INDIGENOUS KNOWLEDGE TRANSFER: THE CASE OF TRADITIONAL MEDICINE AND AGRICULTURAL PRACTICES

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ABSTRACT

Indigenous knowledge is a natural resource and heritage which need to be documented and transferred from one generation to another. It is embedded with the everyday life of people who produced it so that it is a way of their living and being. It is also a social capital and social asset to solve local problems. It consists of both tacit (implicit) and explicit knowledge. The paper defines indigenous knowledge as a system of knowledge that emanated from the socio-cultural milieu of people and knowledge transfer. The transfer of knowledge and skill from experts to other members of the community is believed to be used. However, knowledge is not transferred as it stands, instead, new knowledge is added to the previous one in each step of transfer, that entails indigenous knowledge is not fixed but dynamic. The purpose of this paper is to explain how indigenous knowledge transfer occurs based on empirical data. The study employed qualitative case study. Data were gathered using semi-structured interviews, informal discussions, and field notes. The voices of respondents were video recorded that were later transcribed verbatim. Thematic analysis was used for the study. This includes both conceptual and relational thematic analysis to make codes and categories. As a result, categories such as apprenticeship learning and learning by doing were developed. Out of these categories a theme of experiential learning emerged. This indicated the conclusion that indigenous knowledge transfer can contribute to the pedagogy of science education if it is integrated and applied in schools. *[African Journal of Chemical Education—AJCE 12(2), July 2022]*

INTRODUCTION

Since the term indigenous knowledge is value laden, it possesses to have different meanings, as a result there is no standard definition of Indigenous Knowledge (IK). However, [1] opines that IK is regarded as Indigenous Science (IS), Folk Knowledge (FK), Traditional Knowledge (TK), Traditional Ecological Knowledge (TEK), Local Knowledge (LK), and People's Knowledge (PK) among others. We can use these terms without considering their hegemonic stances. This is because Westerners tried to define IK by undermining the knowledge and the people who produced it. Accordingly, Westerners define IK as primitive, local, traditional, non-scientific, irrational, and static as if IK is frozen in time and place [2].

Generally, indigenous knowledge (IK) is defined as a form of knowledge and skills that societies develop outside the mainstream scientific knowledge or as a foundation for the scientific knowledge. But this study is guided by Ogawa's definition of IK that refers to it as 'systems of knowledge of nature developed by a culture indigenous to a region or country' [3]. With this understanding, traditional Ethiopian knowledge of nature is IK. Similarly, the mainstream Western scientific knowledge about nature is by itself IK of its scope. Indigenous knowledge is a kind of knowledge and cosmology not only related to the past but also the present [3]. This means, IK is not static and not confined to only original inhabitants as it is widely assumed to be, rather it is dynamic which can be created, modified by any one at any time. Any community can produce IK, rural or urban, original or immigrant based on empirical data or rational ways of knowing [4]. However, [5]

posits the empirical and rational form of knowledge is culture-laden that differs based on a worldview.

Western science (WS) follows reductionist and mechanistic approach using scientific method to knowledge production. For instance, in the reductionist approach there exists separation of humans from nature and separation of nature from culture [6]. On the other hand, knowledge production in the IK is through intimate interaction, and holistic relationship between the social and the physical environment. According to [6], it is this connection which provides mutual or harmonious existence and used to develop context specific knowledge. This basic difference in knowledge production either through connection or reduction has its own role in creating power separation which considers a particular knowledge superior to another. In other words, such power separation marginalizes IK as knowledge in development and education sectors.

Accordingly, the Western science is taken as a remedy for every problem that humans face. This trend in relying on Western science marginalizes other ways of knowing that are different from Western perspectives. In addition, Western science provides narrow and perhaps distorted images of nature [7]. Concerning the nature of WS, it is found to be dualistic in approach based on reductionist and mechanistic worldview, objective, universal, dominant, and culture and context free in its representation. This parameter put in place by WS ruled out IK as non-scientific and with no value except in spiritual realm [8]. This nature of WS together with its asymmetric expansion from the center to the periphery makes science as the only means to understand the world [9]. As a result, the

IK of non-Western people is made to be undermined and marginalized not only by the Western world but also by the local people through the influence of school science.

As science is believed to address nature in a mechanistic and reductionist approach, and objectively, those that are beyond such approach are not covered by science. This invites for an attempt to use other ways of knowing (IK) in approaching the world from a different perspective and this helps to come up with complete and holistic solutions to the recurrence of undermining IK. Among sub-Saharan countries, Ethiopia is a country that has its written language with its own unique alphabet and traditional education. The traditional (indigenous) education covers centuries old experiences embedded with either religion or socio-cultural knowledge [10]. Not only these, but people had also designed and built sophisticated obelisks, buildings, walls, statues, monuments, and technologies. The knowledge and skills were created by the local people without any so-called modern knowledge, skill of mathematics, and engineering. Having seen all these, modern education system should have been founded on traditional education and indigenous knowledge of the people to transfer this sense of knowledge creation to the young generation. This could have helped the present generation to spring from the works of her/his forefathers by following their foot prints. As the saying goes, “When you follow in the path of your father, you learn to walk like him” (Ashanti Proverb), albeit the question of extending the gained knowledge. This is made possible if the knowledge and skills were well documented and transferred. However, lack of documentation and

influences of the dominant western knowledge caused by various factors affected building the indigenous (traditional) knowledge and technologies to stagger with lack of knowledge transfer.

Local indigenous practices regarding traditional medicines, agriculture, and others are not yet fully studied from the point of view of knowledge transfer. As a result, there is scarcity of literature concerning indigenous ways of knowledge creation and transfer in Ethiopia [10], though knowledge transfer of some indigenous knowledge is accomplished in the form of training [11]. Since IK is largely tacitly stored in the minds of an individual in the form of mental model, it can be exchanged with other individuals through sharing of their experiences in the form of practices. Through enhancing tacit knowledge flow by means of practice involving the interaction of humans (socialization), it is possible to transfer knowledge. Hence, it involves the sharing of experiences through practice that makes it better than knowledge transfer in school science where direct transmission of information is done from a teacher to students.

Knowledge transfer in the IK is in the form of situated learning in that it occurred through participation of trainees in an activity useful for their survival. This goes with the conception of legitimate periphery of learning. In such kinds of sharing knowledge, social interaction is mandatory since it creates a context so that individuals can learn by participating in activities. As the trainee is novice, s/he moves from the periphery to the center through active engagement (legitimate peripheral participation). Finally, s/he will be an expert to perform a task in other words; it is a type of learning through observation and imitation [1]. This is a form of learning through practice or by experiencing

the task to accomplish it correctly as observed from the experts. Hence, it is a form of performance-based learning. This paper presents issues that trigger the rethinking of documenting IK as Chiro and indicates the extent of their integration with the school science.

Statement of the Problem

Despite the importance of indigenous knowledge as a foundation for improved learning progression, the indigenous knowledge practices in general and those of traditional medicines, agriculture, and others relevant IKs are not yet fully studied from the point of view of knowledge transfer, and in the Ethiopian context. As a result, there is scarcity of literature concerning indigenous ways of knowing and knowledge transfer in Ethiopia, and the integration of IK in the school science is scanty. In support of this the recent general education curriculum framework of Ethiopia [20] indicates as one of its aims 'utilizing indigenous knowledge and skills for the advancement of the self and the society' (p.4). Nonetheless, Ethiopia is one of the old civilizations in the world that had proven legacies of advancement that could form the base for the need to elaborate IK. To date there is excessive use and dependency on traditional medicines in many parts of the Country. But, either these forms of knowledge are in the minds of individuals or are not in any ways integrated with the school science. This delved the impetus to conduct this study. Since there are wide areas of coverage with respect to traditional medicine, this study tried to limit itself to an area called Chiro.

The objective of this study is to investigate knowledge transfer among elders in Chiro district and to see its implication to science education.

In line with the above objective, the study sought to address the following research question:

1. How does indigenous knowledge transfer look like among elders?
2. What implication does it have to science education?

RESEARCH METHODOLOGY

The study used transformative participatory paradigm (TPP). Researchers concerned with indigenous knowledge usually focused on social justice and transformation. As a result of this relationship between transformative participatory paradigm and Indigenous knowledge, we used the TPP to be appropriate to guide the process of the study. Therefore, we approached the participants from a TPP perspective using sociocultural theory of [12] as a theoretical lens and Ubuntu as conceptual framework. The application of sociocultural theory and Ubuntu helps to have a productive relationship with the participants through respecting their socio-cultural values.

The study employed an exploratory qualitative case study that enables to explore the issue from the participants' perspective and is important to help their voices to be heard. The study area was Chiro. Chiro is in West Hararghe, Oromia Regional State, Ethiopia It is located some 330 km to the east of Addis Ababa. The following are some of the reasons for choosing this study area. First,

the area consists of both indigenous and invasive plants including traditional medicinal plants. Second, traditional medicine practices are commonly practiced in the district where I also was one of the beneficiaries. Third, the familiarity of the area to the first author is another criterion since I worked there as a schoolteacher.

The target population encompassed elders (healers and farmers) who are expected to have the required knowledge and skills accumulated through time. Accordingly, five male elders of 50-70 years of age were selected as samples using snowball and purposive sampling techniques. Data collection tools include semi-structured interviews, focus group discussion, field notes, and informal discussions.

Data analysis involves thematic analysis. Conceptual analysis was used to inspect the data to determine the frequency of certain words appearing in a text to be represented as codes and similar codes are clustered together to form categories used to give themes and patterns during relational analysis. The excerpts from the verbatim and field notes are presented based on their potential and representativeness to answer the research questions.

The data are presented in the form of direct quotations and the report on the data were analyzed in a narrative form to present the findings of the research. To ensure trustworthiness we used long terms and repeated observations at the research site and the data were examined repeatedly to ensure the voices are explored exhaustively. In addition, the use of different data collecting methods and member checking and forwarding follow up questions were used to ensure the

credibility of the research findings. Debriefing was also used to ensure the credibility of the data. Detail description of the methods used, thick description of the process and the data, and being objective about the data collected are some of the measures which are taken to achieve transferability.

In this research work pseudo names for participants are used to ensure their anonymity and elders are referred as Obbo, as is appropriate to address older people in the Oromic custom. Accordingly, the categories are used as subtopics as seen hereunder.

RESULTS

Apprenticeship Learning

Knowledge transfer to someone they want to transfer is based on community of practice as the following excerpt represents it.

> *The elders ask us to follow while they are going to collect medicinal plants, order us to buy some from the traditional drug shops even from markets after that once we are examined to be trustworthy, they show us how to prepare drugs from a particular medicinal plant and gradually order us to provide patients drugs by preparing according to the dose. By doing so, we can learn first from elders by spending many years and gradually upgrade the skill through experience.* (Obbo Mohammed, 14/1/20)

From the above excerpt, we can understand that knowledge transfer in the IK is through oral explanation and demonstration; hence it is a form of apprenticeship. It involves learning through practice. Informal discussion held with this elder disclosed that: indigenous knowledge transfer has strong link to learning practical skills which are useful to individuals and society [11]. The elders

consider certain criteria while they determine to transfer the knowledge to someone up on an old age or illness that risks them to death as follows.

How could you transfer the knowledge that you have to others?

> *Before we transfer the knowledge either to our elder sons or anybody willing to have this knowledge, we examine the character of the individual. And we should ensure that the person is loyal, honest, and can serve the society without abusing them. After we make sure the individual fulfills strong attachment to God and other things, we allow the individual to approach us. In this field you know there are some who are abusing people by asking much money, do harm against others by receiving money from their enemy, etc. Thus we should be more careful in transferring our knowledge but once the individual is found innocent and curious to know the knowledge and is willing to serve the people, we can do whatever we can to help him learn from us*. (Sheikh Jibril, 11/1/20)

As the above excerpt shows knowledge transfer follows certain procedure in TM practices such as being the eldest son, curious to know, being honest, loyal, having a sense of humanity not to harm the society, and being spiritual. Only individuals who can fulfill these criteria are the ones allowed to approach to elders and get trained. Otherwise, they will not transfer the knowledge to any layman. They do this because some irresponsible people who are not developing expertise on the field and pretend to be healers can abuse the knowledge and the people. These irresponsible ones can mislead people without knowing the correct medicinal plant for a particular disease and even they may harm people. By doing so, they probably make the names of true healers to spoil on the eyes of people as a result people may lack trust on the true healers. Due to this reason and others

such as the widespread use of allopathic medicines, the number of traditional healers decreased. Not only healers are declining in number but also the knowledge started to dwindle.

As a result, some known healers died without transferring their knowledge fore fearing that these individuals can harm innocent people [13]. This is humanity (Namummaa, Ubuntu) by itself [17]. They want to transfer their knowledge to those who are selected to be true healers by observing their characters such as loyalty, honesty, hospitability, having humanness, spirituality etc. These criteria for an individual to be a healer show that those individuals who can serve the people using MPs and other things like animal parts should exhibit the principles of Namummaa (Ubuntu). As Ubuntu is an African religious and code of conduct or ethical base that healers should exhibit, Namummaa did the same for Oromo people [9]. Those who are robbers and thieves are simply deceiving people to fulfill their self-interest and give priority to their individual interest than the community.

According to an informal discussion held with a participant he said that:

> *If they get the right persons, they take them to the wild where medicinal plants are found and order them to collect and handle the plants following their instruction, bring home and plant in home garden if possible. They tell them which plant and its parts are appropriate for which disease and show them how to take the required parts of the medicinal plants including how to prepare, store, and limit the dose. Gradually when they are sure they developed the required expertise they order them to administer drugs in case of their absence.* (Obbo Mohammed, 14/1/20)

Elders have shared responsibility for training their disciples and learning and on the part of the trainee they are expected to perform by imitating and practicing. Healers ask the trainee to fetch

drugs from the local market if the MPs are not found from the wild and help him to develop his knowledge and skill. This is a form of apprenticeship learning through legitimate peripheral participation.

Sometimes when they are absent for some kind of social chores, and when the elder thinks that the trainee is able to deliver the service, he asks him to serve the people seeking the services. Thus, the trainee learns by performing every step starting from collecting MPs, knowing the specific types and their parts, diagnosing the clients up to administration of the drugs. Such knowledge cannot be completed all at once instead it is a lifelong learning so that it is up to the individual to continue improving the knowledge through experience even while he is giving the service, embedding experiential learning.

Such individuals are mostly intelligent and store the tacit knowledge in their own mind and can remember because they have curiosity to think and perform the necessary procedures. They also develop it through continuous engagement. Even when the elder is at home, he orders the trainee to prepare the drugs out of medicinal plants as shown and he is learning by performing it which cannot be forgotten for life. It is a kind of training or apprenticeship where the individual is first approaching the expert, try to fetch something, buy and collect plant materials when ordered by the expert, gradually he starts to do or perform according to the instruction that he has received and begin to do it as the expert did. Finally, though the training is not formal to be awarded with certificate, the

trainee can start his own service by improving and researching new methods and new medicinal plants depending on his/her creativity. Social acceptance is also their certification.

Sometimes formal instruction could be given when the trainee makes mistakes [14]. While they are transferring the knowledge it is just a relay, in that the knowledge is transferred in subsequent steps from one generation to other in the form of training, however, knowledge is not transmitted as it is. In each step some improvement is made so that some knowledge is added on it. It is a form of creating new knowledge, at least improvisation. Moreover, indigenous knowledge is not the possession of individuals even if individuals create knowledge, they will make it community's property through sharing or transferring. This is explicated by the next excerpt.

> *Once an individual develops some knowledge or technology, he/she shares among the people, and we discuss about it and if possible, we make some improvement.*

The community's knowledge is kept by knowledge custodians either shared among them or transferred to their disciples through apprenticeship training to make this knowledge part of their daily life. However, the present generation is not willing to heir this time long and valuable knowledge because of generation gap created between old people and youths. Informal discussion with an elder has confirmed that.

> *Only few youngsters are coming to us and show their curiosity to tap this knowledge and we are worried about the future whether the knowledge will continue.*

Their worries are true because as most healers are old people, whenever they die there may not be any one to inherit and pass on the knowledge to the next generation. And it is time to explore and document this valuable knowledge to integrate with modern systems of medicine and science education to ensure its continuity. Science/biology curriculum should create a space for the integration of IK to document and even transfer to the next generation. The inclusion of IK to the formal curriculum is also proposed by the Ministry of Education of Ethiopia.

Above all, it is the responsibility of the youths to inherit it, maintain it, innovate it, and pass to the next generation. As Odora-Hoppers said, it is our wealth, and we should not neglect because it is our heritage [15]. We must respect what we have and develop it to provide the service in a more efficient ways. We have to stop seeking solutions to our problems from others and if possible, we have to integrate it with other knowledge system to get synergy and in this way, we can contribute for the global knowledge economy. However, the young generation undermines this knowledge and seeks solutions for local problems from outside and hate to learn this knowledge as if they become primitive, spurious, and back ward, as they think it to be [16]. But our solutions are at our hands since our problems are different from theirs.

Concerning the traditional knowledge, the learning of this knowledge is lifelong because it is associated with everyday life to be learnt throughout life and is contextual (situated). It is related with the actual life of the elders and elders are responsible to transfer it as they are the custodians [11]. We can infer this idea from the following excerpt.

One of the discussants disclosed that (a developmental agent)

> *We are not in a position to transfer the knowledge; instead, it is the duties of the elders who over time collate more knowledge and skill. And it is a requirement for the young generation to respect, spend time with them and give the required dignity to elders to get the knowledge and skills necessary to make them competent in the community. Elders are responsible to transfer knowledge of the community to the young generation in the form of training.* (Obbo Nuredin, 20/3/20)

According to the above excerpt, elders are responsible to transfer IK to youths. Learning of IK is life long and needs therefore a form of apprenticeship effected by training. It is as such necessary for the young generation to fulfill certain criteria such as respecting elders, spending time with elders, giving the required emphasis to traditional knowledge to be full members of a community and to lead their life accordingly. It is also a sign of respect to ask elders about any knowledge. Thus, youths have to learn competencies as performing traditional medicines and agricultural practices which are knowledge and skills of the community through observation, demonstration, and performing to have meaningful role in the community. Equally important is elders have shared responsibility to train youths on certain competencies that youths are required to have. Youths have to perform practically what are orally explained depending on their age and stages of development. It is usually boys who perform traditional medicines and agricultural practices [11]. Therefore, traditional education is job and gender specific; however, women are also involved in many of the medicinal and agricultural practices even if they are not trained directly like boys. Most learning is done through observation and applying practically so that it is a form of active learning

or student-centered learning which participate learners in the whole process of learning and is different from what students are experiencing at school as we can see it next.

Learning by Doing

The involvement of learners in acquiring IK, elaborated above is apprenticeship form of learning. Equally, the engagement seeks learning by doing. Respondents were asked how they transfer their knowledge and skill. In response, one respondent noted:

> *Knowledge is the property of the people, and everybody knows what we are doing here. There is a free flow of knowledge among the community. If somebody discovers something, he/she will show the new thing to the elders and friends, and all involve in discussion about the new thing and devise a means of applying it to the farm and see the result. If the new discovery is fruitful, the whole people will apply it and become the beneficiaries.* (Obbo Seid, 28/3/20)

The above excerpt shows that knowledge is community's property and there is no individual sense of ownership. The knowledge can be transferred by means of demonstration and doing. After its practicality is validated as useful knowledge, it becomes community's property through sharing. Knowledge transfer according to this discussant is open to anyone who needs it as he has dealt about traditional agricultural practices. If it were a traditional medicine practice, it should have been transferred only to someone who fulfills certain criteria. However, elders are responsible to transfer the knowledge because a person with an old age means, he/she knew more than youths so that they have to teach the young generation as they reach the required age.

Here in the rural areas, children perform different activities depending on their age. When they reach the required age to perform agricultural practices, their fathers or elders in the community teach them how to perform the skills which are vital for their later life while they become farmers. However, it was learned that traditional education is gender specific which discriminates youths based on their sex and other contingent criteria. Accordingly, boys and girls are only obliged to do something based on their age to play his/her role as husband and a wife [11]. This is against the contemporary notion of gender equality.

Here teachers are the elders and school is the open environment (under the trees) and education is holistic and prepares the youths for life. Because of this reason trees have values among the local people, they can be places where they discuss and solve their problems individually or communally, serve as sacred places and they serve also as places where people exchange knowledge among each other [17]. And it is the community's responsibility to make youths to be efficient performers of life skill practices such as traditional medicines and farming, behaving in terms of communities' norms, values, and cultures. Unless youths are learning traditional knowledge, it is very difficult to produce people who can maintain the knowledge and skills which are expected of them.

Therefore, elders who are knowledge keepers and transferors should gather girls and boys and teach what they need for future life irrespective of their gender. This can ensure the contribution of both girls and boys to the sustainable life of the community.

Shekh Jibril also expressed his view about how knowledge is transferred as follows.

> *I transfer the knowledge that I have to others if they have a need to know it. You are an example you came to me and told me that you need the knowledge for educational purpose and after I have seen your letter and I became convinced that you will not use it for other purpose and shared you what I know hoping that you will do something good for the promotion of the knowledge in education and it is up to you how to use it.* (Sheikh Jibril, 11/1/20)

The above excerpt shows elders are willing to transfer their knowledge based on willingness and on purpose. They need to know first for what purpose individuals need to use it because there may be people who abuse the knowledge. They need to protect the knowledge from abusers since some individuals abuse the people by acting as true healers where they are not. As a result, elders are committed to transfer their knowledge and skills to those whom they knew very well. He continued to tell that:

> *Here are two people who learn 'Quran' with me and show great interest towards traditional medicine among other disciples. They want to follow my footstep and do whatever I order them and after I have seen their interest and good behavior, I allowed them to observe what I do.*

During the time of the interview, the two disciples were there, listened and saw what the Sheikh was doing. This is how the knowledge is transferred and improved from time to time. Knowledge transfer of the IK is usually done by oral transmission. It is observational by demonstrating their expertise practically and this was evident during the interview which was conducted with the elders. For instance, the community knowledge held at the hands of the elders

was exchanged with the interviewer researcher through oral description, explanation, and demonstration. They were demonstrating how they were preparing the drugs, which ingredients are combined at what concentration, what amount is given at a time and at what interval. But the interviewer simply observed without involving in the activities. On the other hand, when it was conducted to others who need to follow their footsteps, they learn by observing, performing, or doing practically what they observed from the elders. Hence, it is a form of learning by doing.

Learning in the IK is practice based embedded with the life of individuals which is different from the formal schooling. In science education, which is confined to classrooms, students are separated from the nature, culture, elders, and the environment and acquire knowledge as fixed but not as wisdom. Indigenous knowledge transfer is purposive in that people become curious to know the local plants and animals based on their use as food, medicines, fuel, etc. This knowledge is usually transferred to others through learning by doing. Therefore, for meaningful science learning to occur, IK has to be integrated with school science to get all the above pedagogical benefits accorded from the IK.

Based on the analysis of data on knowledge transfer one theme was developed from the categories. Accordingly, knowledge transfer is experiential or practical. Thus, the analysis of data showed that the local community contributes a lot to science education in terms of the way knowledge is transferred. As a result, it is better to apply such techniques to science/biology

education to enhance its quality and is also an advocacy for the contribution of the local people to biology education by making it contextually relevant and meaningful.

DISCUSSION

The discussion proceeds based on the theme that emerged during the analysis of data. The result of this study is in confirmation with O'ocnnor's explanation in that learning in the indigenous education is related to life-skill training where the trainees are required to observe, imitate, and develop expertise on specific fields by doing [18]. In association to these, the indigenous knowledge transfer is equivalent to project work where the trainees are learning in the outdoor to perform a specific task through practice. As a result, experiential learning is significant to prepare youths for employment because it is job or purpose oriented [18]. During such training, if they do any mistake, they will be given warning followed by formal instruction hence, knowledge transfer includes both informal and formal instructions. Such an education is performance oriented which is accomplished by doing with the involvement of the mind and the sense organs and is hands-on and minds-on.

Since indigenous education is related to the survival of the community, it involves observation, imitation, utilization, and respect to nature [18]. Thus, observation is the first step in knowledge transfer (learning) and next the trainees learn how to perform the task by themselves through repeated practice occurring in an open space. This type of learning is experiential, and learners can make meaning from experts and from their experiences to make it lifelong learning. The

result is also in line with Dlamini who explain that while elders train their disciples, they are converting their tacit knowledge to explicit knowledge through observation, oral explanation, and demonstration [19]. This means knowledge is reduced into information that can be codified and easily transferred to others. Through conversion of tacit to explicit knowledge, one can share his/her knowledge to others.

Hence, indigenous pedagogy is experiential accorded with legitimate peripheral approach and through practice-based learning and considers IK as a living process important for their survival [1]. Such a pedagogy unlike the transmissive ways of learning allows a student to explore his/her unique learning style, abilities, and pace of learning [1]. The teaching and learning process in schools did not incorporate indigenous ways of knowing (learning). According to [1], such methods of learning include, observing, listening, and participating with a minimum of intervention and instruction. It is self-controlled or self-regulated learning where students take responsibility for their learning like constructivist approach to learning. In indigenous education, apprentices are directly engaged in learning process by doing under the guidance of experts. Here, learning is not designed to pass examination but to know how to do a specific task and survive because indigenous knowledge is a means of living and a way of being. Therefore, indigenous education which is based on experiential learning is like constructivism [18]. We argue that this form of learning or transferring knowledge should be applicable in science education for students to ensure meaningful learning and to help them transfer their learning into authentic situations.

CONCLUSION AND RECOMMENDATIONS

Indigenous knowledge refers to knowledge attached with everyday life of people who produce it. It is produced based on the worldview and socio-cultural background of people. Indigenous knowledge is tacit which is embedded with practice and experience of individuals and can be transferred with others through tacit knowledge flow, largely converting the tacit to explicit and from knowing to doing. There are few individuals who are knowledge and technology creators. They are specialists who are endowed to make solutions to problems of their generations. Although these individuals create knowledge, through discussion and dialogue (transfer) with other members of a community, they make knowledge the property of people. Regarding traditional medicine, healers consider certain criteria to keep the knowledge from abusers while they transfer the knowledge to someone up on old age or illness that risks them to death.

Knowledge transfer in the IK is done by oral transmission while they are discussing the new idea and is also observational through demonstration of their expertise experientially. Thus, IK is transferred through apprenticeship training and learning by doing which gives it the nature of an experiential learning. Moreover, the indigenous knowledge transfer is job specific meaning it is purposive. Therefore, it is mandatory to integrate IK with science subjects and courses to utilize methods of IK transfer as pedagogical tool for effective science instruction, and to strengthen the link between schools and the community. Indigenous knowledge besides providing contents to

science subjects and courses it also contributes in terms of pedagogical (instructional) method to provide PCK for meaningful learning of science.

Hence, it is possible to recommend that indigenous knowledge has to be integrated with science subjects and courses to gain all the benefits of IK.

It is indicated in the recent general education curriculum framework [20] that IK need to be integrated in the school curriculum, but it is wise to explore, organize and document the available IK to be able to integrate meaningful IK that is context relevant and age appropriate.

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