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Scientific Skills and Concept Learning by Rural Women for Personal and National Development

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ABSTRACT

paper examined scientific skills and concept learning by rural women for personal and national development. The research design employed was a quasi-experimental, one-group pre-test and post-test design. A non-formal science program package to enhance and empower the rural women's knowledge and skills in their daily activities (nutrition, sanitation, health, agriculture, and water use) was designed and validated by three experts from the Science Education Department of a University. The reliability coefficient was 0.80, and the program was taught for 6 weeks to the rural women to determine its effect on the rural women's skills and knowledge in the five variables considered. The results showed that there was appreciable improvement on their skills and knowledge in health, water use, nutrition, sanitation, and agriculture. This supports the study of Nnachi (2008) who was of the opinion that training and practice increased rural women's skills. Based on these findings, the researchers recommended that rural women should be empowered by science education for maximum productivity, self, and national development.

KEY WORDS: scientific skills; concept learning; rural women; national development

INTRODUCTION AND REVIEW OF THE LITERATURE

Science is both a body of knowledge that represents current understanding of natural systems and the process, whereby that body of knowledge has been established and is continually extended, refined, and revised. Science plays a vital role in the lives of individuals and the development of a nation. It is acknowledged that the gateway to the survival of a nation is its scientific and technological ability (FAO, 2011; FME, 2008). Science equips the individual with knowledge and skills on indices of development such as nutrition, water use, agriculture, sanitation, and health. Skills are learned abilities while life skills are abilities, which a person uses in daily life. It becomes worrisome when these essential life skills and knowledge of science needed for development are lacking among rural women, defined here as those who live in an environment called the village.

Rural women tend to have the same culture, religion, and vocation (farming). Some are literate, some semi-literate but most of them are illiterate. Rural women are active agents of economic, social change, and environmental protections but in many ways and to various degrees, constrained in their role as farmers, producers, processors, investors, caregivers, and consumers. Rural women are the backbone of agricultural labor force across developing world. Surprisingly, it was estimated by the 2012 World Bank Report that 70% of the world's population was living below the poverty line, 60% of which were women with a purchasing power is the US $614 compared to men's US $1495 (FRN, 1997). In addition, the World Bank (2012) report stressed that people living on less than US dollar 1.25 per day fell from 47% in 1990 to 22% in 2010 across developing countries, of which Nigerian is one. FAO (2011) tried in helping rural women's right to land, leadership opportunities, and choices to participate in shaping laws, policies, and programs but there was no program to increase their skills and knowledge in science to help in their daily life activities.

Issues Facing Rural Women

Child mortality and morbidity rates remain alarmingly high, and the prevalence level or communicable diseases are high among rural women, and this was attributed to bad sanitation, lack of education, and access to portable water (Friedrich, 1998). Thus, infection rate among females aged 20-24 years is 56% while 60% for ages 15-25 years. In addition, most of these girls have dropped out of school. In rural agriculture, women are responsible for carrying out 70% of the labor, 50% of animal husbandry, and 60% of food processing activities, even though they have little or no scientific knowledge and skills (Devasia, 1995; Agbo, 2010).

These challenges are aggravated by the global food economic and security crisis and climate change. Impoverished rural women often degrade natural resources, which need to be consumed properly, to meet their needs for money, fuel wood, land to grow food, etc. This abuse often causes soil erosion and a dwindling water supply, which results in the country expending a lot of money to address. No wonder, the

United Nations (UN) set aside October 15th as International Day of Rural Women. The UN (1992) stated that more than 780 million people in the world suffer from chronic malnutrition each year, of which 13 million are children below the age of five. In recent times, this number has grown worse because of wars and disasters escalating the problem for refugees. Suffice to say that the UN's (1992) Agenda 21, "integration of environment and development concerns and greater attention to them will lead to the fulfillment of basic needs, improved living standards for all, better protected and managed ecosystems and a safer, more prosperous future" (p. 3) can only become a reality through large scale changes in rural women's attitude, education, skills, knowledge about the environment and their daily life activities, which this paper seeks to undertake.

Five indicators of development (nutrition, water use, agriculture, sanitation, and health) as stipulated by the UN (2015) were chosen for the package for rural women knowledge awareness and skills development in science. UN (2015) stressed that there was widespread recognition that the world was facing a growing water crisis, affecting the well-being of millions of the poorest people. Rapidly growing population, urbanization, agriculture, and climate change contributed to greater competition and scarcity of water resources. Water is critical to the livelihood and well-being of the world's population. The effect of pollution and environmental changes affect water, and so rural women need to be knowledgeable on this. The UN (2015) reported that 1.1 billion people lack access to drinking water and this increased water related diseases, especially in rural areas. Rural women are important stakeholders in water and land conservation, rainwater harvesting, and watershed management (UN, 2015).

Mucavele (2017) asserts that women are the backbone of the development of rural and national economies. They make up 43% of the world's agricultural labor force, which rises to 70% in some countries. Also in Africa, 80% of the agricultural production comes from small farmers who are mostly women in rural environments. No wonder, the UN (2015) called for more knowledge for indigenous rural women in irrigation and watershed management and sanitation.

Sanitation matters have far-reaching impact on everything, from health and safety to education and livelihood. Embracing the World (2014) noted a lack of sanitation was a daily reality for 2.5 billion people and so a lack of better hygiene could increase the incidence of diseases and mortality from diarrhea to stunting and malnutrition. The occurrence of open defecation behind the house is very rampant in rural villages. No issue touches the lives of rural women more than that of sanitation. For many, this requires using public toilets where there is often a queue and the potential to encounter disease causing organisms. As a result, some women resort to waking before dawn to defecate in the open bush, which has many other consequences.

Houdegbe (1985) pointed out that malnutrition in rural women was often caused by ignorance or lack of information on what foods should be eaten. Dietary customs and taboos deeply anchored in some families deprive rural women of the nutrient required by their bodies. Since women are constantly concerned with doing the most for their families and satisfying almost all their needs, they never rest during the day; are excessively tired and sleep 5-6 h a night.

Despite the fact that women produce much of the food in developing countries, they remain more malnourished than most men are (FAO, 2016). In many rural societies, women eat less food than men do, especially when food is scarce. The UNICEF (n.d.) pointed out that a third of women of reproductive age in India are undernourished with a body mass of 18.5 kg/m^2. It is a well-established fact that an undernourished mother inevitably gives birth to an undernourished baby perpetuating an intergenerational cycle of malnutrition. In addition, undernourished girls have greater livelihood of becoming undernourished mothers. It is also globally acknowledged that focusing on the first 1000 days of a child's life, that is, from conception to 2 years of age, is a critical window of opportunity to address child stunting which rural women know nothing about.

Therefore, Houdegbe (1985) pointed out the lack of information on health matters, distance from health centers, limited financial resource in the rural populace, lack of transportation, etc., as problems to rural women health.

Skills are learned abilities while life skills are abilities that one uses for living. To Nnachi (2008), acquisition of skills occur only when enough impressions are made on the mind in such a manner that the body can base on such impressions, perform affectively, psychomotively, or cognitively. A skill is a product of knowledge or experience acquired through training or practice after series of impressions (Immah, 2017).

Science skills comprise the ability to make good observations, communication, classification, measurement, inferring, and predicting, for example, making qualitative observations using our senses (Hundeker and Badami, 2014; Moyo and Francis, 2010). The skills of the rural women to be enhanced in this study were skills in preparing a balanced diet; preparation of a meal called turn brown for kwashiorkor child; skills on water filtration and purification; skills on how to prevent communicable diseases; choosing family planning for good health; skills on effective use and application of fertilizers on the farm; irrigation; and skills on livestock management in integrated farming.

A concept is an abstraction of events, objects, or phenomena that seems to have certain properties or attributes (Lewis and Kelly, 1987; Castro, 1995; FOA, 2011). Concept learning is brain-centered and has five important elements, name, definition, attributes, value, and examples (Nnachi, 2008). A concept becomes meaningful to a learner when there are many opportunities to experience examples or instances of the concept. This concept learning to Layton (1996) equips the individual (specifically for this study, rural women) with knowledge and skills, which will enable them to live well in

society and this brings changes in their lives and conversely leads to development. Development in this paper means, enabling rural women to accomplish things they could not do before (UN, 1997).

Modern development encourages people's participation, which have become the central issue of our time and this requires communication skills and partnership. In the same vein, the UN stressed that unless people themselves were the driving forces of their own development, no amount of investment or provision of technology inputs will bring any lasting improvements in their lives (Geertje, 1991; Women's Learning Partnership, 2012). It was against this backdrop that the researchers developed a science package on concepts that revolved around rural women's daily life activities (nutrition, agriculture, health, water use, and sanitation). This was aimed at equipping them with the science skills and knowledge of these concepts to help them participate actively in their development activities. In addition, this would help in their self-development in form of increased income, better nutrition, security, communicative skills, and interaction with other partners to create networking. The national development would be in the form of less malnutrition cases, less over population, better sanitation, less cutting down of forest trees for wood, and an increased gross personal income.

The theoretical/conceptual framework for this research was anchored on the theory of scientific humanism by Dewey (1980). Scientific humanism believes that the well-being of humanity can be served by extending our knowledge about people and nature using it to improve social, more, and material life. The theory believes that science is humanistic and not materialistic.

A model of central human capabilities was used in this study (Figure 1). A facilitation approached targets groups. Facilitators provided a conducive environment for the participants who were encouraged to explore, experiment, research, and learn in the experiential learning stages. They experienced both facilitated activities as well as they had the freedom for self-development. Assignments involved group work in the form of discussions and information sharing. There were democratic group interaction and mutual cooperation, which also resulted in improved general skills.

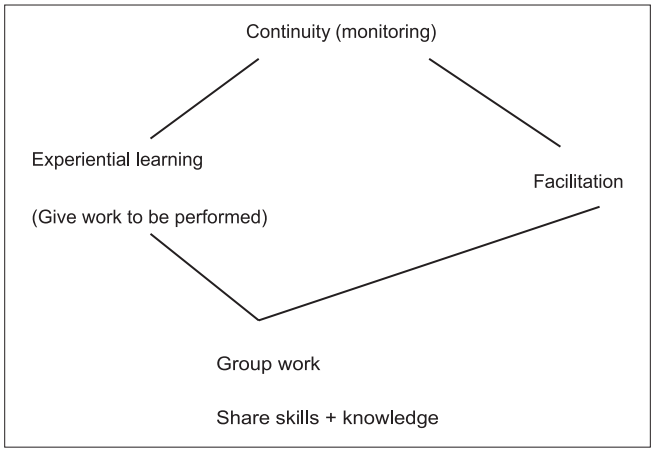

Figure 1: Component of life skills education

METHODOLOGY

The purpose of this research was to equip rural women with some scientific skills and concepts for personal and national development. This would be achieved through explicit teaching of targeted of skills and concepts. The following research questions guided the research:

1. What are the effects of the training on scientific skills on rural women performance in agriculture, nutrition, health, sanitation, and water use?
2. What impact has the science concept on rural women awareness of issues related to nutrition, water use, sanitation, health, and agriculture?

The research questions were addressed using mean scores, and standard deviations of the two survey instruments. One hypothesis was tested at the 0.05 level of significance.

There was no significant difference in the impact of the science package of the skills of rural women with different educational levels. This was analyzed using one-way analysis of variance (ANOVA).

The research design was a quasi-experimental one-group pre-test and post-test design. The population was rural women in the Ogbadibo local government area of the Benue state, Nigeria. The population comprised of illiterates, primary, secondary, and above levels of education and totaled approximately 47,000 adult females. The sample for the study was 100 rural women selected or sampled using cluster sampling method from three districts, which was made up of 14 wards and 139 villages. Two wards in each district and three villages were selected through random sampling. The number of households in the six wards and nine villages were approximately 1000 households. The researchers clustered these households into 16 square blocks giving rise to 600 sampling units. A table of random numbers was adopted to select the blocks from this total. Eventually, 180 blocks were selected and the households that fell within these blocks and the rural women living in these households were invited to participate in the study. This research was carried out under the supervision of the University of Jos. Participants took part in the study voluntarily.

Two instruments developed by the researchers were used for the study. One of the instruments was called the non-formal science skills and concept package for rural women (NFSSCPRW) and the second the test of rural women skills on some scientific concepts (TORWSOSSC) (Appendix 1). The instruments were validated by three experts from the Department of Science and Technology Education of the University of Jos. Test-retest and Pearson's product moment correlation were used to establish the reliability, and the result was 0.80.

The science package (NFSSCPRW) was taught by the researchers to the rural women for 8 weeks mostly in the evenings after the

day's work. The TORWSOSSC instrument was administered immediately after the treatment to determine the impact on the rural women's skills and knowledge performance for nutrition, health, water use, sanitation and agriculture.

RESULTS

The results are presented in Tables 1-4.

Research question 1: What are the effects of scientific skills training and concept learning on rural women performance in agriculture, health, sanitation, water use, and nutrition?

There was an increase in the mean scores of all five variables after the training. Each of these increased showed a significant impact.

Research question 2: What impact has the science concept on rural women awareness of issues related to nutrition, water use, sanitation, health, and agriculture?

Table 2 reveals that the skills and knowledge of the rural women increased after the treatment. These scores were positive changes in mean scores in all the variables tested.

Analysis to Test the Hypothesis

There is no significant difference in the impact of the science package in the skills of rural women with different educational levels in sanitation, agriculture, water use, and health.

It could be expected that the effects of the program would vary with the educational background of the rural women. The highest effect was on those with primary education even though it could be assumed that those with secondary school background would give a higher effect but was not the case. This could mean that the concepts and skills taught would have been developed before in their schools before the program delivery in this study.

The analysis shows a positive effect of the science program on the skills of rural women. As a result, the null hypothesis was

Table 1: Effects of science education program on the skills of rural women in agriculture, sanitation, nutrition, water use, and health

Variable	Treatment	N	Mean±SD	DF	Calculated t-value	ρ value
Agriculture	Before	100	1.29±1.45	198	9.28	0.00
	After	100	3.23±1.50			
Sanitation	Before	100	1.44±1.12	198	10.19	0.00
	After	100	3.3±1.44			
Health	Before	100	1.28±0.97	198	16.06	0.00
	After	100	6.29±2.96			
Water use	Before	100	1.13±0.72	198	2.92	0.00
	After	100	3.0±1.26			
Nutrition	Before	100	2.73±1.93	198	13.27	0.00
	After	100	8.32±3.74			

SD: Standard deviation

Table 2: Impact of the training on the skills of rural women in agriculture, water, sanitation, nutrition, and health

Variables	Agriculture		Water use scores		Sanitation scores		Nutrition scores		Health scores	
	B	A	B	A	B	A	B	A	B	A
Maximum scores attainable	6	6	6	6	6	6	20	20	17	17
Maximum scores attained	4	6	2	6	3	6	0	15	3	15
Minimum scores attainable	0	0	0	0	0	0	0	0	0	0
Minimum scores attained	0	1	0	1	0	1	1	3	0	1
Mean scores	1.29	3.23	1.13	3.0	1.44	3.30	2.73	8.32	1.28	6.29
Mode	0	3	1	3	2	3	3	8	1	3
SD	1.45	1.50	0.7	1.3	1.12	1.43	1.93	3.73	0.97	2.96

Key: B: Before treatment, A: After treatment. SD: Standard deviation

Table 3: Impact of science package on rural women skills with different educational levels

Categories	N	Mean	Sum of squares		SD	F	df between	df within	Significant
			Between	Within					
Illiterate	35	24.02	3314.29	11267.859	10.43322	14.265	2	97	00
Primary education	29	38.17			9.30848				
Secondary education	36	33.91			12.11935				

SD: Standard deviation

Table 4: Post-test on skills of rural women with different educational background

(i) Educational level	(J) Educational level	Mean difference I-J	Standard error	ρ value	95% confidence interval	
					Lower boundary	Upper boundary
Illiterates	Primary level	14.14384*	2.7064	0.00	19.5153	8.7724
	Secondary level	8.88810*	2.55846	0.00	13.9659	3.8103
Primary education	Illiterate	14.14384*	2.7064	0.00	8.7724	19.5153
	Secondary level	5.25575	2.68931	0.05	0.0818	10.5933
Secondary education	Illiterate	8.88810*	2.55846	0.00	3.8103	13.9659
	Primary level	5.25575	2.68931	0.05	10.5933	0.0818

*The mean difference is significant at the 0.05 level

rejected because the program had differing impacts on the skills of the rural women with different educational backgrounds.

DISCUSSION

The study examined scientific skills and knowledge of rural women and was concerned about personal and national development. The purpose was to train rural women on new farming techniques, teach them about nutrition, sanitation, health, water use, and agriculture to increase good sanitation practices, improve health, and their standard of living. Two research questions guided the work, and a hypothesis was tested using ANOVA.

Table 1 shows the effects of the science program on the skills of the rural women in the selected science concept variables. The data on this table show that exposure of rural women to a science education program improved significantly the skills of these rural women. The greatest improvement was in nutrition, followed by health, water use, agriculture, and sanitation. The mean score for nutrition before the program was 2.7 and 8.3 after, a gain of 5.6 while in health, the mean score before was 1.3 but 6.3 after, a gain of 5. The same trends were seen across the other variables. This means that the program caused an improvement on mean scores of each variable examined. These findings confirm the views of Cronbach (1963), Castro (1995), Suradi et al. (2013), and FAO (2011) that skills are improved on if an individual repeats an activity many times by observing others; and this was exactly what was provided by the programme.

Table 2 addressed of the impact of science concepts on rural women awareness on the variables examined. The data from this table reveal a rise in the maximum scores attained under each variable. Health mean score rose from 1.28 to 6.29, sanitation from 1.44 to 3.30; water use mean score from 1.13 to 3.00; agriculture from 1.29 to 3.23 while nutrition increase from 2.73 to 8.20. The mean score was highest in nutrition. More skill was gained in nutrition and health, but there were increases in other variables. This shows trend of positive impact of science concept learning on rural women awareness, which translated to better performance in health, sanitation, agriculture, nutrition, and water use and consequently that of the nation. This supports their assertion by UN (1997) and Eriba (2000) that education, especially in science increases the skills of rural women in handling water, food, storage, and production.

The null hypothesis was tested using ANOVA, and it was observed on Table 3 that the effects of the non-formal science program on the skills of rural women with different educational background varied. The highest effect was on those with primary school education, even though it was expected that those with a secondary background should have the highest effect. This could mean that the variables treated may have been acquired by secondary school leavers in the school and so did not ve not much effect. On Table 3, the results also show that the program had positive effects on different educational background suggesting that education helps in acquisition or improvement of skills. This study confirms the assertion by Geertje (1991), Castro (1995), World Bank (1992), Devasia (1995), and Meliko and Oni (2011) that women with education gain more science skills better than illiterate ones. Consequently, the null hypothesis was rejected because the program had differing effects on the skills of rural women with different educational background. This skills gained will help develop both the individual (rural women) and transform their society.

CONCLUSION

The findings from the study points to the fact that although much attention had been given to women issues lately, past neglect has caused a low level of rural women's education. Hence, this study becomes relevant because rural women need education and skills in all spheres of their daily life activities for self-development, material, and the society. In addition, science concept learning and science skills acquisition have been shown in this study to develop the rural women by enhancing their knowledge, capabilities, and skills. Skills were acquired faster by educated rural women than the illiterate ones. Therefore, education in science is necessary for self-development and rural transformation. The researchers noted that science plays a vital role in the lives of individuals and development of a nation; and also the gateway to survival of a nation scientifically and technologically. Therefore, it becomes worrisome when those essential skills and knowledge needed for development are lacking in rural women. If we want a reduction in unwanted pregnancy but proper use of

natural resources, good personal hygiene and family size rural women need more awareness, education and training in science education.

RECOMMENDATIONS

Based on the findings of this research, the following recommendations are made:

1. Rural women should be motivated to acquire science skill since science is a way of life and the world now is technologically driven. Look for current events that excite them
2. Reinforce scientific thinking in rural women
3. Create in rural women the desire to know by seeking explanations to phenomena or what she does daily
4. Train rural women in learning to solve life problems in a variety of ways
5. Science education should be increased, encouraged and made an integral part of mass literacy programs
6. Adult learning centers to be set up in every community.

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APPENDIX

Teaching syllabus for the Non-formal science education programme for rural women:

Week 1 and 2	Food, types, importance, balanced diet and mal-nutrition
Week 3 and 4	Water, types, sources and uses
Week 5	Purification of water, conservation of water drought, water borne disease
Week 6 and 7	Health, personal hygiene, breast feeding, reproduction, family planning, communicable diseases, population and consequences
Week 8	Local and modern farming techniques fertilizer application, storage of crop, pest and control irrigation.

A NON-FORMAL SCIENCE EDUCATION PROGRAMME FOR RURAL WOMWN (NFSEPFRW)

S.No	Topic	Contents	Performance objectives	Activities/learning experience	Materials	Evaluation strategies
1	Nutrition	Food (type), importance, balance diet vitamins, malnutrition and disease control	The various communities should know the food types, be able to control kwashiorkor and value of balance diet and be also to know the danger of not meeting this food value	Why do you eat the food you eat? Discussion on different types of food eaten by the community and the forms it should be taken to have more value. Teacher to demonstrate what balanced diet is by mixing the various types of assignment: Ask the participants to go round the village medical centre and identify malnourished child. Children and be able to say the characteristic features of such	Provision of the real food stuff available in the community, show posters, show picture of children with Kwashiorkor and those of healthy children if any child within the community, that is kwashiorkored, such child can be used.	Questioning participants to show their understanding of the topic and show they can prepare a balanced diet. Production of tom-brown by individuals
2	Water and Sanitation	Types of water sources, uses, purification, conservation (storage) drought, care of the surrounding, water born diseases control of the diseases (e.g.) guinea worm, cholera, diarrhea, pollution, etc.,	Device effective means of waste disposal, cultivate habits that favour prevention of water borne diseases and be able to purify their water and maintain clean surrounding	Group participation: Discussion, Demonstration of effective protection of water sources, means of waste disposal and disease prevention practices. Questioning: How do you purify your drinking water? Demonstrate how do you know of any disease associated with water, how can it be avoided?	Pictures, real life situation (i.e. sufferer of guinea worm, river blindness), diagram of diarrhea patient, models	Questioning, give group projects to identify the common causes of these water borne diseases in the communities.
3	Health	Personal hygiene, breast feeding, reproductive health (family planning, health of the mother and child, abortion), communicable diseases, population and consequences of high population, malaria	The various communities should know the causes of drought, to develop principles of personal hygiene, family and community sanitary practices	Demonstration of effective protection of water sources. Discussion of effective ways of preparing for drought, effective ways of waste disposal. Able to identify the various types of family planning methods.	Pictures, charts, diagrams and models	Questioning participants to show their understanding of the various types of family planning, causes of diseases in the community and outbreak. How can they prepare themselves for drought period and also preparation of ORT for diarrhea patient. How long do you breast feed? What happens when you stopped your child before this time?
4	Agriculture	Local and modern technique, fertilizer application, storage, pest and disease control	The community women should know the new technique of farming, fertilizer application and control of pest in storage system	Group participation, demonstrations, Questioning	Real instrument and role models. Ask women to perform the application of fertilizer, identify the common pests and new storage techniques	

TEST OF RURAL WOMEN SKILLS IN SOME SCIENTIFIC CONCEPTS (TORWSOSSC)

1. Provided are foods found in your locality
   a) Sort them into groups of carbohydrates, protein, and fats and oils
   b) Name three food from these food types provided that keep the body fresh and balanced in elements
   c) Select from the food items provided, the ones you would use to prepare a balanced diet. Give reasons for your choice.
2. Demonstrate the preparation of:
   a) Turn-brown which nourishes babies during teething
   b) Here are two pictures of children (a healthy child and kwashiorkored child). Explain what you have observed from each of the pictures
   c) State remedies for kwashiorkor
   d) Demonstrate how you can preserve water in good condition
   e) Pick a card from the flash cards provided that appropriately demonstrates how to get set for drought
   f) Demonstrate the skill of water filtration that you know using the materials provided
3) Provided are two pictures illustrating two houses in the village. Which one is poorly ventilated?
   b) State 2 effects of bad ventilation
   c) There are some diseases called communicable disease. Name them and explain how to prevent them
4) On display are the different types of family planning devices, pick from among them the type you are using
   b) Discuss the benefits sand the disadvantages
   c) Where can you go for help if you need one
5) You have been provided with three types of fertilizers: NPK, Chicken faeces.
   Explain why, when and how you will apply each of them to a maize plantation.