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THE TRANSMISSION OF TRADITIONAL ECOLOGICAL KNOWLEDGE

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ABSTRACT

It is now increasingly appreciated that while Traditional Ecological Knowledge (TEK) has much to contribute to the management and conservation of renewable natural resources, as well as providing powerful indicators for focusing scientific research of the Western tradition, it is being rapidly lost owing largely to ineffective transmission to younger members of societies. Further, whereas bodies of TEK have been documented in detail, extremely little is still known about the processes of its transmission between or among generations. This is a serious omission in the study of TEK, since the ways in which it is transmitted within a society may provide crucial guidelines for the design and implementation of extension and training programs.

In this paper (1) generalized characteristics of the process of traditional knowledge transmission are hypothesized, based on a literature survey; (2) the fundamental socio-cultural and institutional importance inherent in the processes of knowledge transmission is examined; (3) a brief empirical case study of the structure of the transmission of traditional knowledge in a peasant community of the Orinoco delta, Venezuela, is presented; followed by (4) a brief summary of a highly contrasting case from Polynesia.

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INTRODUCTION

Although knowledge is the foundation of social life, the sociology of knowledge, and particularly its transmission between generations, remains a neglected field. This is extraordinary in view of the fundamental socio-cultural importance of the process. Similarly, although children and young people participate actively in economic activities of households in the Third World, little is known of their contribution to community life or of the socialization and transmission of knowledge to them, and related processes whereby they eventually become fully productive adult members of society.

In rural subsistence communities in particular, traditional knowledge is of central concern to the regulation and balance of exploitative pressures that permit an ecosystem to maintain stability and regenerative capacity. But, almost without exception, most ethnographers, if they discuss childhood at all, have little to say about how traditional knowledge of specific skills is transmitted. The impression conveyed is that skills are transmitted and acquired in a disorganized, unstructured and highly individualistic manner. All studies of the ecology of human subsistence and food procurement neglect the processes

whereby information concerning either the preservation of the system's integrity or its modification are transmitted from one generation to the next.

Because continuity from one generation to the next is implicit in the concepts of culture and society, the ethnographic literature concerned with generational transmission of information tends to deal with questions of how children are incorporated into their groups in only very broad terms of analysis of cultural and social systems. Such analysis is more informative about the totality of what children learn than about how they acquire traditional ecological knowledge about specific tasks and skills.

However, it is clear from the persistence of social and cultural forms that learning at such general levels is not only structured but also culturally specific: there is no reason to suppose that the acquisition of particular traditional economic and ecological skills is any less so. The scanty data on the subject bear this out. For example, Raum (1940) identified the ages when Chaga boys are shown which banana leaves are best for fodder; Wagley (1957) described Guatemalan Indian boys receiving miniature hoes; and Mead (1930) detailed the experience of Manus children piloting adult canoes. The typical way in which the organization of subsistence training has been mentioned briefly is exemplified by the works of Holmberg (1950) Levine and Levine (1963), Read (1960), and Whiting (1941), among others (cf. Ruddle and Chesterfield, 1977).

The often fragmented and cursory data on subsistence-level societies throughout the world, obtained by researchers from a

wide range of disciplines, yield remarkably consistent generalizations about certain structural and processual characteristics of the transmission of traditional knowledge. These may be summarized as follows (Ruddle and Chesterfield, 1977):-

(1) There exist specific age divisions for task training in economic activities;

(2) Different tasks are taught by adults in a similar and systematic manner;

(3) Within a particular task complex (e.g., gill-netting, in fisheries) individual tasks are taught in a sequence ranging from simple to complex;

(4) Tasks are gender and age specific and are taught by members of the appropriate sex;

(5) Tasks are site specific and are taught in the types of locations where they are to be performed;

(6) Fixed periods are specifically set aside for teaching;

(7) Tasks are taught by particular kinsfolk, usually one of the learner's parents; and

(8) A form of reward or punishment is associated with certain tasks or task complexes.

Just as traditional knowledge and its transmission shape society and culture, so too, in reverse, culture and society shape knowledge. These are reciprocal phenomena, as is to be expected. Thus vastly differing constructions of knowledge and processes of transmission, as well as the social uses to which knowledge is put, occur worldwide. To exemplify this, in the

second part of this paper I use contrasting cases from Venezuela and Polynesia.

Finally, a caveat is required here. It should be asked if the topic we are examining is really "ecological knowledge" or "environmental (including the social environment) knowledge". The former term implies an awareness in a given society of the systemic interactions among the components of an environment; an ethnoecological construct. In the absence of such a concept, and with the substitution of a unifying matrix imposed by an outside investigator, which might erroneously assume local systems thinking, the topic is really "traditional environmental knowledge", in its broadest sense.

THE KEY SOCIO-CULTURAL ROLE OF TRADITIONAL KNOWLEDGE TRANSMISSION

In addition to its practical aspects of ensuring sustained resource management, the transmission of traditional knowledge is also of fundamental socio-cultural importance to any society. During knowledge transmission over several generations social institutions are gradually crystallized; routine or habitual ways of doing things gradually become the customary way that things are done. Thus for children a community's customary way eventually becomes the given-received social world, an analog of the biological-physical world with which it overlaps, and which for them, unlike for the originators of a system, is a reality of which they had no part in shaping.

Further, in the process of transmitting knowledge to a new generation, the transmitter's sense of reality is strengthened:

"...if one says 'this is how these things are done' often enough one believes it oneself" (Berger and Keller, 1964). Thus "... only with the transmission of the social world to a new generation does the fundamental social dialectic appear in its totality.(And)... only with the appearance of a new generation can one properly speak of a social world" (Berger and Luckmann, 1984: 79).

The social world (embodied in traditional knowledge) becomes enlarged during transmission. The original creators of a social world would have been able to reconstruct the circumstances under which that world was established (the process of recollection enables recall of why an institution was established). But, of course, each new generation of receivers of knowledge understands the history and context of its society's institutions only by increasingly attenuated hearsay. The rationale underlying "custom", "tradition", normative and actual behavior, and rules and regulations must therefore be provided to "learners" by "teachers" via legitimating formulae that are consistent, comprehensive. and conveyed to all children.

That leads to the need for social controls to handle deviance and to ensure compliance with social norms. A person is more likely to obey a rule that he or his local community has established than one imposed externally, therefore there is a need to control deviance by ensuring compliance under the threat of sanctions.

Institutionalization occurs in any arena of collectively relevant conduct, and the processes may occur concurrently within institutions formed concurrently in several arenas (e.g.,

agricultural activities and fishing activities, or, in communities with mixed economies, without specialization, a single institution may embrace all productive arenas).

Although there is no reason to assume that such different institutions will necessarily cohere into one set of institutions, the empirical evidence shows that they generally do so. Explanation of this phenomenon is of fundamental importance for understanding the functions of traditional knowledge, be it ecological knowledge or any other branch of a society's total stock of knowledge.

The logic of institutions and that of the linkages among them emerges not from the institutions per se. but from the way in which they are treated by conscious reflection upon them by those that operate within them. When such reflection is common to the various operators, it provides a logical framework for an institution. This logic also emerges from the reciprocity that occurs among operators of different systems, as among fishermen and farmers, women and men, and different age sets, for example. Continual acts of reciprocity establish the collective consciousness of a logical framework for linked resource systems and their accompanying institutions. (This can also emerge within a household[s] that practise a mixed economy.) In this way, universes are shared and institutions integrated together.

Thus knowledge assumes a pivotal role in any community: integration of an institutional order is understandable only in terms of the "knowledge" that its members have and share of it. However, this does not necessarily imply complex indigenous theoretical constructs about the character of institutions,

although this, too, is of importance. The primary knowledge is "pre-theoretical knowledge: "... the sum total of 'what everybody knows' about a social world" (Berger and Luckmann, 1984). At this level, "... every institution has a body of transmitted 'recipe knowledge' (Schutz, 1960) ...that supplies the institutionally appropriate rules of conduct" (Berger and Luckmann, 1984).

Such knowledge underlies the dynamics of institutionalized conduct and defines the areas of such conduct, as well as both defining and constructing the roles to be played in the context of such institutions. By definition, then, such knowledge also controls and predicts all such conduct by the operators within a resource system. Since such knowledge comprises a body of generally valid truths about reality, any deviance from the social order is a departure from reality - a deviance that could be variously interpreted as depravity, a symptom of mental illness, ignorance, criminality, wilfulness, or a sign of a power struggle aimed at the eventual usurpation of authority.

Thus a society's stock of knowledge, when either put into operation or reflected upon, becomes the local world; it becomes co-extensive with "the knowable" and provides the framework via which that which is "...not yet known will come to be known in the future" (Berger and Luckmann, 1984), i.e. the acceptance or not of innovation. In these terms knowledge is the key dialectic of society, since knowledge about society both captures everyday social reality and continuously reproduces it.

For example, a body of knowledge develops over generations to refer to the various activities involved in a given resource system, say fishing, takes on a linguistic form. This is

extremely important, since:-

(1) vocabularies define species, habitats, weather patterns, sea conditions, seasons, fish behavior, and the like;

(2) a collection of "recipes" must be learned in order to fish both correctly and with consistent success;

(3) knowledge is also a channelling and controlling force that underlies fishing institutions;

(4) in the persistence and crystallization of fishing institutions knowledge becomes the objective description of the activity/institution; and

(5) an objective arena/field/ethnoscience of fishing develops parallel with the activity of fishing.

This body of knowledge is transmitted to the next generation as an objective truth during socialization, and so is internalized as subjective reality. This transmission yields and gives identity to a specific type of person, a fisherman, whose (principal) social universe is constituted by that body of knowledge. As a consequence, to be an active fisherman implies that there exists a social world defined and controlled by a discrete body of arcane knowledge about fishing.

Only a fraction of an individual's experience is consciously retained and thus "makes sense". What is retained and shared by persons pursuing a common activity (e.g. fishing) becomes codified - usually in specific linguistic terms - and thus can be transmitted coherently to the next generation.

"The transmission of the meaning of an institution is based on the social recognition of that institution as *a* 'permanent' solution to a 'permanent' problem ..." (Berger and Luckmann,

1984). Therefore potential "...actors of institutional actions must be systematically acquainted with these meanings. This necessitates some form of educational process" (Berger and Luckmann, 1984; second emphasis added), to structure the transmission of any given body of knowledge, such as traditional ecological knowledge of fishing.

THE STRUCTURE OF TRADITIONAL KNOWLEDGE TRANSMISSION IN A MIXED PEASANT ECONOMY IN THE ORINOCO DELTA, VENEZUELA

The traditional system of knowledge transmission examined on Guara Island, in the Orinoco Delta of Venezuela (Ruddle and Chesterfield, 1977) is highly structured and systematic, with either individual or small group instruction. Emphasis is placed on "learning by doing", through repeated practice over time rather than by simple observation and replication. Regardless of the complex of tasks to be taught, a teacher's first step is to familiarize the learner verbally and visually with the physical elements of the appropriate location. The entire complex is demonstrated over a period of time; proceeding additively and sequentially from simple to complicated steps, the complex is divided into individual procedures that repeat those already mastered. Finally, an entire task complex is learned, with only occasional verbal correction needed. When competent, the learner is allowed to help the teacher, and to experiment and use his/her own initiative, and the teacher gradually eliminates the need to fill that role.

In terms of the generalized structure and processual

characteristics of the transmission of traditional knowledge noted above (p. 3), the system on Guara Island may be described as follows.

(1) Age

The learning of tasks is age-specific (Table 1). Learning to recognize the names and characteristics of the commoner items of the biota is the earliest ecological knowledge transmitted. Between two and five years of age, when a child is becoming mobile and learning to speak, he/she begins to become familiar with foodstuffs and other materials used to satisfy household needs. Older children are mobile and verbal enough to be taught task prerequisite to livelihood activities, complexes of knowledge associated with household maintenance and the preparation and processing of food, and are taken to the fields for the first time to observe cultivation techniques. Eight-year-old boys, now ready for formalized instruction in food production activities, are taught initially to use implements and techniques requiring a minimum of physical strength or skill. Gradually, more demanding task complexes are mastered, until finally boys of 11 to 14 years are prepared in complexes which are either exceedingly difficult to perform or are undertaken in dangerous locations.

(2) Gender

Labor is divided basically according to gender and age, as are the skills taught to a child. Both sexes are instructed in household and preparatory tasks (Table 1) , and with the exception

of the use of the bush knife, in which boys are given special instruction, the training of both sexes is similar. While 8-year-old boys begin intensive training in cultivation and complementary activities, girls continue to perfect skills related to household maintenance, in addition to receiving instruction in those aspects of cultivation for which women are responsible. Though girls learn to sow and plant, to select seeds, and to care for the dooryard garden, other aspects of cultivation, animal husbandry, fishing, and hunting are taught only to boys. Plant and animal identification, harvesting for the pot, small-scale fishing, and the care of animals are learned by both sexes, mostly during early childhood.

(3) Sequencing

Task complexes are taught sequentially (Table 2), the simpler and more familiar parts being taught first. Ability to identify food plants by name and characteristic is among the earliest skills developed, and once a plant's characteristics are known, children are trained in its procurement from easily accessible sites, using implements of an appropriate size. As strength and skill increase, training is provided for the acquisition of a greater quantity of food, for entrance into more dangerous locations, like backswamps, and for greater discriminatory capabilities.

Both task complexes and individual tasks are taught sequentially, building on skills already developed, until an entire complex of tasks has been mastered. Age and strength, as well as skill and experience, determine advancement to successive

levels.

(4) Location

Children are taught to take advantage of the seasonal range and local diversity of food resources, with the objective of ensuring a full cognizance with all local food resources. From earliest training in the dooryard garden, and in the river in front of the house, children of both sexes learn the rudiments of food preparation and household maintenance, as preparation for participation later in food production. Later, the cultivated field (for use of the bush knife, child care and cultigen identification) and pastures and grasslands (for horse-riding) become the sites for generalizing practice.

Cultivation tasks are taught almost entirely within the locale designated for a cultivated field, for, with the exception of early harvesting and plant identification, which is taught in the dooryard garden, a child become a cultivator in the fields proper. Similarly, except for learning to care for and feed animals in the village, all animal husbandry instruction takes place in pastures and grasslands. Children are trained to fish and hunt in sites frequented by target species. Early education takes place in the river and cultivated field, but as a boy grows and becomes more skilful, he is taught to fish and hunt in the more dangerous backswamps and grasslands.

(5) Duration

Although it is realized that learning to manipulate the complex deltaic ecosystem is a life-long undertaking, formal or

structured training in subsistence pursuits lasts only for about 8 years, when boys are between the ages of 6 and 14. During this period, specific times during the daily work routine are allocated for instruction (Table 3) . The duration of these periods is a function of both the complexity of what is being taught, and of the frequency with which training is undertaken. Similarly, the duration of both intensive training and the number of repetitions per session depend on both the laboriousness of the tasks, and the age at which the learner is introduced to them.

(6) Reinforcement

Children are punish only for breaching household rules during early childhood, never for deficiency in skill. Children learning subsistence activities are, rather, chastized when they fail in a task by being made ashamed of their failure to fulfil obligations both to themselves and to the non-food-producing members of their families. Thus a child's reciprocal responsibilities to its family are emphasized.

Rewards, however, are not entirely lacking: small children learning to cook may be given pieces of food for their assistance; boys are exhorted to learn cultivation tasks by a promise of their own small bush knife or of a small field of their own; and children of both sexes may be rewarded for animal care with the ownership of a hen or pig. Nonetheless, it is felt that the principal reward comes from proficient performance in itself, and a steady progression toward becoming acknowledge as a persons "who knows".

(7) Teaching Labor

The input of person-hours to instruction in all food-production activities combined comprises 14 percent of the total labor input required to operate the entire household subsistence system (Table 4).

Training in cultivation and complementary activities, like training in household chores, is almost *a* family undertaking (Table 5). Men are the principal teachers of subsistence activities, and women of household chores. Certain cultivation tasks, like harvesting in the dooryard garden and some planting tasks, are performed by females, who are also the teachers of these tasks. Beyond the provision of a basic knowledge of wild fauna, imparted to the learner by his/her entire family, and the aspects of learning fishing, hunting and animal husbandry that take place in the village, training in complementary activities is done by the father, sometimes assisted by a child's grandfather or older brother.

THE TRANSMISSION OF TRADITIONAL KNOWLEDGE ON PUKAPUKA: A POLYNESIAN CONTRAST

A striking contrast with the traditional education system described above for Guara Island is found on Pukapuka, one of the Cook Islands, of Polynesia, as analyzed by Borofsky (1987), and which appears to be typical of much of Polynesia. In Polynesia, much of the corpus of traditional knowledge is transmitted informally, as on Rotuma (Howard, 1973) , for example. But, as on Pukapuka, both formal and informal patterns occur.

In Polynesia, the transmission of traditional knowledge occurs within the all-pervasive context of "status rivalry" (Goldman, 1970; Howard, 1972; Marcus, 1978; Ritchie and Ritchie, 1979; Shore, 1982; Borofsky, 1987), or competition over status issues. On Pukupuka, such status issues of relevance to the transmission of traditional knowledge are (1) social hierarchy, dependency, and deference to superiors, and (2) autonomy and peer equality (Borofsky, 1987). Superior persons are deferred to by virtue of their social rank, not because they possess a superior knowledge, and as an affirmation of their own status and worth, people challenge, qualify or elaborate on, the knowledge of others (Borofsky, 1987). Further, knowledge is not always acquired or used for practical everyday purposes, since an appearance of being knowledgeable and the manipulation of knowledge are used to create/enhance the status of an individual.

On Pukapuka, most knowledge is transmitted in the context of an activity; in a situationally relevant purpose of performing daily tasks. This is similar to the situation on the Polynesian island of Tikopia (Firth, 1936), as elsewhere in Polynesia (Ritchie and Ritchie, 1979). Thus, for example, place names on a reef and the names and characteristics of reef fishes are gradually acquired as boys accompany their fathers on fishing trips. Some knowledge, however, is taught-learned for enjoyment, such as the entertainment provided by the narration of legends that, over time, gradually socialize children into a group's traditions.

On Pukapuka, verbal instruction is rare, and both children and adults learn by observation followed later by imitation, and

like Tubuai, another Polynesian island (Levin, 1978), where learning is based on close observation, formal instruction is minimal, and questioning, especially by children, discouraged, accept where it pertains to concrete situations. Observation is of paramount importance; "knowledge is something grasped visually (Borofsky, 1987: 81-82), and most Polynesians are visually oriented toward knowledge. Listening to the conversations of others is a second important means of acquiring knowledge. Repetition of observation, listening and practice is the principal factor in the Pukapukan transmission of knowledge.

Learners attempt to maintain their own status vis-a-vis teachers by themselves regulating when and where they will acquire knowledge. Status is also the reason why adults do not ask questions of others, since this would imply/reveal one's own ignorance, and, on the other hand, might cause the person questioned to either loose face or be subject to ridicule if an incorrect or inadequate answer is give. Casual, indirect conversation about a topic, however, saves face.

Ridicule of others, a "pervasive element in Pukapukan education" (Borovsky, 1987:92), is an important means of asserting one's own status and competence. And children are physically punished for doing things wrongly. In contrast, praise and encouragement is uncommon. This seems to be widespread in Polynesia (Levy, 1973; Levin, 1978; Hooper, 1990).

Challenge, and indirect criticism, joking and teasing among adults, are also used as educational tools. The resultant pressure and competition is a stimulus to learning. Hence, for the young, learning is often a humiliating and painful

experience, and many people prefer to learn on their own (Levy, 1973; Borofsky, 1987).

CONCLUDING COMMENTS

In any society, the transmission of traditional knowledge between/among generations is a complex and fundamental process embedded within the deep socio-cultural structure. It is this characteristic, rather than the inherent complexity of any biological and physical environment, that determines the intricacy and methods of the transmission process and the complexity of the curriculum. Thus the formal/informal distinction is of little relevance, since the concern must be with the holistic study of a society, of which it might be said that the curriculum and process of knowledge transmission is culture itself, which is by no means haphazard or unstructured, regardless of the methods of knowledge acquisition used, be they silent and individual observation and imitation, or additive and sequential direct teaching-learning.

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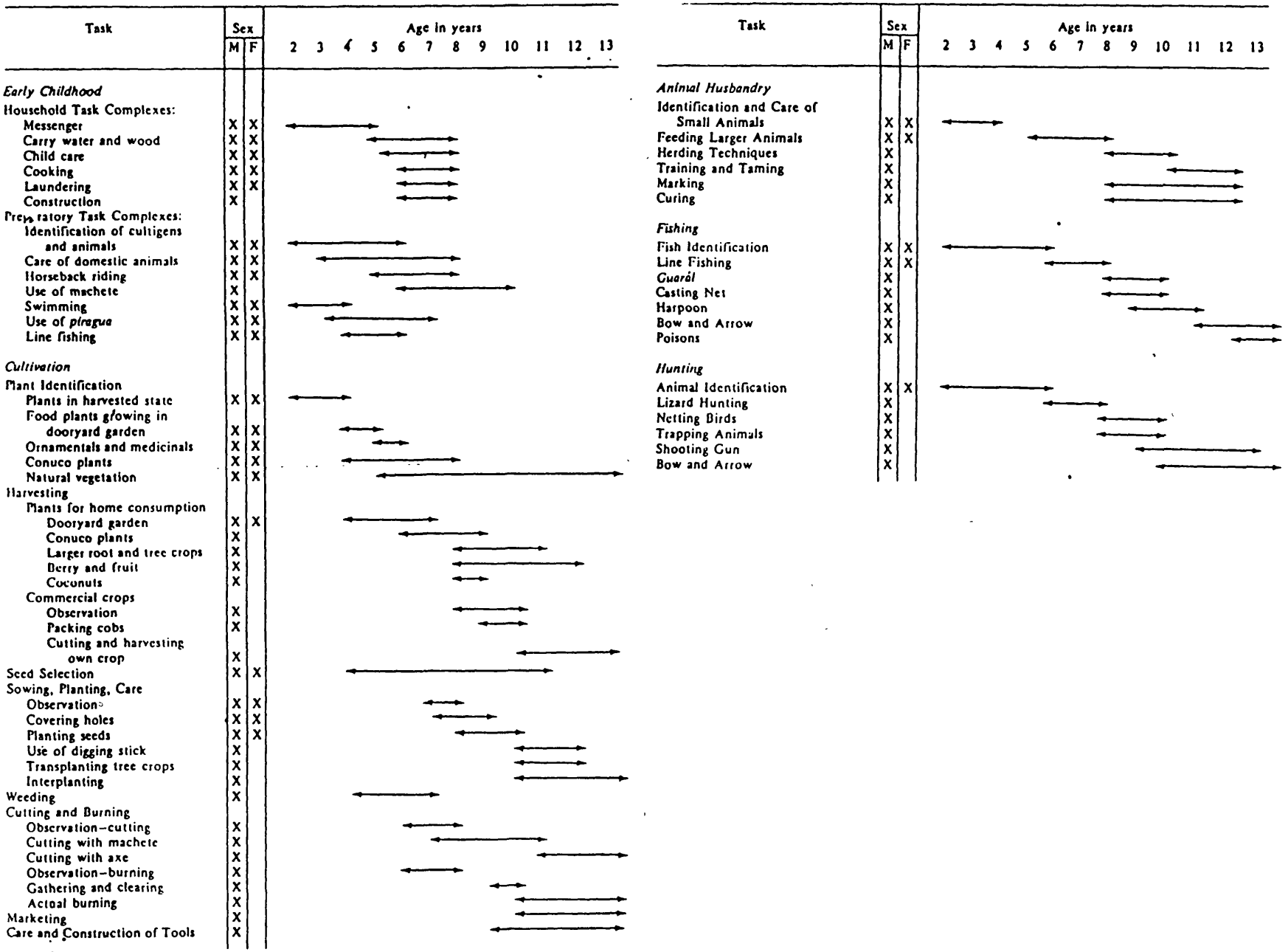
TABLE 1: DIVISION OF TASK COMPLEXES BY GENDER AND AGE OF LEARNER



Task	Sex M	Sex F
Early Childhood		
Household Task Complexes:		
Messenger	X	X
Carry water and wood	X	X
Child care	X	X
Cooking	X	X
Laundering	X	X
Construction	X	
Preparatory Task Complexes:		
Identification of cultigens and animals	X	X
Care of domestic animals	X	X
Horseback riding	X	X
Use of machete	X	
Swimming	X	X
Use of *piragua*	X	X
Line fishing	X	X
Cultivation		
Plant Identification		
Plants in harvested state	X	X
Food plants growing in dooryard garden	X	X
Ornamentals and medicinals	X	X
Conuco plants	X	X
Natural vegetation	X	X
Harvesting		
Plants for home consumption		
Dooryard garden	X	X
Conuco plants	X	
Larger root and tree crops	X	
Berry and fruit	X	
Coconuts	X	
Commercial crops		
Observation	X	
Packing cobs	X	
Cutting and harvesting own crop	X	
Seed Selection	X	X
Sowing, Planting, Care		
Observation	X	X
Covering holes	X	X
Planting seeds	X	X
Use of digging stick	X	
Transplanting tree crops	X	
Interplanting	X	
Weeding	X	
Cutting and Burning		
Observation–cutting	X	
Cutting with machete	X	
Cutting with axe	X	
Observation–burning	X	
Gathering and clearing	X	
Actual burning	X	
Marketing	X	
Care and Construction of Tools	X	

Task	Sex M	Sex F
Animal Husbandry		
Identification and Care of Small Animals	X	X
Feeding Larger Animals	X	X
Herding Techniques	X	
Training and Taming	X	
Marking	X	
Curing	X	
Fishing		
Fish Identification	X	X
Line Fishing	X	X
Guaral	X	
Casting Net	X	
Harpoon	X	
Bow and Arrow	X	
Poisons	X	
Hunting		
Animal Identification	X	X
Lizard Hunting	X	
Netting Birds	X	
Trapping Animals	X	
Shooting Gun	X	
Bow and Arrow	X	

TABLE 2: SEQUENCE OF LEARNING WITHIN AN ACTIVITY

Early Childhood

Household Task Complexes:

- Messenger
  - Verbal and physical identification of objects
  - Holding
  - Carrying
- Carrying Water and Wood
  - Identification of water and wood sources
  - Carrying small loads
  - Carrying water and wood for daily needs
- Child Care
  - Cleaning and swaddling
  - Assisting to walk
  - •Carrying small loads
  - Watching
- Cooking
  - Fetching foodstuffs
  - Preparing utensils
  - Cooking foodstuffs
  - Combining of foodstuffs
- Laundering
  - Laundering of one piece
  - Gradual increase of quantity
- Construction
  - Retrieving
  - Hammering and mixing
  - Cutting and shaping

Preparatory Task Complexes:

- Identification of Cultigens and Animals
  - Visual exposure to those used in cooking
  - Repetition of names
  - Verbalization of characteristics
  - Retrieval of catch or harvest
- Care of Domestic Animals
  - Throwing food to chickens and ducks
  - Naming of personal pet
  - Bundling of fodder for larger animals
  - Carrying of bundles
- Horseback Riding
  - Sitting on horse
  - Clinging to walking horse
  - Using reins to guide and stop
  - Cantering and galloping
- Use of Machete
  - Gearing brush with grapnel
  - Slicing with machete
- Swimming
  - * Floating on piece of wood
  - Paddling with arms and legs
  - Dog paddling without wood
  - Swimming with crawl stroke
- Use of *Piragua*
  - Playing in boat
  - Pretending to paddle
  - Untying boat
  - Pushing off
  - Entering boat
- Fishing with Line
  - Catching bait
  - Baiting hook
  - Tying hook to line
  - Pulling in fish

Cultivation

- Vegetation Identification
  - Verbal identification of plants consumed from dooryard garden
  - Identification of medicinals and decuratives
  - Identification of tree crops
  - Universally-cultivated conuco crops
  - Specialty crops
  - Rastrojo
  - Grassland
  - Swamps
- Harvesting
  - For home consumption
    - Carrying harvested plants
    - Pulling and picking
    - Removal of small root crops with machete
    - Cutting of larger root crops
    - Picking berry crops
  - Commercial crops
    - Cutting maize
    - Chopping smaller tubers
    - Cutting large root crops
    - Picking trees and berries
- Seed Selection
  - Seed plants used at table
  - Grain plants
  - Seedlings from tree crops
  - Plants propagated by cuttings
- Sowing and Planting
  - Sowing of annuals
    - Maize
    - Covering holes
    - Placing maize seeds
    - Use of digging stick
    - Individual differences among annuals
  - Planting of root crops
    - Cleaning and preparation of clones
    - Laying out of clones
    - Placing and covering of clones
    - Use of shovel
    - Transplanting of tree crops
    - Interplanting in small conuco
- Care
  - Weeding
  - Use of grapnel
  - Use of machete
  - Weeding of maize
  - Weeding of polycultural conuco
  - Protecting conuco from birds
- Cutting
  - Collecting cut material
  - Slashing underbrush with machete
  - Cutting saplings with axe
  - Cutting trees with axe
  - Construction of scaffolds
  - Identification of rastrojo
- Burning
  - Piling cut material
  - Gearing of firebreak
  - Firing against wind in conuquito
  - Identifying degree of dryncss of cut vegetation
- Marketing
  - Pricing
  - Guarding dugoul
  - Selling from dugout
  - Selling in market
- Care and Construction of Tools
  - Sharpening machete
  - Locating wood for handles
  - Shaping handles
  - Tying on blades

TABLE 2 (CONT'D)

Animal Husbandry

Identification and Care of Small Animals
- **Verbal identification of cascrio animals**
- Feeding of small animals
- Care and feeding of animals within caseno

Herding, Taming, and Marking
- **Rounding-up piglets**
- Carrying piglets
- Training of young pigs
- **Marking of piglets**
- **Naming of cattle**
- Feeding cattle and horses
- **Roping cattle**
- **Herding cattle in *chiqueros***
- **Marking calves**

Curing and Butchering
- **Curing cattle**
- **IInlflifiitiK plf.***
- **butchering cattle**
- **Herding cattle to Uracoa**

Fishing

Identification of Fish Brought to Village
Fishing with Hook and Line
Use of *Guaral*
- **Baiting hook**
- **Pulling in fish**
- **Casting *guaral***
- **Playing fish**

Casting Net
- **Pulling in net**
- **Throwing small ncl**
- **Fishing with companion**
- **Use adult gear**
- **Repair and construction**
  - **Knot net**
  - **Sew net**
  - Location of wood
  - Shaping of wood

Harpoon
- **Fetching fruit**
- **Pull in catch in carlo**
- **Throwing length of wood**
- **Throwing at inanimate objects**
- **Throwing at small fish**
- **Throwing at large fish**
- **Fishing with harpoon in backswamps**

Bow and Arrow
- **Shooting smalt bow at large inanimate objects**
- **Shooting birds and animals**
- **Shooting fish**

Construction and repair
- **Location of wood**
- **Shaping of wood**
- **Tying of points**

Poisons
- **Searching for plants**
- **Blocking stream**
- **Throwing poison**
- **Removing fish**
- **Cutting trees**

Marketing
- **Carrying surplus to friends or relatives**
- **Selling surplus in village with father**
- **Guarding boat in Tucupita market**

Hunting

Identification of Animals Brought to Village
Lizard Hunting
- **Beating of brush**
- **Bludgeoning of lizard**

Netting
- Gearing undergrowth
- Scattering grain
- Constructingblind
- **Pulling net**
- Hunting with small net
- Selling surplus
- **Repair and construction**
  - **Knot**
  - **Sew**

Trapping
- **Retrieving catch**
- Searching for materials
- **Placing and tying trigger**
- Use of miniature traps
- Use of rope trap

Shooting Gun
- Care and handling
- **Loading**
- **Shooting at large inanimate objects**
- **Shooting at birds**
- **Shooting at mammals**
- Hunting in backswamps

Bow and Arrow
- Shooting at inanimate objects
- Shooting small birds
- Holding torch
- Shooting large animals

TABLE 3: DIVISION OF TASK COMPLEXES BY LENGTH, FREQUENCY, AND DURATION OF TRAINING

Task	Age	Length of training session	Frequency of session	Repetitions per session	Duration of intensive training
Early Childhood					
Household Task Complexes:					
Messenger	2-3	5 mins	3 times/wk	2-3	2-3 mos
Carry water and wood	5-8	10 mins	daily	1 or 2	2-3 mos
Child care	5-8		2-3 times/wk	1	1-2 yrs
Cooking	6-8	10-15 mins	daily	1	1 yr
Laundering	6-8	10-15 mins	twice/wk	1	1-2 yrs
Construction	4-12				
Preparatory Task Complexes:					
Identification of cultigens and animals	2-6	2-3 mins	daily	2-3	5 yrs
Care of domestic animals	3-7	5-10 mins	daily	20-30	4 yrs
Horseback riding	3-8	15-30 mins	daily	1-2	5 yrs
Use of machete	6-8	2-3 hrs	1 time/wk	10-12	2 yrs
Swimming	2-5	30 mins	2-3 times/wk	many	2 yrs
Use of *piragua*	1-8	15-30 mins	2-3 times/wk	many	3 yrs
Line fishing	6-8	30 mins	2-3 times/wk	many	2 yrs
Cultivation					
Plant Identification					
Plants in dooryard garden	2-6	5 mins	daily	many	4 yrs
Conuco plants	4-6	5 mins	daily	many	2 yrs
Natural vegetation	5-15	5 mins	daily	many	10 yrs
Harvesting					
Plants for home consumption					
Plants in dooryard garden	2-6	30 mins	daily	many	2 yrs
Conuco plants	6-8	15-30 mins	daily*	many	3-6 mos
Larger root and tree crops	8-10	30 mins	daily*	many	3 mos
Berry and fruit crops	8-12	30 mins	daily*	many	3-6 mos
Commercial crops	8-12	1 hr	daily*	many	2 yrs
Seed Selection	4-10	10-15 mins	daily*	many	4 yrs
Sowing, Planting, Care					
Covering holes	8-9	30 mins	one day	5-6	1 season
Placing of seeds	8-9	½-1 hr	daily*	5-10	2 seasons
Laying out cormels	9-10	½-1 hr	daily*	5-10	1 season
Use of digging stick (shovel)	10-12	½-1 hr	daily*	many	2 seasons
Transplanting	10-11	½-1 hr	daily*	5-6	1 season
Interplanting	10-13	½-1 hr	daily*	many	3 yrs
Protecting plants from birds	8-10	10 mins	one	1-2	1 day
Weeding	6-8	1 hr	one day	10-20	2 yrs**
Cutting	10-14	1 hr	daily*	many	4 yrs
Burning	10-14	1 hr	daily*	many	4 yrs
Marketing	10-11	30 mins	1-2/wk	many	1 yr
Care and Construction of Tools	9-14	1 hr	when needed	5-6	4-5 yrs
Animal Husbandry					
Identification and Care of Small Animals	3-8	5-10 mins	daily	20-30	4 yrs
Feeding of Larger Animals in Potreros	8-10	30 mins	daily	4-5	1 yr
Herding Techniques	8-14	1 hr	daily*	30-40	1 yr
Training and Taming	8-12	1 hr	daily*	many	1 yr
Marking	8-12	1 hr	daily*	4-5	1 yr
Curing	8-14	1 hr	when needed	4-5	1 yr
Fishing					
Fish Identification	2-6	2-3 mins	3-5 times/day	many	4 yrs
Line Fishing	6-8	30 mins	2-3 times/mo	many	2 yrs
Guaral	8-10	15-30 mins	1-2 times/wk	many	1 yr
Casting Net	8-10	15-30 mins	1-2 times/wk	many	1 yr
Harpoon	10-12	15-30 mins	daily	many	4-6 yrs
Bow and Arrow	10-14	1-2 hrs	2-3 times/wk	many	4-6 yrs
Poisons	8-12	1 hr	3-4 times/yr	2-3	1 yr
Hunting					
Animal Identification	2-6	2-3 mins	3-5 times/day	many	4 yrs
Lizard Hunting	6-8	5-10 mins	1/mo	1-2	1 yr
Netting Birds	8-9	½-1 hr	2/mo	many	2 yrs
Trapping Animals	8-9	½-1 hr	1/mo	many	2 yrs
Shooting Gun	10-12	15-30 mins	2-3 times/wk	many	2 yrs
Bow and Arrow	11-14	1-2 hrs	2-3 times/wk	many	4-6 yrs

* In season

** Includes time spent in learning the use of the *machete*

TABLE 4: ESTIMATED LABOR INPUTS PER ANNUM

Activities and task complexes	Total input of man-hours	Man-hours spent teaching	Percentage/Input of man-hours spent teaching
Cultivation (per ha)			
Maizal Site Preparation	220	47	21
Cleaning for Re-Use as Conuco[a]	124	17	14
Sowing and Planting Conuco[b]	355[c]	47	20[d]
Weeding[e]	240	25	10
Harvesting[f]	170	26	15
Marketing[g]	200	13	6
Subtotal	1309[h]	175	15[h]
Animal Husbandry			
Daily Maintenance[i]	400	48	12
Supplemental Feeding, Marking, and Curing	140	32	23
Training and Taming	40	10	25
Marketing	140	16	11
Miscellaneous Tasks	50	6	12
Transhumance	64	*j*	*j*
Subtotal	834	112	13
Fishing with:			
Line[k]	200	27	14
Guaral	74	15	20
Casting Nets	58	12	21
Harpoon[l]	36	3	8
Bow and Arrow[l]	24	3	13
Suffocants	16	2	13
Subtotal	408	62	15
Hunting			
Lizard Hunting[k]	24	2	8
Netting Birds	96	12	13
Trapping Mammals	24	3	13
Shotgun (Use of)[l]	250	25	10
Bow and Arrow (Use of)[k]	60	7	12
Subtotal	454	49	11
TOTAL	3015[m]	398	14[m]

[a] Refers to *maizal* only.
[b] Calculated for conuco only using data for maize, beans, manioc, sweet potatoes, cush-cush, and yams.
[c] Labor supplied by head-of-household, his wife, and pre-adult son(s).
[d] Percentage calculated using 66.6 percent of total input of man-hours.
[e] Calculated on basis of 5 weedings per year in conuco.
[f] Total refers to conuco and includes maize (35 hrs.), manioc, sweet potatoes, cush-cush and yams (70 hrs., Musaceae [44 hrs.] and tree crops [22 hrs.]). Time includes allowance for sacking, transporting, storing and marketing produce in caserío.
[g] Not calculated per ha.
[h] Subtotal reduced by 119 hours in calculating percentage to allow for 33.3 percent reduction of input in sowing and planting corresponding learner's labor input.
[i] Task complex performed mostly by women and children.
[j] Task complex taught in other situations.
[k] Task complex performed mostly by boys.
[l] Not including practice time.
[m] Percentage calculated from a total reduced by the 119 hours which correspond to learner's labor input per year per ha. in sowing and planting.

	Relationship to Learner							
	Father	Mother	Older sibling		Grandparent		Compadre	Other
			Brother	Sister	Grandfather	Grandmother		
PRE-ACTIVITY PERIOD								
Early Childhood								
Household Task Complexes								
Messenger	–	Mo	–	Mi	–	S	–	–
Carry water and wood	–	Mo	–	Mi	–	S	–	–
Childcare	–	Mo	–	Mi	–	S	–	–
Cooking	–	Mo	–	Mi	–	S	–	–
Laundering	–	Mo	–	S	–	S	–	–
Construction	Mo	–	Mi	–	S	–	–	–
Preparatory Task Complexes								
Identification of cultigens and animals	Mo	S	S	S	S	S	S	–
Care of domestic animals	–	Mo	–	S	–	S	–	–
Horseback riding	Mo	–	Mi	–	S	–	–	–
Use of machete	Mo	–	S	–	S	–	–	–
Swimming	–	S	Mo	Mo	–	–	–	–
Use of *piragua*	–	S	Mo	Mo	–	–	–	–
Line fishing	S	–	Mo	–	–	–	–	–
ACTIVITIES								
1. *Cultivation*								
Plant Identification								
Plants in dooryard garden	–	Mo	–	Mi	–	S	–	–
Conuco plants	Mo	–	S	–	S	–	–	–
Natural vegetation	Mo	–	Mi	–	S	–	–	–
Harvesting								
Plants for home consumption								
Dooryard garden	–	Mo	–	Mi	–	Mi	–	–
Conuco plants	Mo-A	–	Mi	–	Mi	–	–	–
Larger root and tree crops	Mo-A	–	Mi	–	Mi	–	–	–
Berry and fruit crops	Mo-A	–	Mi	–	Mi	–	–	–
Commercial crops	Mo-A	–	Mi	–	Mi	–	–	–
Seed Selection	Mo	S-A	–	Mi	–	Mi	–	–
Sowing, Planting, Care								
Covering holes	S	Mo	–	Mi	–	Mi	–	–
Placing of seeds	Mi	Mo	–	Mi	–	Mi	–	–
Laying out cormels	Mi	Mo	–	Mi	–	Mi	–	–
Use of digging stick	Mo	–	–	–	Mi	–	–	–
Transplanting	Mo	–	–	–	Mi	–	–	–
Interplanting	Mo	–	–	–	Mi	–	–	–
Protecting young plants from birds	S	–	Mo	–	–	–	–	Mo
Weeding	Mo	–	S	–	S	–	–	–
Cutting	Mo	–	–	–	S	–	–	–
Burning	Mo-A	–	–	–	S	–	S	–
Marketing	Mo-A	–	Mi	–	Mi	–	–	–
Care and Construction of Tools	Mo	–	–	–	S	–	–	–
2. *Animal Husbandry*								
Identification and Care of Small Animals	–	Mo	–	S	–	S	–	–
Feeding Larger Animals	S	Mo	S	S	S	S	–	–
Herding Techniques	Mo	–	Mi	–	Mi	–	–	–
Training and Taming	Mo	–	Mi	–	Mi	–	–	–
Marking	Mo	–	Mi	–	Mi	–	–	–
Curing	Mo	–	Mi	–	Mi	–	–	–
3. *Fishing*								
Fish Identification	Mo	S	S	S	S	S	S	S
Line Fishing	S	–	Mo	–	–	–	–	–
Guaral	Mo	–	Mi	–	S	–	–	–
Casting Net	Mo-A	–	–	–	S	–	–	–
Harpoon	Mo-A	–	–	–	S	–	–	–
Bow and Arrow	S	–	–	–	S	–	S	S
Poisons	Mo	–	–	–	S	–	S	–
4. *Hunting*								
Animal Identification	Mo	Mi	S	S	S	S	–	–
Lizard Hunting	–	–	Mo	–	–	–	–	Mo
Netting Birds	Mo	–	Mi	–	Mi	–	Mi	–
Trapping Animals	Mo	–	Mi	–	Mi	–	Mi	–
Shooting Gun	Mo-A	–	–	–	Mi	–	–	–
Bow and Arrow	Mo-A	–	–	–	Mi	–	–	Mi

A: All–Task taught exclusively by person.
Mo: Most–Task principally taught by person.
S: Some–Person undertakes some share of training.
Mi: Minimal–Only occasionally teaches task.
– In normal circumstances task never taught by person

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Bow and Arrow[l]	24	3	13
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Subtotal	408	62	15
Hunting			
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[f] Total refers to conuco and includes maize (35 hrs.), manioc, sweet potatoes, cush-cush and yams (70 hrs., Musaceae [44 hrs.] and tree crops [22 hrs.]). Time includes allowance for sacking, transporting, storing and marketing produce in caserío.
[g] Not calculated per ha.
[h] Subtotal reduced by 119 hours in calculating percentage to allow for 33.3 percent reduction of input in sowing and planting corresponding learner's labor input.
[i] Task complex performed mostly by women and children.
[j] Task complex taught in other situations.
[k] Task complex performed mostly by boys.
[l] Not including practice time.
[m] Percentage calculated from a total reduced by the 119 hours which correspond to learner's labor input per year per ha. in sowing and planting.

TABLE 5: DIVISION OF TASK COMPLEXES BY TEACHER

	Relationship to Learner							
	Father	Mother	Older sibling		Grandparent		Compadre	Other
			Brother	Sister	Grandfather	Grandmother		
PRE-ACTIVITY PERIOD								
Early Childhood								
Household Task Complexes								
Messenger	–	Mo	–	Mi	–	S	–	–
Carry water and wood	–	Mo	–	Mi	–	S	–	–
Childcare	–	Mo	–	Mi	–	S	–	–
Cooking	–	Mo	–	Mi	–	S	–	–
Laundering	–	Mo	–	S	–	S	–	–
Construction	Mo	–	Mi	–	S	–	–	–
Preparatory Task Complexes								
Identification of cultigens and animals	Mo	S	S	S	S	S	S	–
Care of domestic animals	–	Mo	–	S	–	S	–	–
Horseback riding	Mo	–	Mi	–	S	–	–	–
Use of machete	Mo	–	S	–	S	–	–	–
Swimming	–	S	Mo	Mo	–	–	–	–
Use of *piragua*	–	S	Mo	Mo	–	–	–	–
Line fishing	S	–	Mo	–	–	–	–	–
ACTIVITIES								
1. *Cultivation*								
Plant Identification								
Plants in dooryard garden	–	Mo	–	Mi	–	S	–	–
Conuco plants	Mo	–	S	–	S	–	–	–
Natural vegetation	Mo	–	Mi	–	S	–	–	–
Harvesting								
Plants for home consumption								
Dooryard garden	–	Mo	–	Mi	–	Mi	–	–
Conuco plants	Mo-A	–	Mi	–	Mi	–	–	–
Larger root and tree crops	Mo-A	–	Mi	–	Mi	–	–	–
Berry and fruit crops	Mo-A	–	Mi	–	Mi	–	–	–
Commercial crops	Mo-A	–	Mi	–	Mi	–	–	–
Seed Selection	Mo	S-A	–	Mi	–	Mi	–	–
Sowing, Planting, Care								
Covering holes	S	Mo	–	Mi	–	Mi	–	–
Placing of seeds	Mi	Mo	–	Mi	–	Mi	–	–
Laying out cormels	Mi	Mo	–	Mi	–	Mi	–	–
Use of digging stick	Mo	–	–	–	Mi	–	–	–
Transplanting	Mo	–	–	–	Mi	–	–	–
Interplanting	Mo	–	–	–	Mi	–	–	–
Protecting young plants from birds	S	–	Mo	–	–	–	–	Mo
Weeding	Mo	–	S	–	S	–	–	–
Cutting	Mo	–	–	–	S	–	–	–
Burning	Mo-A	–	–	–	S	–	S	–
Marketing	Mo-A	–	Mi	–	Mi	–	–	–
Care and Construction of Tools	Mo	–	–	–	S	–	–	–
2. *Animal Husbandry*								
Identification and Care of Small Animals	–	Mo	–	S	–	S	–	–
Feeding Larger Animals	S	Mo	S	S	S	S	–	–
Herding Techniques	Mo	–	Mi	–	Mi	–	–	–
Training and Taming	Mo	–	Mi	–	Mi	–	–	–
Marking	Mo	–	Mi	–	Mi	–	–	–
Curing	Mo	–	Mi	–	Mi	–	–	–
3. *Fishing*								
Fish Identification	Mo	S	S	S	S	S	S	S
Line Fishing	S	–	Mo	–	–	–	–	–
Guaral	Mo	–	Mi	–	S	–	–	–
Casting Net	Mo-A	–	–	–	S	–	–	–
Harpoon	Mo-A	–	–	–	S	–	–	–
Bow and Arrow	S	–	–	–	S	–	S	S
Poisons	Mo	–	–	–	S	–	S	–
4. *Hunting*								
Animal Identification	Mo	Mi	S	S	S	S	–	–
Lizard Hunting	–	–	Mo	–	–	–	–	Mo
Netting Birds	Mo	–	Mi	–	Mi	–	Mi	–
Trapping Animals	Mo	–	Mi	–	Mi	–	Mi	–
Shooting Gun	Mo-A	–	–	–	Mi	–	–	–
Bow and Arrow	Mo-A	–	–	–	Mi	–	–	Mi

A: All–Task taught exclusively by person.
Mo: Most–Task principally taught by person.
S: Some–Person undertakes some share of training.
Mi: Minimal–Only occasionally teaches task.
–: In normal circumstances task never taught by person.