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Validation of Indigenous Knowledge Practices Among Teachers in Lower Secondary Schools in the Central Region of Uganda

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Abstract

This study employed a cross-sectional survey to explore the underlying hypothesized measurement model structure of the concept of Indigenous Knowledge. A self-administered questionnaire with 45 items was piloted on a sample of 456 respondents of both private and government secondary schools of the central region in Uganda. A Principal Component Analysis (PCA) was done on a sample of 456 respondents to extract a five-factor dimension of Indigenous Knowledge which includes processing of foods, oils, fragrances, and pesticides; food harvesting and crop storage; food preparation; environment protection; and medicinal herbs. Initially, the Indigenous Knowledge construct consisted of seven sub-constructs with a total of 45 items. Data from A sample of 732 respondents was further collected after a pilot study to facilitate a confirmatory factor analysis (CFA) of structural equation modelling (SEM). CFA further confirmed that Indigenous Knowledge is a five- multidimensionality construct. The findings diverge from previous studies, which indicated that Indigenous Knowledge is measured by seven sub-constructs. In conclusion, the underlying factors of Indigenous Knowledge may vary across studies, and future longitudinal studies are recommended to further explore the consistency of these findings with an emphasis on the measurement and conceptualization of the construct.

Keywords: environment protection, exploratory and confirmatory factor analysis, food preparation and processing, fragrances and oils, Indigenous Knowledge, medical herbs

Integration of Indigenous Knowledge into the education system has become a focus for educationists and gained global attention due to its relevance and the deep-rooted knowledge systems that guide human existence and interactions with the environment. Today, the world faces numerous challenges, including environmental degradation, climate change, and societal issues that were previously unseen. These emerging problems have driven scholars in education to explore how past generations managed to survive and protect both the environment and human life. This paper introduces the concept of Indigenous

Knowledge, focusing on its underlying structure within lower secondary school curriculum in the central region of Uganda.

Conceptualisation of Indigenous Knowledge

The concept of Indigenous Knowledge has overtime led to divergent opinions among researchers for instance; Indigenous Knowledge is termed as a product of the surrounding environment upon which the foundation ideologies of our societies are formed (Huaman & Brayboy, 2017; Mawere, 2019; Zidny et al., 2020). It is the conceptualization of skills and philosophies developed basing on long histories of interaction with the natural surroundings based on local societal theories and models. Indigenous Knowledge is also the basis through which local communities formed decisions based on the fundamental aspects of human life, or it is the knowledge developed by local people basing on natural phenomenon to predict human sustainability in complex and uncertain situations (UNESCO, 2021).

Also, Indigenous Knowledge can refer to a unique system of knowledge transferred from one generation to another by a particular group of people through use of oral traditions such as folklores, traditional songs and dances, myths, and rituals (Adam et al., 2021). Since the transfer of this knowledge is achieved through actions and statements, many studies have been done using different models to establish its measurements for example, in a longitudinal study done by Bala et al. (2022) on Digital Socio-Technical Innovation and Indigenous Knowledge, done on communities in the Borneo Malaysian states of Sarawak and Sarawak and the Oran Asli communities in Peninsular Malaysia, it was established that when Indigenous Knowledge is integrated with contemporary system of education, it can provide solutions to the complex situations facing humanity through the use of problem-solving scenarios.

The same study indicates that, human challenges are solved through the use of socio-technical innovation model (community learning connector based on activity-based mentoring, guided learning scenarios, tacit knowledge link and memory snapshots). It is therefore important to train teachers with skills of knowledge integration to prepare learners imbued with their Indigenous Knowledge practices to address the 21st Century challenges (Miiro & Baguma, 2023; Miiro, 2022).

Since Indigenous Knowledge was a basis for making decisions regarding food security, education, natural resources management, animal health and other important activities that shape human life, it is indiscriminative in nature and thus Indigenous Knowledge acts as a social capital and constitutes the main assets for control of human lives (Dansu, 2023).

A qualitative study done by Adam et al. (2021) in Kota Belud, Sabah using semi-structured interviews on six informants reflected that Indigenous Knowledge was transferred to other generations through collaboration methods, establishment of cultural centres, social events and implementation of cultural law. However, there were serious challenges that hindered this process for instance change of religious beliefs and indigenous livelihood practices, contact with both dominant and non-indigenous groups, and the economic development pressures. The purpose of this study is to examine the underlying factor structure of Indigenous Knowledge in the lower secondary schools in Central region of Uganda.

Janardhanan et al. (2018) in their paper Eco-resurgence for Asia: Invoking Indigenous Knowledge and Philosophy to Shape Economic Recovery and Sustainable Living, suggest that learning cultural philosophies and traditions will help Asian countries to survive in the emerging uncertainties in the world. This study suggests that Asian countries should integrate mainstream curriculum with Indigenous Knowledge and this should be achieved through collaboration in promoting and pooling good practices from Indigenous Knowledge and its philosophies at all levels of education. A study done by Zidny et al. (2020) on a multi-perspective reflection on how Indigenous Knowledge and related ideas can improve science education for sustainability, they suggest different models of teaching and learning to cause innovative behaviour among learners. Therefore, it is imperative to integrate contemporary science education into Indigenous Knowledge so as to develop a more balanced and holistic worldview, intercultural understanding, and sustainability among learners. This is done to increase the connections of the teaching of science to the everyday life of students and society (McGinty & Bang, 2016).

The concept Indigenous Knowledge was used by communities to control hunger, environmental degradation, diseases and poverty. The challenges facing humanity today are a weakness of western modern sciences which has failed to provide a permanent solution to society, thus giving a profound background to integration of Indigenous Knowledge into the curriculum to cause innovative behaviour (Torri & Laplante, 2009; Zidny et al., 2020).

Modern scientists have acknowledged that indigenous science was used to protect nature for instance; indigenous soil taxonomies, soil fertility, agronomic practices (terracing) like organic fertilizers application, crop protection, contour banding, multi-cropping, conservation of soil and water, and ant-desertification practices (Higgs et al., 2004; Torri & Laplante, 2009; Zidny et al., 2020). Unfortunately, total education cannot be achieved without employing new ways in the curriculum and pedagogy beyond science theories and facts (Miiro & Otham, 2016). Integrating Idigenous Knowledge and science gives learners chances of interacting with their surrounding environment and nature (Yazidi & Rijal, 2024), when this happens there are higher chances of students to think logically, responsibly, critically, and creatively in responding to community challenges paused by the impact of science and technology on life and society (Handayani et al., 2018).

Tharakan (2016), in a study on Indigenous Knowledge systems for appropriate technology development states that Indigenous Knowledge and their systems prepare learners to understand the foundation of their culture and appropriate technologies that were used to protect basic water needs, sanitation and agriculture. These compilations regarding Indigenous Knowledge were done in only two countries; China and India.

Through the historicisation of Indigenous Knowledge, it is observed that four philosophical issues are emphasized. These four philosophical questions include; where did I come from? how did I come here? Why am I here? and where am I going? These questions frame the kind of knowledge that an individual is exposed to at a given stage in life. The emphasis is however more on the purpose of life. Based on this background it can be noticed that learning was more of nurturing, upbringing and preparing a community child for the society to advance community transformation and development.

In recent years, there has been a growing realization that integrating Indigenous Knowledge into formal education can lead to more meaningful and contextually relevant learning experiences for students worldwide (Chisholm & Leyendecker, 2008; Muthee, et al., 2019; Un, 2012). Likewise, the Ugandan education system has made efforts to incorporate Indigenous Knowledge into the curriculum, recognizing its potential to enhance students' understanding of local contexts, foster cultural pride, and promote sustainable development. For instance, the National Curriculum Development Centre (NCDC) has been actively involved in integrating Indigenous Knowledge into the curriculum (Tabuti & Van Damme, 2012).

The NCDC has collaborated with indigenous communities and experts to identify and document Indigenous Knowledge systems, and has developed curriculum guidelines and learning materials that incorporate indigenous perspectives and practices in some of the subjects like history, agriculture, and local and foreign languages. This has been to ensure that Indigenous Knowledge makes more meaning to the 21st century teacher and learners. However, the gaps for effective incorporation of Indigenous Knowledge into the curriculum and its implementation are still lacking a measurement model to guide the process. Therefore, the purpose of this study was to validate Indigenous Knowledge practices at the lower secondary education level in central Uganda.

Types of Indigenous Knowledge

Indigenous Knowledge is embedded in various spheres of human life, including geographical, social, economic, and political aspects. According to Gupta (2012), Indigenous Knowledge encompasses technologies, natural resources, informal and formal education, human resource preparation and management, beliefs, and material apparatus. Much of this knowledge remains undocumented, making it difficult to transmit effectively. Mwebesa et al., (2007), in their study on Collaborative Framework for Supporting Indigenous Knowledge Management, employed techniques such as modelling unstructured environments, collaborative frameworks for knowledge management, knowledge elicitation, and tacit knowledge representation. Their results emphasized the importance of advancing a framework with a valid and credible structure to guide the integration of Indigenous Knowledge into mainstream education.

In Uganda, the recognition of Indigenous Knowledge in the education system is influenced by the country's commitment to promoting cultural diversity and inclusivity (Adyanga, 2014; Ajwang, et al., 2023; Rosnon & Talib, 2019). However, these efforts will only be impactful if teachers are equipped with the knowledge of the dimensions that guide the implementation of an Indigenous Knowledge framework to address societal issues. Thus, this study aims to bridge the knowledge gap by exposing teachers to both Indigenous Knowledge and educational needs that enhance teaching and learning (Adam et al., 2021; McGinty & Bang, 2016; Zidny et al., 2020).

Problem Statement

In general, the concept of Indigenous Knowledge has impacted on the development of different communities worldwide and this has been acknowledged adequately in research. However, most studies have not focused on the measurements for the concept of Indigenous Knowledge (Ugulu, 2013). Orlove et al. (2010) indicate that most of the studies so far have focused more on preservation and transmission of Indigenous Knowledge with emphasis on attitude formation and behaviour from one generation to another. Whereas defining and measuring the conceptualization of Indigenous Knowledge is important towards education for socio-economic transformation, its conceptualisation has led to inconsistences and major flaws in studies linking it to education. Thus, generating conflict and variation among researchers in defining and measuring Indigenous Knowledge.

Indigenous Knowledge has become an important matter towards preservation of humanity and its surrounding though many studies have not focused on the validation and interplay of processing of foods, oils, fragrances, and pesticides; food harvesting and crop storage; food preparation; environment protection; and medicinal herbs all of which are closely linked to the concept (Takeuchi & Shaw, 2009). It is important that validation and confirmation of its measurement scale are carried out so as to guide future studies, a factor that has been overlooked by many emerging studies on the concept of Indigenous Knowledge today. A number studies (Da Silva et al., 2023; Kezabu, 2018; Magara, 2015; Kagoda, 2009) have been done on the incorporation of Indigenous Knowledge into the education system of Uganda due to its valuable resource for enhancing the relevance and effectiveness of educational programs, life and transformation of communities. However, studies on the validation of true parameters and theoretical frameworks for its implementation seem to be scanty, yet the background of Indigenous Knowledge in education in Uganda seems to be diverse due to a range of indigenous communities, each with its unique cultural heritage and knowledge systems (Ajwang et al., 2023; Huaman & Brayboy, 2017). These communities have developed extensive knowledge and skills in areas such as agriculture, traditional medicine, religion, natural resource management, and craftsmanship among others which have been passed on through oral traditions and experiential learning. since Indigenous Knowledge has become a focal point of reshaping future education systems, this study sought to develop, validate and establish reliability of Indigenous Knowledge measurement scale to guide its integration into education systems.

Given the background provided, this study sought to determine whether factors such as processing of foods, oils, fragrances, pest control, planting and mulching, harvesting, post-harvesting, crop storage, entrepreneurship, food preparation, environmental protection, and medicinal herbs are the true underlying elements used to measure Indigenous Knowledge practices in lower secondary schools in Uganda's central region.

Objectives of the Study

The objective of the study was threefold;

1. To identify the major factors that explain the structure of Indigenous Knowledge among teachers in lower secondary school in the central region of Uganda.
2. To establish the validity of the Indigenous Knowledge construct measurement scale based on the data obtained.
3. To confirm whether Indigenous Knowledge construct is measured by the sub-constructs: processing of foods, oils, fragrances, and pesticides; food harvesting and crop storage; food preparation; environment protection; and medicinal herbs.

Theoretical Framework

This study draws its theoretical framework from a mixture of previous studies done on the concept of Indigenous Knowledge mainly; (Ugulu's (2013) notion of traditional knowledge as three multidimensional concept – Attitudes toward plant and animal knowledge, Attitudes toward traditional medicine knowledge and Attitudes toward general environmental knowledge, and Orlove et al.'s (2010) conceptualisation of Indigenous Knowledge that centres on Commercial land use, Crop harvest, Environment protection, and Medical herbs and traditional crops. In the context of this study, lower secondary school teachers were asked if they knew what constitutes Indigenous Knowledge, its nature and its impact on learners' holistic development towards socio-economic transformation of their communities. However, there was no well-grounded study to measure the seven sub dimensionalities of Indigenous Knowledge as reflected by different studies reviewed. Thus, giving this study, a firm foundation to use the two studies and examine the underlying structure of Indigenous Knowledge.

Methodology

Research Design, Sample Size, and Instrument

The study utilized a cross-sectional survey design within a quantitative research paradigm. Data were collected from randomly selected 456 teachers in private and government secondary schools across Uganda's central region. Section A of the questionnaire included Sex, class taught, subject, name of the school, name of the district, and county/Municipality as demographic variables.

Section B of the Survey tool covered the seven sub-constructs as described above, with 45 items.

Data Collection and Cleaning

Permission was obtained from the Uganda National Council for Science and Technology (UNCST) and individual schools before distributing 600 questionnaires, of which 468 were returned (78% response rate). After cleaning, 456 responses were deemed valid. Data screening included outlier detection and normality tests to meet the prerequisites for multivariate analysis.

The numbers of participants which were found with serious issues were eliminated before normality test. Out of the 460 returned questionnaires, four outliers were eliminated thus qualifying 456 for further analysis. This is a pre-requisite for a researcher that intends to use multivariate technique in his or her research (Ibrahim et al., 2014). This helps the researcher to have a deeper understanding of what has been gained from the field.

To arrive at normality checks and outliers, data was computed first using SPSS to attain items that measure the underlying dimensionalities of each of the variables (Ary, at al., 2010). Data normality was attained through the use of regression technique. The data further indicated that four items were about the threshold of 13.8 Mahala Nobis distance levels thus deleting them to avoid exaggerated figures. This was done to ensure that the robust technique of exploratory factor analysis gives results that address the objectives of the study.

Before exploratory factor analysis, a descriptive analysis was examined to expose the reader to the demographic factors of the respondents that participated in the study.

The sample consisted of 283 male (62.1%) and 173 female (37.9%) respondents, randomly selected from 51 schools in six districts: Kampala (32.9%), Wakiso (23.6%), Mukono (18.2%), Luwero (16.6%), and Kayunga (7.0%). Also, the findings reflected that teachers are distributed to different classrooms as showed below; 54 (11.8%) teach classes that range from one to two only, 37 (8.1%) teach classes from one to three and 365 (80.0%) teach classes from one to four. Meanwhile the subjects taught in these schools showed that 18 (3.9%) teach agriculture, 10 (2.2%) teach Arabic language, Art and design (6.0%), 52 (11.4%) teach Biology, 25 (5.5%) are chemistry teachers, 1 (.2%) teach computer studies, 27 (5.9%) teach Christian religious education, whereas English language is taught by 39 (8.1%), Entrepreneurship reflected 14 (3.3%), 35 (7.7%) are teachers of Geography and 56 (12.3% are teachers of History. Islamic religious education was represented by 11 (2.4%), Kiswahili 6 (1.3%), Literature 6 (1.3%), Luganda 21 (4.6%), Mathematics 49 (10.7%), Physical Education 3 (.7%), Physics 38 (8.3%) and 11 (2.4%) showed that these teach both Christian religious education and entrepreneurship.

From the demographic data, it can be observed that a number of respondents who participated in the study taught both human and natural science subjects. Therefore, it was important to understand that there is Indigenous Knowledge in each of the subject domains.

Principal Component Analysis (PCA)

PCA was employed to identify the dimensional structure of the Indigenous Knowledge construct. Using Promax rotation, the original seven sub-constructs were reduced to five, accounting for 63.8% of the total variance. Items with low factor loadings (<0.5) or multicollinearity issues were excluded (Baglin, 2014; Coughlin, 2013; Ibrahim & Mohd Noor, 2014; Ngure, Kihoro, & Waititu, 2015; Watkins, 2018).

Underlying Structure of Indigenous Knowledge Construct

The construct of Indigenous Knowledge initially consisted of seven sub-constructs with a total of 45 items. However, after conducting Principal Component analysis (PCA), some sub-constructs were removed due to low correlation coefficients (< ±0.5) and a weak correlation matrix. This indicated that these sub-constructs did not exhibit a patterned relationship with the items that had higher correlation values (< ±0.9). After removing items with multicollinearity issues and lower values, the Indigenous Knowledge construct retained five sub-constructs comprising 31 items. This decision was supported by the recommendation that a study with a sample size of 300 or more is considered stable if the factor loadings exceed 0.512 (Samuels, 2016; Taherdoost et al., 2020). Additionally, previous studies (Magara, 2015; Seleke et al., 2019) mainly focused on higher education levels with different variables related to knowledge levels, experience, and research. In contrast, this study targeted lower secondary teachers whose working environments and experiences differ significantly.

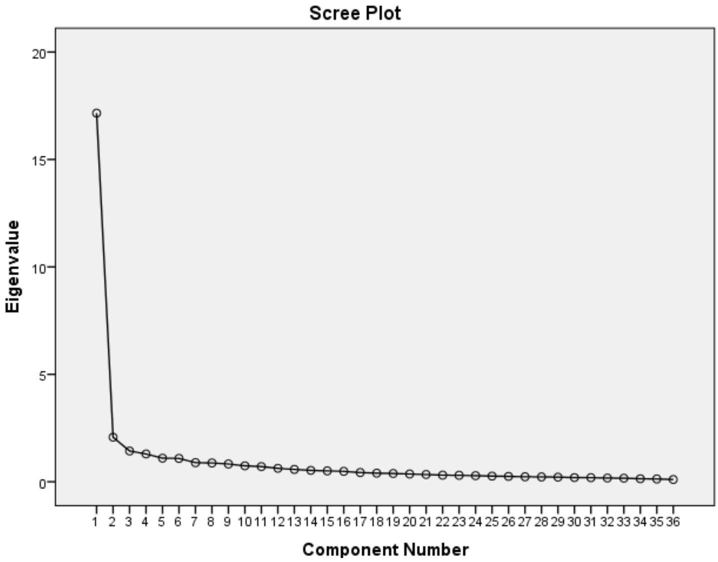
Furthermore, items scoring below 0.5 were excluded, supported by Bartlett's Test of Sphericity (Approx. $\chi^2 = 18483.669$, DF = 990, $p < 0.000$), which indicated no significant relationship among the items. The Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO = 0.934) confirmed that the sampling was sufficient, exceeding the acceptable threshold of 0.7 (Ishiyaku, et al., 2016).

The study findings diverged from prior studies, (Chabaya & Raphinos, (2023); Kaya & Seleti (2013); Pokhrel (2024); which suggested that Indigenous Knowledge is measured by seven sub-constructs: processing food, planting and mulching, harvesting, entrepreneurship, food preparation, environmental protection, and medicinal herbs. In contrast, the EFA results indicated that the construct is measured by five sub-constructs: processing food, harvesting, food preparation, environmental protection, and medicinal herbs.

To further validate the underlying structure of the Indigenous Knowledge construct, a scree plot (Figure 1) was analysed, confirming the retention of five factors. The total variance explained by these five constructs was 63.8%, supporting the study's findings and ensuring the construct's reliability.

Figure 1

The Underlying Five-Factor Structure in the Scree Plot



Therefore, the construct Indigenous Knowledge is a five factor dimensions as shown above. This is because the factor loadings for each of the factors were above 0.5 without cross loadings amongst them. The details of the five factor loadings with their respective item's eigenvalue, total value explained for each and communalities are indicted in the Table 1.

Table 1

Factor Loadings, Eigenvalue, Total Variance Explained and Communalities of the Five-Factor Structure of the Indigenous Knowledge Construct

Factor and item	Factor Loadings	Eigenvalue	Total variance explained	Commu nalities
Processing of foods, oils fragrances and pest sides		**17.1**	**43.2%**	
I teach students plants that generate natural pesticides	**.584**			**.486**
I teach my students how to manufacture oils from plants	**.577**			**.674**
I teach students how to generate herbal medicine from plants	**.675**			**.729**
I teach students different resourceful plants for health	**.677**			**.736**
I teach students how to manufacture local juice and alcohol	**.784**			**.730**

Table 1 (continued)

Factor and item	**Factor Loadings**	**Eigenvalue**	**Total variance explained**	**Communalities**
Harvesting, post harvesting and storing crops		**2.07**	**7.1%**	
I teach students how to prepare gardens before planting crops	**713**			**.777**
I teach students how to plant crops	**.750**			**.781**
I teach students different ways of weeding plants	**.768**			**.832**
I teach students how to harvest crops and keep them after (post-harvest handling)	**.750**			**.803**
I teach students how to dry crops	**.506**			**.251**
I teach students ways of storing harvested crops	**.636**			**.734**
Food preparation		**1.43**	**5.8%**	
I teach students names of traditional food	.668			.710
I teach students the usefulness of traditional food	.650			.724
I teach students the traditional ways of preparing food	.702			.804
I teach students that steamed food is health for our lives and we should continue with the practice	.668			.744
I teach students how to keep steamed food warm and ready for eating anytime	.669			.773
I teach students the usefulness of banana leaves in food preparation	.703			.760
I teach students how to prepare a variety of traditional foods using indigenous methods	.626			.738
Environment protection		**1.29**	**4.1%**	
I teach students the meaning of environment	.621			.668
I teach students the importance of environment to man and animals	.634			.704

Table 1 (continued)

Factor and item	**Factor Loadings**	**Eigenvalue**	**Total variance explained**	**Commu nalities**
I teach students the impacts of climate change on the environment, weather, food systems	.875			.808
I teach students the value of wetlands, lakes, rivers, forests and other natural sources of water	.800			.733
I teach students how Weather changes affect food production, housing, health and/or public safety	.749			.670
I teach students Indigenous Knowledge Programs to prevent erosion, conserve and/or restore wetlands, rivers and waterways	.727			.650
Indigenous Knowledge in the curriculum will be good to protect, preserve and transmit traditional seeds and other food sources, methods and practices	.771			.599
Medical herbs		**1.09**	**3.5%**	
I teach students about Herbal medicine	.639			.784
I teach students the Correct definition of herbal medicine	.717			.731
I teach students the different types of Ugandan or African herbs and correct usage	.769			.821
I teach students the Ugandan herbal pharmacopoeia	.826			.752
I teach students how to squeeze and soak plant leaves (process) for herbal medicine	.739			.737
I teach students how to boil roots and leaves and make herbal medicine	.703			.620

With further evaluation on the eigenvalue procedures, the results further reflected that the eigenvalue was greater than 1.0 thus indicating that the construct of Indigenous Knowledge is measured by five sub-constructs and this was explained by 63.8% of the total variance without cross loadings among the items of different factors. The results further reflected from Table 1 of communalities that, there was a significant correlation among factors of Indigenous Knowledge, where the score under the same table ranged from 0.515 to 0.911.

Following data cleaning, out of the 45 items across seven sub-constructs, only 31 items were retained for further analysis. The factor loadings for these items ranged from 0.584 to 0.875, with specific ranges for each sub-construct (e.g., food processing: 0.584–0.784, environment protection 0.621–0.875).

Reliability

The reliability for each sub-construct and the entire Indigenous Knowledge construct was assessed using Cronbach's alpha, with a threshold of 0.05, as shown in Table 2. This analysis revealed that the reliability coefficients for the sub-constructs ranged from 0.830 to 0.944, with the overall construct achieving a Cronbach's alpha of 0.950. These findings differ from previous studies reviewed above, suggesting that the dimensional structure of Indigenous Knowledge might vary depending on the context and sample.

Table 2

Number of Items for Each Sub-construct and Cronbach's alpha

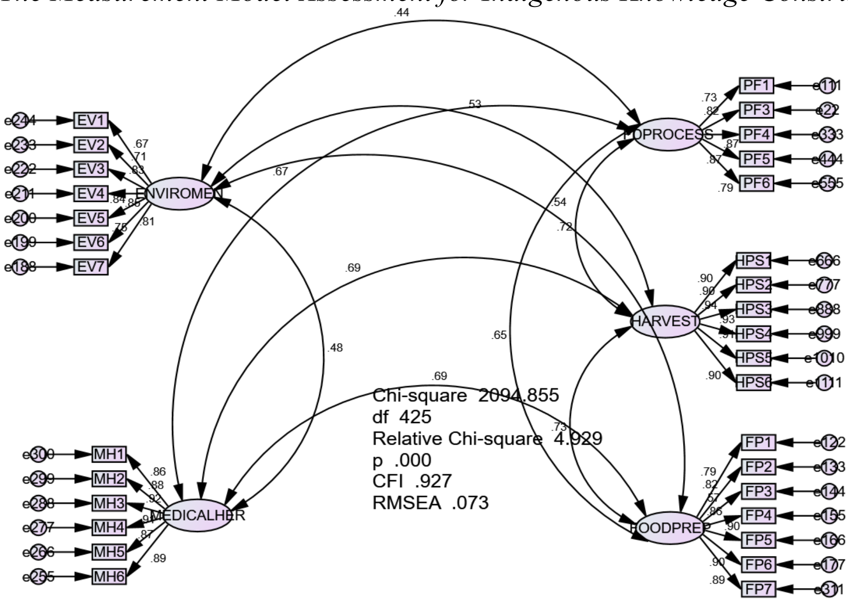
Factor	Number of Items	Cronbach's Alpha
Processing of foods, oils fragrances and pest sides	5	0.872
Food harvest and, post-harvest	6	0.830
Food processing	7	0.940
Environment protection	6	0.900
Medicinal herbs	7	0.944
Total	**31**	**0.950**

A data set of 734 randomly chosen participants was used to further validate and confirm the underlying structure of theoretical model of Indigenous Knowledge construct, the relationship and the correlation among the sub-constructs for each of the study variable, confirmatory factor analysis (CFA) was used. This was done to confirm whether the latent variables and their indicators are true measurements of the construct (Hoyle, 2000). The divergent and convergent validity was assessed using structural equational modelling analysis on a sample of 734 respondents that volunteered to participate in the study as shown in Figures 2 and 3 below.

From Figures 2 and 3 below, the measure models for construct Indigenous Knowledge of the study are presented using (CFA). The findings were presented in consideration of the measurement fit indices that Squared Multiple correlation coefficient, composite reliability, statistically significant of the estimated coefficient, and average variance extracted. This is because these parameters are associated with observed variables.

Figure 2

The Measurement Model Assessment for Indigenous Knowledge Construct

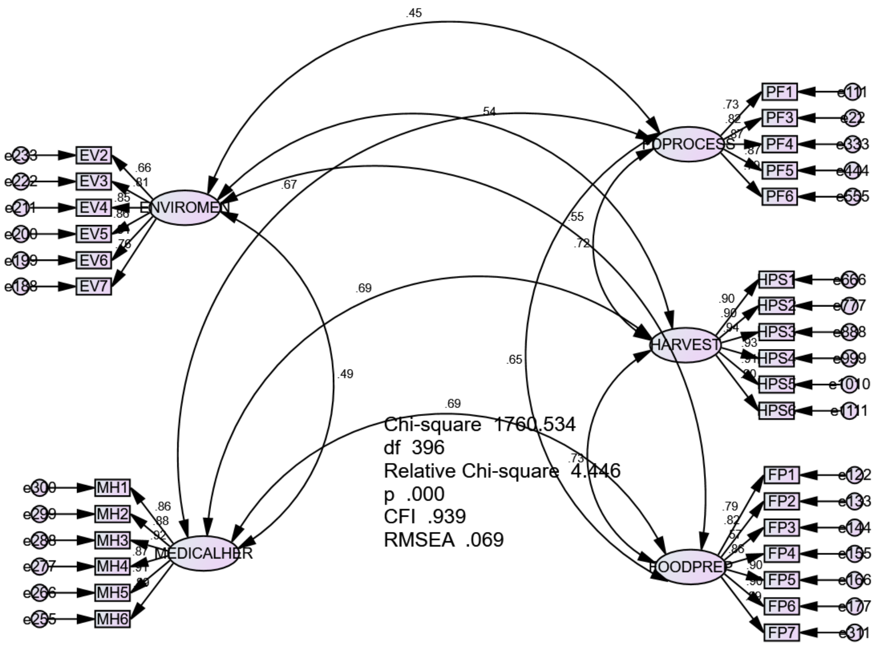


From Figure 2, the measurement model assessment and analysis, the fit indeces reflect that Chi-squared test (χ^2) 2094.855, Comparative fit index (CFI) .927, Root Mean Square Error of Approximation (RMSEA) .073, degree of freedom (df) 425, p-value .000, relative χ^2 4.929. When the model failed to produce the Required RMSEA between .06 to .07, some of the items were eliminated to improve on the score indices as showed in Figure 3 below.

From 3 of the modified measurement model assessment and analysis, the fit indices reflect that Chi-squared test ($\boldsymbol{X^2}$) was 1760.534, DF 396, relative Chi-square 4.446, p.000, CFI .939, RMSEA .069. From the findings it is clear that Indigenous Knowledge construct in the context of Uganda is measured by five factors that (Environmental protection, Food harvest, Medicinal herbs, food preparation and food preservation).The findings from Figure 3 further reflected that factor loading values were between .05 to .93 (Hoyle, 2000), thus exhibiting good fit indices.

Figure 3

Modiefied Assessment Model of Indigenous Knowledge Construct



The findings further showed that critical ration (values) from the all-factor items in the construct of Indigenous Knowledge is >1.96 This reflects that the construct items are significant reflector of Indigenous Knowledge at p< 0.5.

Also, Chi-square (squared multiple correlation) showed that the percentage variance explained by all the factors of the construct range from 0.48 to 0.72 as shown by correlation arrows. Thus in the SMS analysis it can be alluded that in general the factors' explanation is acceptable. This is in line with Byrne (2009), who states that having a minimum value of 0.409 and maximum of 0.818 are the threshold for giving acceptable explanation of the predictors. Furthermore, the item factor loadings for all the predictors also ranged from 50% to 93% which was deemed acceptable for the loadings of the variable Indigenous Knowledge (Miles & Shevlin, 1998).

Validity and Reliability of Indigenous Knowledge Construct

It can be observed from the previous section that the construct and its factors showed internal consistency with all items exceeding the threshold of ≥ 0.7 for Cronbach's Alpha (α). In addition, the composite reliability (CR) values were above the acceptable threshold of ≥ 0.6, as shown in Table 3 below.

Table 3

Convergent Validity for Indigenous Knowledge Construct

Sub-construct	Items	Factor loading
Food processing	FP1	.733
	FP3	.822
	FP4	.867
	FP5	.872
	FP6	.791
Cronbach's Alpha ≥0.7		.830
Composite reliability		0.81
Average variance explained		0.72
Food Harvesting	HPS1	.897
	HPS2	.896
	HPS3	.936
	HPS4	.929
	HPS5	.907
	HPS6	.896
Cronbach's Alpha ≥ 0.7		0.7
Composite reliability		0.72
Average variance explained		0.8
Food preparation	FP1	.786
	FP2	.822
	FP3	.573
	FP4	.864
	FP5	.896
	FP6	.903
	FP6	.886
Cronbach's Alpha ≥ 0.7		.749
Composite reliability		0.71
Average variance explained		0.68
Environment Protection	EV7	.762
	EV6	.835
	EV5	.859
	EV4	.850
	EV3	.807
	EV2	.662
Cronbach's Alpha ≥ 0.7		
Composite reliability		0.8
Average variance explained		0.61
Medicinal Herbs		
	MH6	.886
	MH5	.907
	MH4	.873
	MH3	.918
	MH2	.881
	MH1	.860
Cronbach's Alpha ≥ 0.7		0.82
Composite reliability		0.8
Average variance explained		0.83

The study further indicates the divergent validity extracted from data analysis in the Table 3. The AVE for each of the factors are presented in the diagonals within Table 4. It is evident that the average variance explained (AVE) for the construct employed in a given study should be higher than the value of squared correlation in order to attain the test requirements. Thus, discriminant validity for the measurement model and the squared correlation are shown in Table 4.

Table 4

AVE for Indigenous Knowledge Measurement Model

Dimension	1	2	3	4	5
HER	0.83	0.53	0.52	0.29	0.48
FP	0.73	0.68	0.42	0.30	0.48
FPR	0.72	0.65	0.68	0.30	0.48
ENV	0.54	0.55	0.55	0.67	0.24
MD	0.69	0.69	0.69	0.49	0.79
Composite Reliability	0.97	0.94	0.94	0.92	0.96

NB: The diagonals indicate values of the average variance extracted (AVE) for each of sub-construct's dimension; and below the diagonal are the correlation matrices, while the shared variance is above the diagonal

From Table 3, the findings of the study reflected both the divergent and convergent validity and the AVE from Table 4 were above the threshold of 0.5 thus indicating the presence of convergent validity for the construct Indigenous Knowledge. Also, discriminant or divergent validity was attained due to large AVE values of the corresponding shared variances above the diagonal. Lastly the moderation between inter-factor correlation was also exhibited thus Indigenous Knowledge construct is a multifactor construct with different interconnected sub-constructs. The composite reliability also for each of the sub variables of Indigenous Knowledge ranged between 0.97 (Harvesting food) and environment 0.92 as showed above.

Discussion

The aim of this study was to explore and validate the underlying structure of the seven constructs of Indigenous Knowledge. From the study findings evidence shows that the concept Indigenous Knowledge is a five-factor construct in the Ugandan context especially at lower secondary school level. It has also reflected that the five-structure construct is valid and reliable. Thus, this study has added an understanding on the body of knowledge in different ways. First it has offered empirical evidence that Indigenous Knowledge is defined by five sub-constructs. The study findings were both in agreement with earlier studies like Jonjoubsong and Thammabunwarit (2016); and Orlove et al. (2010). Second, the results further showed that Indigenous Knowledge is composed of five but distinct related sub-constructs examined by the study as processing of foods, oils, fragrances, and pesticides; food harvesting and crop storage; food preparation; environment protection; and medicinal herbs.

Third, based on the study findings, a survey instrument of Indigenous Knowledge with 31 items and five sub-constructs has practically and empirically proved valid and reliable. It is therefore the novelty that future studies can apply in other studies and on other levels of education.

Conclusion

From the study, the results confirmed that Indigenous Knowledge construct has five dimensionalities even though some studies indicated seven sub-constructs before as shown in the literature. It is therefore important that whenever there is need for integration of Indigenous Knowledge in the formal education systems these key parameters should be considered especially on the African continent like Uganda is doing. This is because like any other part of the world and Africa, Uganda has a very rich culture imbued in different traditions and these range from social, economic, political and religious sphere. These aspects have a lot of attachment to human development, survival and community transformation.

Therefore, for any country that intends to score high strides in political and socio-economic transformation of their communities, they should invest more in integration of Indigenous Knowledge into the education so as to make meaning to the lives of its society and the surrounding. The best ways through which governments can address both parents' and community's desires is in the provision of education that leads to self-discovery, innovation and employment for community transformation and most of this is imbued in the construct of Indigenous Knowledge. Many countries from different parts of the world, Uganda inclusive have taken on this strategy to change their communities through provision of integrated education for both human and economic transformation especially at different levels of education.

Recommendations

Since it has been found that the concept of Indigenous Knowledge is a multidimensional construct, future studies should not use or interpret composite scores to determine the integration of the construct in the main stream education. The study suggests the use of five separate scores on processing of foods, oils, fragrances, and pesticides; food harvesting and crop storage; food preparation; environment protection; and medicinal herbs). It is also important to understand that to arrive at reasonable results, researchers should examine all the five sub-constructs of Indigenous Knowledge together in order to arrive at the intended framework.

Given the fact that the study was carried out using a cross-sectional design future studies may be carried out using longitudinal design to establish whether the findings will be different. There is also need to re-examine and refine the conceptualization of Indigenous Knowledge with all the seven factors at higher levels of education to establish whether findings will be different. Lastly its vital to incorporate Indigenous Knowledge concepts into main stream curriculum to increase the level of innovativeness among learners while using their surroundings.

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