acquisition and transfer of IP need to be developed. The teaching and learning of IP also need to be developed in both formal and informal educational systems.

III. STATEMENT OF THE ROBLEM

Indigenous Knowledge Systems in Africa have been neglected for a long time [11]. This has resulted in underdevelopment of its associated IK inclusive of the IP imbedded in it. Indigenous Physics has not been developed together with its teaching, learning, and practices. If IP is developed, it can help in the generation and enhancement of knowledge that can be used in solving some of the problems that are in Africa [5]. Western science has been implicated in many of these problems including world's ecological disasters [13], [14] like drought which is caused by among other factors, excessive draining of atmospheric water through cloud seeding [4]. There is ample evidence that western science is also under attack in the US, particularly under the Trump administration [15], [16]. There are also populist movements and a pattern of rejection of western science globally [16], [18]. Indigenous knowledge is increasingly being recognized as an important legitimate source of understanding of the physical world [19]. It is against this background of the realization that IP is compatible with Africa's environments and socio-economic contexts that the study seeks to find ways IP can be demystified and developed so that it can be included in finding solution to problems in Africa and even beyond. When IP is demystified and developed it can be taught, learnt, and applied in both formal and informal situations.

IV. RESEARCH QUESTIONS

1. What are the socio-economic problems in Zimbabwe that can be solved by application of IP according to advanced level physics teachers and elders?
2. How can IP be developed according to advanced level physics teachers and elders?

V. THEORETICAL FRAMEWORK

The study is premised upon Post-colonial theory ideas grounded in interpretive indigenous research paradigm. Post-

colonial Theory illuminates the link between the past, present and the underdeveloped state of IP. Indigenous physics has undergone stages of colonization, decolonization, and re-colonization. There is negation of IP as a valuable knowledge and this is similar to what [20] view as a form of cognitive imperialism that denigrates some other forms of knowledge. Post-colonial theory challenges the formally underdeveloped to reclaim, revitalize, and develop their lost intellectual and cultural values to re-establish a rich knowledge base [21]. The theory emphasizes the need to revisit, recognize, acknowledge, revitalize, and develop African cultural ways of doing things to bring back the lost heritage of wisdom. In the context of this study Post-colonial theory that formed the theoretical framework does not seek to allow IP to occupy all space and time or to replace western physics which dominates the world, it however suggests pluralism in philosophical and scientific views without hierarchy. Popp [22] notes that, both WP and IP approaches and perspectives have their strength and should be allowed to complement each other.

VI. PARADIGM

The study was based on the interpretive African-indigenous paradigm. The choice of this was premised on the fact that the study was done through an African perspective and generates views from people within their Shona culture. It allows information of indigenous people which is not documented to be captured through discussions and this integrates indigenous voices. Lowan [23] posits that, in an indigenous paradigm, knowledge holders (participants) share community knowledge with the researchers as cultural associate, a community, and family member. The researcher needs to operate within the Indigenous Interpretive Research framework to provide an insider description of the community's IK and thus the researcher's IK.

VII. METHODOLOGY

The study adopted a Qualitative research design. It was a descriptive multi-case study in nature.

Qualitative data were collected using questionnaires, interviews, and focus group discussions for teachers and cultural talks for Elders. The questionnaire contained both open ended and closed questions to allow collection of detailed data[24].The drafts of the questionnaires and interview guides were pilot tested on samples of the teachers that were purposefully selected. The participants involved in the piloting of instruments were excluded from the main study to avoid data contamination[25]. The use of multiple methods and sources for gathering data from the participants improved the trustworthiness of findings and authenticity of the research process. Questions for the interview were both open and closed-ended, based on the respective specific objectives of the study.

Participants included 18 physics teachers who were purposefully and conveniently selected from eight local high schools and 22 elders from one of the indigenous

communities who were selected by convenience sampling in Masvingo District, Zimbabwe. Permission to apply the data gathering instruments to elders and schools was granted by the District Administrator (DA) and the ministry of primary and secondary education respectively. It was disclosed to the participants that their participation was voluntary.

Data were collected separately from the community elders and physics teachers because the two groups of participants could not be brought together for the purposes of the study because of the school timetable.

The researcher used conversational thematic data analysis adopted from as informed by [23]. Conversational thematic data analysis adopted preceded from conversion of verbal data to textual data in the case of interviews and cultural talks, pre-coding, actual coding, categorization, and finally themes. These themes are illustrated with direct quotes from the focus group discussions, Cultural talks, field notes, and one-on-one interviews. Data related to the themes were presented in narrative form supported by excerpts from different participants' responses and were inserted to validate the themes. Only participants' validated verbatim English translations of excerpts were given to save space. Pseudonyms were used to ensure anonymity and confidentiality of the participants.

The participants

The participants were involved in interactions with IPK and practices in some way. These were drawn from Masvingo district where the study was conducted. Colonization occurred when the Portuguese invaded parts of the country in the 16th C and the British in 1890 and their colonizing influence still permeates this society today, suppressing the indigenous way of living and distorting the cultural and intellectual norms of the indigenous people [24].

Elders The Elders were purposively sampled from Karanga speaking Chimuto community. Most of the elders had been in the area for more than 40 years and their average age was 70 years. All of them grew up in the area with their parents who were mainly peasant farmers living traditionally and depended mainly on local resources and traditional technology for their livelihood and had not attended school beyond primary level.

The sample had 22 elders and represented a broad spectrum of IPK practitioners. The sample included farmers, traditional leaders, traditional healers, and "witch doctors," and assistant to the chief. The sample of elders had a fair representation of both men and women which enabled the researcher to get information about IP associated with both sexes. Elders in the community were considered the repositories of IK and its associated physics knowledge.

Teachers

The eight teachers who were interviewed together with the other twelve teachers formed the focus group (a total of eighteen). Their teaching experiences, ranged from 6 years to

25 years, with an average of 8 years. They were all trained and qualified to teach physics. All of them had teaching degrees from state universities in Zimbabwe. The average age of the teachers was 50 years. Teachers were involved in the study as they act as filters through which knowledge and experiences are screened for meaning [28].

VIII. RESULTS AND DISCUSSIONS

Findings were based on the experiences and views of the participants as shared in their own voices in the questionnaires responses interviews and cultural talks. Conversational Thematic data analysis revealed some themes that emerged which are presented below.

Theme 1: Acknowledgement of awareness of the existence of Indigenous Physics knowledge

This theme came from the analysis of data and responses of participants to the question "Does Indigenous Physics exist."

Thirty eight out of forty participants indicated that they were aware of the existence of IPK. One Elder during an interview commented that

We inherited this important knowledge that is being used in our community which you are calling Indigenous Physics from our ancestors who have been using it for a very long time. Our Elders would tell us about this Knowledge during our traditional cultural talks during cultural meetings (Elder Moyo).

The excerpt indicates that IPK is generally transmitted orally from generation to generation through informal traditional learning platforms and this was also observed by [30], [5] observed that "IPK" has been there from time immemorial providing solutions to societal problems and natural challenges and the excerpt also testifies that. FAO, IFAD, UNICEF, WFP, and WHO [31] add that, IPK has been repeatedly and continuously being employed for centuries and was effective (or was locally perceived as such). However, only two participants expressed ignorance of the existence of IPK. This was as a result of personal indiscriminate as IP was not being recognized as important in their communities and also that they were not conscious of the fact that some of their IK and practices were actually IP and its application as the knowledge was expressed in non-conventional science terms and nomenclature in their communities. In addition to that the knowledge was not conforming to formal aspects of standard scientific account. The implications of this theme is that there is limited understanding of what really constitutes IP and people have to be conscientized about its existence.

Theme 2: Effects of underdevelopment of IP.

Underdevelopment of IP inclusive of its practices has also led to other challenges in indigenous communities. Some elders confessed that they were no longer performing their IP practices well and some have abandoned the practices completely because of some stereotypical threats and the

interrupting cognitions produced from stereotype awareness. The excerpt below reveals this

Europeans have allowed all IPK and practices to fall under the rubric of witchcraft, sorcery, and wizard because of their little knowledge about this knowledge and associated practices. We are now ashamed of being caught using some of this type of knowledge but long ago it was an acceptable norm. Nowadays things have changed (Elder Magumbo)

The excerpt also indicates that there is good and bad IP and the colonizers have categorized them all as bad (uroyi/ubuthakhathi). The excerpt also shows that the IPK practices were acceptable in their societies before colonization and its current underdevelopment is because colonizers did not understand it. This is similar to the observation made by [32] that early anthropologists, missionaries and colonial administrators tended to describe African indigenous knowledge through misleading terms such as primitive, superstition, magic, witchcraft and fetish because they misunderstood Africa. This also agrees with [30] who asserts that Colonial authorities, the world over, have persistently ignored, misunderstood and even decimated Indigenous peoples and their knowledge. These saw the elders concealing the "useful" underdeveloped IP practices which [33] called Stigma concealment as testified in the excerpt below

Aaaaa...We live within societies structured in ways that perpetuate stigma. We enter into social interactions with an expectation that we would be rejected by others because of our stigmatized social status of being custodians and practitioners this underdeveloped IK. This is not good (Elder Moyo).

This is in agreement with [33] who observed that the expectation of rejection, regardless of whether the rejection occurs or not produce a cognitive burden. Other problems associated with the underdevelopment of IP are also captured in the following excerpts

Indigenous Physics practitioners live a stressful life every day. They are directly discriminated from participating in some events, receive poor services in public places like stores because of stereotype, and prejudice as a result of their stigmatized status, underdeveloped, and labeled indigenous physics practices (Teacher Mufari).

Aaah....We sometimes become targets of assault, harassment, and bullying. We are not protected from all forms of discrimination. We are normally targeted by witch hunters Tsikamutanda or tsikamutandas-plural who are usually hired by our chiefs and village headmen. These would sniff out and pounce indiscriminately on our indigenous physics artefacts some of which are used in indigenous atmospheric physics practices associated with rain making and declare us scornfully as dangerous witches in the communities. This is painful, particularly when people view us with suspicion and horror (Elder Dumbu).

Tsikamutandas are sometimes sanctioned and blessed by the traditional chiefs and headmen to come and hunt for witches in our communities. Honest Indigenous Physics users are also caught in the crossfire and forced to admit that they are witches yet what they have is not witchcraft, but it is useful knowledge and practices that have sustained people for generations. What is wrong with their indigenous rain making practice if I may ask? (Teacher Moyo)

Tsikamutanda/tsikamutandas(plural) refers to a group of self-proclaimed illegal male prophets and traditional healers who are neither registered as prophets nor traditional healers as required by the Zimbabwe Traditional Medical Practitioners Council Act, Chapter 79 [34]. The excerpts indicate lack of protection of IPK custodians and practitioners from the government and even the local leadership like chiefs. It seems like the people are convinced that IPK is useful and not bad like rainmaking although it can be abused in some cases like in the case where lightning is used to fix enemies. This agrees with [35] who observed that although laws prohibiting mankind of discriminatory life events related to stigmatized status exist, many stigmatized individuals are not protected from multiple forms of discrimination even by policy. Also emerging from the excerpt is the willingness of Elders to share the knowledge when it has been demystified and developed.

Theme 3: Indigenous physics and Technological problems.

Areas where IP can be applied in solving technological problems were consciously and unconsciously given by the participants as they tried to expand their responses. Thirty Eight out of forty of the respondents believe that IP can go a long way in helping in solving technological problems. This statistic suggests an overwhelming support for the need to revitalize and develop IPK arguing that the methods involved in IP can solve technological problems if all traditional rules and regulations are explained and followed. On the contrary only two of the respondents saw nothing being offered by the traditional approach in solving technological problems. The two expressed reservations. This might have been caused by the lack of knowledge on IP.

Technology related problems that could be solved by application of IPK revealed by participants include electric power generation and resource exploitation. The views from the participants indicate that the use of IP particularly in creation and arresting of lightning may lead to solving of problems such as shortage of power for industry, use of unclean sources of power that cause pollution like biofuels. Responses to do with how creation of lightning can solve electricity provision problems are indicated in the quotes below

Our ancestors taught us traditional ways of creating lightning and using lightning but those who still remember how it is done normally do it privately because people have labelled the practice as witchcraft(Elder Shungu).

Some Indigenous Physics practitioners in our community can create and control lightning. I believe people would benefit if the power from lightning can be harnessed and channelled into the national power grid. There is a huge voltage that is associated with lightning strikes (Elder Juru).

People used to fight using mheni as one of their indigenous weapons. In some cases the targeted enemy would divert or diffuse the lightning strike to protect himself from the strike. This Knowledge on how to divert lightning strikes which is found in Indigenous Physics Knowledge associated with creation of lightning/mheni may be applied in the designing of Indigenous lightning arresters which can also work as over-voltage protectors to save life, properties, and forests from veld fires (Teacher Ohm)

These indigenous lightning arresters may be used to harness lightning strikes from both natural and man-made lightning which can then be converted to heat for thermal power stations or mechanical energy (Teacher Munda).

The excerpts indicate that the IPK has been passed from past generations and some people have already forgotten part of it and some of the practices. Indigenous knowledge is at risk of being lost in many parts of the world [9], [8]. Covert practice of indigenous practices is also evident in the excerpts. There is also evidence of abuse of the knowledge where it is used in fights although society does not approve it.

Western physics views lightning as an electrical discharge caused by imbalances between storm clouds and the ground, or within the clouds themselves. In western physics a lightning arrester (also called lightning diverter) is a device used on electric power systems and telecommunication systems to protect the insulation and conductors of the systems from the damaging effects of lightning. Some lightning arresters are made of Zinc oxide.

Participants also revealed that Africans need recognition and protection of their IK as indicated in the excerpt below.

Our Indigenous Physics Knowledge should be protected. Since there are a number of international standards of lightning protection systems our own African standard may also be crafted and get registered so that we can openly apply this type of physics knowledge and also protect it from abuse (Teacher Guyo).

The excerpt indicates the need for establishment African standards to protect IK.

International standards include NFPA 780 and 781 which is American [36].

Indigenous remote Communication systems were also cited as another area where indigenous physics have a role to play in solving problems. The existence of remote indigenous communications practices is also confirmed by [37] who metaphorically called the practices "African Bluetooth

system" (ABTS). In the study the existence of "ABTS" is implied in the following excerpts

We have our own indigenous ways of communicating even with relatives who are not in our sight, we can even show videos as we communicate with them in a similar way that people would do when using Skype and Watsup video calls. We are experts at imitating the cries of wild animals and birds to attract them close enough when we want to kill them when hunting. (Elder Moyo).

There is Indigenous Bluetooth technology in the communities which looks more advanced, simple, and cheaper than western physics I am surprise to hear that scientists are celebrating blue tooth technology as a recent and modern invention which came in the 1990s when Africans had it since time immemorial (Teacher Gura).

His views resonate well with Peter (2015) who asserts that people have embraced western science and technology and assimilating Africans' science and technology as though there was nothing like that before. Zeadally, Siddiqui, and Baig (2019)[39] note that, Bluetooth technology was developed by L.M. Ericsson in 1994. Bluetooth's technology allows devices to communicate with each other without cables or wires [39].

In the ABTS case two bodies or devices also communicate without coming into contact. A popular example of its application in African communities what Sibanda (2013)[32] metaphorically called 'blue tooth sex, where there is invisible connection between the perpetrator and the victim who should be within an eye-shot distance or even beyond. The issue of ABTS remains a mystery that creates more questions than answers [32] (Sibanda, 2013). The reason was captured in responses below.

The Indigenous blue tooth technology practitioners were never given a platform to freely give details of the practice because of stigma associated with it. The morally acceptable applications of indigenous blue tooth technology remain a secret and only the immoral application is published and publicized like mubobobo which is described as magical, mystical, and spiritual. This is painful (Elder Hari).

Western physicists have been given a platform to disclose that their Bluetooth technology relies on short-wave radio frequency and employs radio technology called frequency-hopping spread spectrum. With more research the technology which started as an optimal "short-link" radio technology standard for transmitting signals between personal computers to wireless headsets is now being applied in many spheres of life. I wish to see this also being done with our own Indigenous blue tooth practitioners (Teacher Muti).

The responses of the participants indicate that there is good and evil application of IP. The use of "Mubobobo" is one of the evil applications of IP. This agrees with [32] who describes it as mystical and magical remote sexual intercourse. In the excerpts participants advocate for the ABTS practitioners to be given a platform to explain their

practice. They indicate that this may reveal some of the good uses of ABTS and with more research more uses will be discovered.

Transport problems were also cited as one of the technological problems that can be solved by application of IPK. Some subjects gave the following examples which demonstrate that IPK is being used in transport and the practice is being stigmatized. Participants revealed indigenous transport systems that have also been labelled which can also be harnessed to augment the current transport systems. The rusero (reed basket) flighting and the riding of nocturnal animals are some of the Indigenous Physics practices that emerged from the data.

In this community, some people also ride nocturnal animals like hyenas and use them as means of transport like we do with donkeys, horses, and camels. We do not know how they do it because they do it secretly (Elder Moyo).

I strongly believe that if the bio-physics involved in the riding and terming of these nocturnal animals is destigmatized and demystified transport problems will be reduced. People would freely teach each other the biophysics involved in the practice and also improvements would be made through research where necessary. If the aerodynamics, aviation physics, and aerospace physics involved in flying of Rusero are destigmatized, demystified, adopted, and adapted people would do away or minimize the use of aircraft and drowns which causes air and noise pollution and requires expensive infrastructure and specialized training. Transport problems will be reduced (Teacher Zulu).

The excerpts indicate acknowledgement of the use of rusero and nocturnal animals as modes of transport. Literature also indicates that indeed the two are used as indigenous modes of transport. The Sunday Mail of 12 April 2015 has a story of someone who confessed that she had “flown” unimaginable distance in a reed basket [40]. In the same newspaper, in 2014, the residences of Budiriro in Harare discovered two alleged witches whose reed basket “crash-landed” in the suburb. The two claimed that they had flown from a rural location during one of their several night-time escapades. Flying or riding the backs of night animals through the darkness of the night is labeled as humanity’s dark side in the Zimbabwean imagination [41]. Night runners of the Bukusu of western Kenya are among tribes who ride on nocturnal animals and do not consider the practice as witchcraft[42].

Theme 4: Indigenous physics and environmental problems:

Problems that are believed to be solved by ideas from Atmospheric physics in western Physics that can also be solved by ideas from IPK were also revealed in the data. Indigenous physics’ atmospheric management practices have stood the test of time, embodying the knowledge of dealing with different atmospheric problems and challenges accumulated over several generations.

Thirty Nine out of forty of the respondents believe that IP can go a long way in helping in solving environmental problems in Africa. This belief was supported by a sentiment from one of the teachers in an interview captured below

Oooh.., Western science is damaging our environment. I think we need another way of knowing like our own African ways of managing the environment (Elder Taru).

This is also supported by literature which indicates that scientists have recognized that indigenous people have managed the environments in which they lived for generations without significantly damaging the local ecologies [10]. On the contrary, only one of the respondents saw nothing being offered by IP in solving environmental problems. Indigenous physics strategies of managing the environment were captured in the following excerpts

We used to conduct rain making ceremonies (mukwerere) which greatly reduced the frequency of droughts and famine in our land. The chief would call for a meeting with the elders when he sees that people were starving and live stock was dying. This was good (Elder Doro).

Some people in our village can disperse clouds even when it is about to rain the clouds would just disappear from the sky. This is a way of controlling rainfall and reducing possibilities of heavy rainfall that would cause floods and loss of life and property. I am sure there are stubborn members of the community who do this to fix other people, this is not good and is against the spirit of Unhu/ Ubumthu (Elder Tugu).

Indigenous Physics Knowledge of atmospheric physics associated with rain making (Mukwerere) may also be applied to minimize instances of droughts in Africa in place of cloud seeding which causes acidic rainfall among other problems. Acidic rainfall has rendered the world communities vulnerable to dreadful threats of climatic change, global warming, disappearance of biodiversity and desertification (Teacher Gura)

The excerpts indicate indigenous rainmaking and cloud dispersal as some of the IPK that people use to manage their environments. Riffel, Luckay, Angaama, & Magaseti[33] observed that indigenous people have scientifically valid conception of indigenous weather predictions and manipulation. The excerpts indicate that people are skeptical about the use of modern methods of mitigating drought like cloud seeding. State-of-the-art cloud-seeding methods have been adopted before but are costly, less effective, risky, and time-consuming [4]. Cloud seeding is the dispersion of substances into the air(clouds) that saves as cloud condensation nuclei or ice for weather modification that aims to increase precipitation by altering the cloud composition[4].

Theme 5: Indigenous physics and food security problems.

This theme emerged from responses to the question” Do you think IPK can help in solving food security problems?” Food security is “when all people, at all times, have physical, social,

and economic access to sufficient, safe, and nutritious food that meets their dietary needs and food preferences for a healthy and active life”[31]. Thirty Nine out of forty of the participants agreed to the fact that IP can improve food security. This agrees with arguments made by [44] who posits that IP plays a substantial role in food security and improvement of agricultural productivity. Only one participant disagreed and argued that it is only a belief not a reality. The elders gave examples of how they used IP to ensure food security in their communities. They disclosed IP methods captured in the quotes below.

Our hunting tools like bows and arrows, spears, deadfalls and fishing lines ensure that the animals are not depleted from the forests while also have enough meat even for our future generations. These tools are made by our elders in the communities using traditional knowledge. The use of boats for fishing and guns for hunting ensures catching of large numbers of fish and animals respectively. We use some of the traps like “Dihura” for protecting our farm crops from wild animals(Elder Moyo).

Divisi used to make people in communities have enough food for their families but the people who used to practice it have abandoned it and are starving because they now claim to be Christians. They failed to demystify this seemingly enigmatic practice which was eventually labeled witchcraft despite its power in ensuring food security and food sovereignty (Elder shumba).

If the force involved in the operation of divisi is demystified and developed like the forces in the gravitational field of the earth, electric field and magnetic field it can be fully applied and the force field associated will be unpacked and improvements can even be made(Teacher Badza).

The excerpts reveal that IP can improve food security by enabling designing and use of tools that ensure sustainable harvesting and use of natural resources like in hunting and fishing. Dhibhura is an instrument that is designed with a strong cable. If an animal puts its head in the instrument and pulls it, the cable traps the animal by tying itself around the neck of the animal. People can then take the trapped animal for food or can be left on the trap to scare other animals away from the farm. It also reveals the covert application of the knowledge and also the influence of religion on the use of indigenous knowledge particularly on the issue of Divisi. Divisi is an agricultural enhancement practice that has been labeled as charm of magic. This is now believed to be a form of witchcraft among the Shona people.

Theme 6: Views of participants (teachers and elders) on development of IP:

This theme was derived from responses to the question “Do you think it is possible to develop IP and its associated practices. Thirty Nine of the forty participants believe that development of IPK is possible and necessary. The teachers and the Elders proposed strategies that they think would raise

the status level and quality of IP and make it acceptable and impactful to life. These strategies for developing IP that could be adopted to eliminate its persistent state of underdevelopment are reflected in the following quotes.

People should use indigenous terms to name same scientific phenomenon or equivalent technologies or technologies with similar designs or uses to those of western physics for example mheni for lightning, rusero for aircraft, Jerero for physics laboratories or research centers(Teacher Shuro).

Communities should acknowledge and celebrate the gains and achievements registered by practitioners in the indigenous physics field Like Ndunge of Chipinge who is believed to have caused the historic Chimanimani floods disaster by his outstanding knowledge of indigenous atmospheric physics (Elder Shoko).

People should be allowed to teach, learn and research on IP in schools and communities, establish in schools and communities laboratories with both indigenous artefacts and Western artefacts like Van Girraff generators from western physics used to demonstrate electrostatics and indigenous physics apparatus which are used to demonstrate electrostatics like those used to create lightning/Mheni (Teacher Muto).

This excerpt implies the establishment of integrated physics laboratories that tries to show that indigenous physics is also valued just like Western physics.

Encourage people to design virtual indigenous communities representing community of practice of Indigenous Physics to facilitate more research on IKS and improving indigenous knowledge accessibility to people and learners in schools and communities. Textbooks on Indigenous physics and associated practices should be written and even posted on on-line and virtual learning and social platforms (Elder Danda).

This excerpt implies the establishment of what we preferred to call “Indigenous SimCommunities” that allows people to appreciate the beauty of IP as it is applied naturally in the community of practice.

Allow simulations of IP practices to be done as indigenous physics practical activities or assignments during both formal learning in schools and informal learning sessions in communities. An example may be doing practical assignments on how to create and use lightning (Mheni) using Indigenous Physics Knowledge in the same way western physics experiments on properties of lightning are done in high voltage laboratories. This way indigenous and non-indigenous people including learners would get first-hand information that Indigenous knowledge and Indigenous Physics in particular is scientific and derive from empirical processes and evidence(Teacher Kondo).

Allow the use of sacred places associated with indigenous physics to be used as important research sites like sacred cave(Ninga) and also allow people to visit these places freely

so that more information is obtained that can lead to improvement of the effectiveness of the practices (Teacher Doro).

People should demystify and develop indigenous physics knowledge, researchers, research site (e.g. Ninga- sacred caves, graves), custodians (e.g. spirit mediums), and practitioners of the knowledge to promote archaeological inquiry (Teacher Shava).

Those who volunteer to divulge and demystify Indigenous Physics knowledge and practices should be accorded real authority and autonomy (Teacher Tsoro).

The excerpts indicate ways development of IP can be done. Generally, all their suggestions point to the need to improve the image of IP inclusive of its teaching, learning and application to enable it to reach a high levels of acceptability, applicability and effectiveness. The use of ICTs to view and share information about IP was also proposed and evident in the excerpts. The strategies also highlight the need to prove to people that IP is just like any other so called genuine science so that they develop positive attitudes towards it so that they can invest their social and individual capitals in the discipline. Other views which came out include the holding of fairs in which experts in IP and technology gather and showcase their skills and equipment, organizing campaigns in which IP experts facilitate workshops to help people acquire and skills of applying IP, encouraging research about IP and technology. The status accorded to particular knowledge depends on the social context, and is influenced by power relations among those who create and those who make use of the knowledge asserts that conventional 'scientific knowledge' is a cultural artefact of 'Western' culture. Ogawa proposes that every culture has its own science and refers to the science in a given culture as its "indigenous science" [45]. This implies that IP can also be considered as a cultural artefact of the indigenous people which must also be cherished. Indigenous Knowledge inclusive of IP is regarded as a science [44].

Participants acknowledge that, IP like any other science is also prone to abuse by its practitioners. This agrees with observations made by [46] in African societies. They further acknowledged that, there are some components of IP which are considered as good and some which are viewed as bad just like in other sciences. They all agreed that, the abuse of IP and the practicing of the bad IP is not acceptable in their communities and is against the spirit of Ubuntu/ Unhu. The following excerpts indicate these views.

Nevertheless abuses, good and bad practices associated with these heritages exist in African communities. However communities have their traditional ways of dealing with the deviants (Teacher Moyo).

Any technology or knowledge in the hand of an evil minded person is dangerous. A nuclear plant in the hands of the atomic bomb specialist is dangerous but is a useful innovation for electrical engineers who use it for the

generation of thermal electric power. In the same vain indigenous lightning creation knowledge in the hands of an evil minded person is very dangerous, but for one with the heart of assisting people in power generation is a blessing (Teacher Tsanga).

Generally the views of the participants indicate their support for the idea that if IP is demystified and developed some problems in Africa will be solved. The re-adoption of IP would liberate indigenous people from western thought pattern as also noted by [47]. Africans are given an opportunity to escape from mono intellectual perspective on nature and are given freedom and opportunity for self-expression. There are several options in the world to know or do the same thing in different ways, "two-eyed seeing" [48]. It is like seeing the world with the western physics eye and the IP one. Humanity needs two eyed seeing to deal with problems associated to humanity's well-being [47]. Two eyed seeing is about drawing upon the strength of WP and IP to help guide humanity through the twenty-first century. It helps to instil pride in Africans and also assist them to build socio-economic and political units equipped to fight cultural poverty and negotiate justice at both national and international levels [49].

IX. RECOMMENTATIONS

Traditional leadership should find ways of demystifying and developing IPK and their IP based technologies. Zimbabweans and Africans in general should reframe experiences of underdevelopment of IP related problems and take that as an opportunity for activism and social change to improve their social and economic positions. There should be social marketing campaigns and advocacy that shift public attitudes regarding IP inclusive of its associated technologies and practices. Furthermore, efforts to correct misconceptions and incorrect ways of reasoning about IPK need to be carried out. Physics dictionaries, and textbooks were complexities and mysteries around indigenous practices should be published and made available to people. Research about IP should be encouraged.

X. CONCLUSIONS:

The qualitative study indicates that people are aware of the existence of IP and its potential in solving their socio-economic problems. The results also show that some emerging and persistent socio-economic problems in communities can be solved by application of IPK which has been abandoned by indigenous people. The participants indicate that it is possible to use IPK if it is developed together with its teaching, learning, and practice. The study recommends the development of IP so that it can be adopted and applied in solving communities' problems.

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