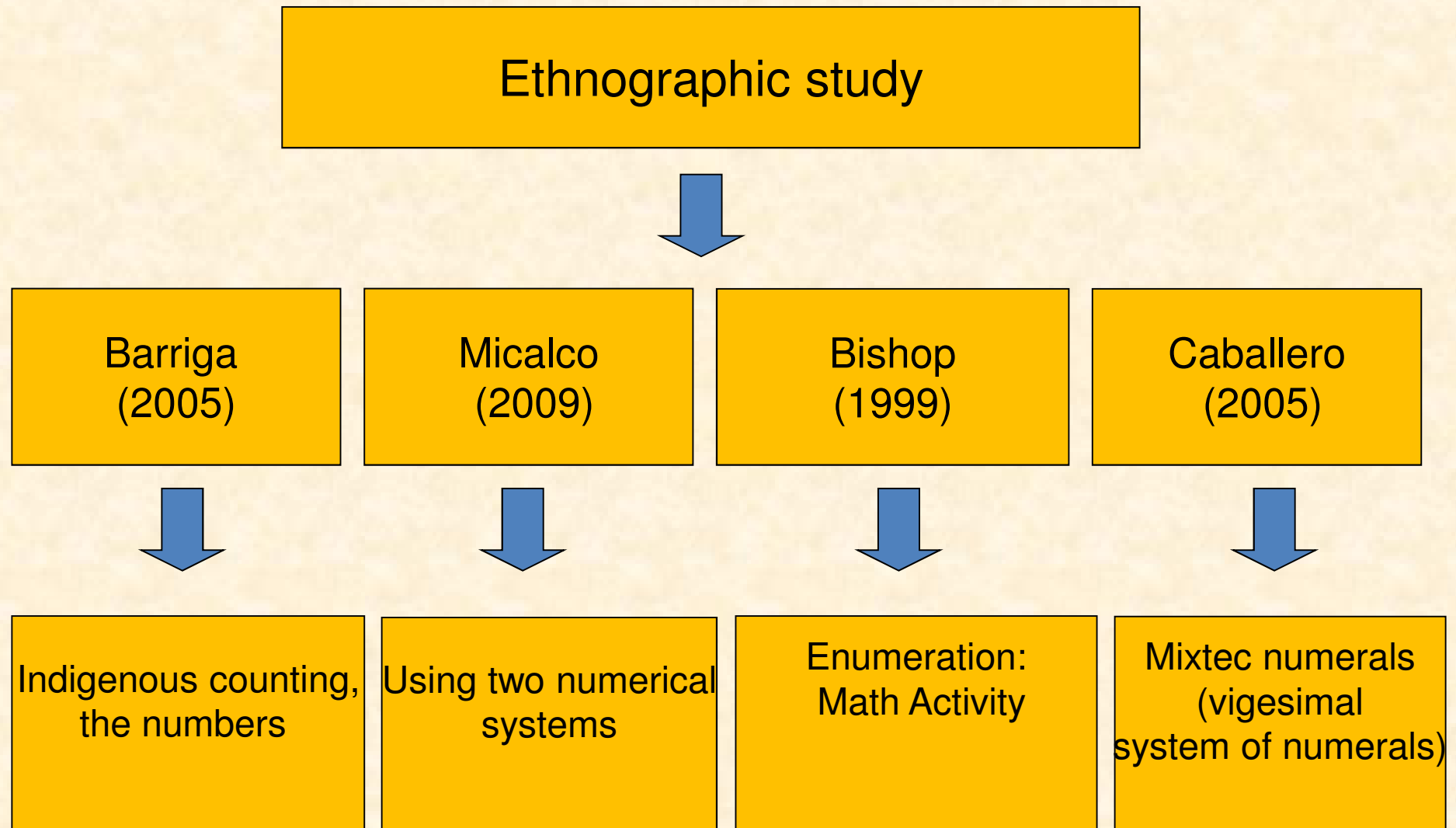


The *Tu'un savi* language revitalization
through the teaching of their oral counting
(vigesimal system)



Fanny Cruz García
Francisco A. Cruz Ramírez

Study Background: Vigesimal system



Study Background: Indo-Arabic numeral system (decimal)

Psychological study



Lerner y Sadovsky
(1994)

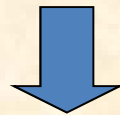


Development of
hypothesis

Study background: The indigenous languages (oral counting)

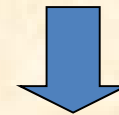
Legal studies

The Political Constitution
of the United Mexican
States (2003)



The rights of speakers
of indigenous languages
of Mexico

National Indigenous
Languages Institute-INALI
(2005)



To promote the strengthening,
development and preservation of
indigenous languages

Tu'un savi language

Feature

Geographical
distribution

Linguistic classification

Demography

Oaxaca, Guerrero,
Puebla

Oto-manguean
Mixtecana
Tonal
81 variant (INALI)

4^o. location
423,216 speakers
(INEGI)

Methodology

A qualitative study

San Juan Mixtepec
(2010)

Cosoltepec
(2012)

participants

Three girls and four boys
aged 7-10 years
tu'un savi Speakers
2nd. and 3rd. Rural Public School
primary grade bilingual Multigrade:
One teacher

Six girls and seven boys
10-12 years
Non-speakers of tu'un savi
5th. and 6th. primary grade
Federal rural public school
Multigrade: three teachers

Stages of study

1st. Structure of mixtec (Tu'un savi) numbers system



2nd. Initial questionnaire: vigesimal system



3rd. Teaching sequence: workshop



4th. Final questionnaire

Results 1st stage: Structure of the *Tu'un savi* system (Mixtec)

- Is oral.
- Is a vigesimal numeral system:
 - It has two additive bases and one multiplicative.
 - Their additive bases are ten and fifteen.
 - The multiplicative base is twenty.

Structure of the *Tu'un savi* system (mixtec): two variants

Numerals 1 to 10 of *Tu'un savi*

Tu'un savi words			
Cosoltepec Variant	San Juan Mixtepec Variant	Spanish translation	Numeral
In	Ín	Uno	1
Ui	Uvi	Dos	2
Uni	Uni	Tres	3
Kumi	Kumi	Cuatro	4
U'un	U'un	Cinco	5
Iñu	Iñu	Seis	6
Usa	Utsa	Siete	7
Una	Una	Ocho	8
In	lin	Nueve	9
Uxi	Utsi	Diez	10

Additive bases
Tu'un savi (Mixtec)

1- ín

2- ui, uvi

3- uni

4- kumi

5- u'un

6- iñu

7- usa, utsa

8- una

9- ĩn, iin

10- uxi, utsi

11- uxi ín

12- uxi ui

13- uxi uni

14- uxi kumi

15- sa'un, tsa'un

16- sa'un ín

17- sa'un ui

18- sa'un uni

19- sa'un kumi

20- oko

Multiplicative base *Tu'un savi* (Mixtec)

1- ín

2- uvi

3- uni

4- kumi

5- u'un

6- iñu

7- utsa

8- una

9- iin

10- utsi o uxi

11- uxi ín

12- uxi uvi

13- uxi uni

14- uxi kumi

15- sa'un

16- sa'un in

17- sa'un ui

18- sa'un uni

19- sa'un kumi

20- oko

40- uvi diko

60- uni diko

80- kumi diko

100- ín cientu

Table of the numeral system of *Tu'un savi*

		ín	ui	uni	kumi	u'un	iñu	usa	una	in	uxi	uxi in	uxi ui	uxi uni	uxi kumi	sa'un	sa'un ín	sa'un ui	sa'un uni	sa'un kumi
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
oko	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39
ui diko	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59
uni diko	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79
kumi diko	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99
u'un diko	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119

Table of the numeral system of *Tu'un savi*

uni diko uxi: $(3 \times 20) + 10$

	ín	úi	uni	kumi	u'un	iñu	usa	una	in	uxi	uxi in	uxi ui	uxi uni	uxi kumi	sa'un	sa'un ín	sa'un ui	sa'un uni	sa'un kumi	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	
oko	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39
ui diko	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59
uni diko	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79
kumi diko	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99
u'un diko	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119

Results of the 2nd stage initial questionnaire: *Tu'un savi* system

- Students in San Juan Mixtepec use some principles of the decimal system to develop the writing of the mixtec system.

Results of the 2nd stage the initial questionnaire: *Tu'un savi* system

Multiplicative (base 20) in the system Mixtec

1 = *ti*
 2 = *vi*
 3 = *na*
 4 = *komi*
 5 = *inu*
 20 = *oko*
 21 = *okoti*
 22 = *okov*
 23 = *okuni*
 24 = *okocumi*
 25 = *okoinu*
 30 = *una*
 35 = *oxi* ~~okov~~ *hsi*
 36 = *okov*
 37 = *okov*
 38 = *okov*
 39 = *okov*
 40 = *oxi*

Writing numbers in Mixtec 35 to 39

35 *oko utsi un'un*
 36 *oko utsi ya*
 37 *oko utsi utso*
 38 *oko utsi un'a*
 39 *oko utsi un'a*
 40 *oxi un'a*
oxi

Results of the 3rd stage: Teaching sequence

- Cosoltepec non-tu'un savi speakers, transiting flexibly between oral Mixtec numerical system and Indo-Arabic written numerical representation.
- They developed hypotheses about groupings in the vigesimal system. Some ideas correspond correctly with the rules of the vigesimal system but not others.

Results of the 3rd stage: Teaching sequence

Exercise relating the names of numbers in Mixtec and their Indo-Arabic representation

Une con una línea los nombres de los números en mixteco con los números.

ui	10
usa	3
kumi	5
uni	2
iñu	9
ín	7
una	4
uxi	1
in	6
u'un	8

Results of the 3rd stage: Teaching sequence

Construction of 10 to 14 in Mixtec

¿Cómo se dice en mixteco del 10 al 14? Fíjate en los ejemplos.

Número	Nombre del número en mixteco
10	Uxi
11	Uxi ín
12	UXI' UI
13	UXI' UNÍ
14	UXI' KUMÍ

Construction of 15 to 19 in Mixtec

2. ¿Cómo se dice en mixteco del 15 al 19?

Número	Nombre del número en mixteco
15	Sa'un
16	Sa'un inu
17	Sa'un usq
18	Sa'un auna
19	Sa'un in

Results of the 3rd stage: Teaching sequence

Construction of 20 to 29 in Mixtec

3. ¿Cómo se dice en mixteco del 20 al 29?

Número	Nombre del número en mixteco
20	Okó
21	Okó ín
22	Okó uí
23	Okó uní
24	Okó kumí
25	Okó u'un
26	Okó iñu
27	Okó usa
28	Okó una
29	Okó in

Construction of 30 to 34 in Mixtec

4. Por ultimo, ¿cómo se dice en mixteco del 30 al 34?

Número	Nombre del número en mixteco
30	Okó uxi
31	Okó ín
32	Okó uí
33	Okó uní
34	Okó kumí

Results of the 3rd stage: Teaching sequence

Extract of dialogue on understanding Mixtec groupings:

Researcher: is *uxi ín* the same thing as *ín uxi*?

Children:- No

Research:- What is *ín uxi*?

Children:- Ten

Researcher:- Or...

Children:- It's a set of *uxi*

Researcher: Is *ín sa'un* the same as *sa'un ín*?

Children:-No

Researcher: - What is *ín sa'un*?

Researcher:- A set of *sa'un*

Researcher: So, what is *sa'un ín*?

Children:- Sixteen

Researcher:- So, is *ín oko* the same as *oko ín*?

Children:- No

Researcher: - What is *ín oko*?

Children:- A set of *oko*. *Ín oko* is a set.

Researcher:- So, what is *oko ín*?

Children:-Twenty one

Researcher:- twenty one what?

Children:- Fingers

Researcher:- Twenty one fingers

Results of the 4th stage: Final questionnaire

Writing tu'un savi numbers

1. Escribe los nombres de los números en mixteco.

18 Sa^oun Uni^o

46 Di^oko i^onu

23 O^oko Uni^o

73 Uni^o Di^oko u^oxi^o
Uni^o,

Results of the 4th stage: Final questionnaire

Matching tu'un savi
names with Indo-Arabic number representations

2. Escribe el número que le corresponde a cada nombre del número en mixteco

Nombre del número en mixteco	Número
Okó sa'un	35
Uni diko una	68
Kumi diko uxi ui	92
U'un diko ín	101

Conclusions

- One of the factors that influence the disuse of the numbering systems of indigenous languages is that it is not taken into account in the teaching of mathematical content in school.
- There seems to be a superposition of the notions of the Indo-Arabic system onto the oral vigesimal Mixtec system. Children of San Juan Mixtepec have oral knowledge of the Mixtec system but have not yet developed writing the names of numbers in school. They develop writing numbers 1 to 34 according to the Mixtec vigesimal system, but from the number 35 they blend their knowledge of the decimal system with the vigesimal system in the writing of numbers.

Conclusions

- Cosoltepec children did not know the Mixtec oral system and have difficulty in understanding the groups that retain the vigesimal characteristics of that system.
- The notion of quantification is one aspect of the language has been weakened and has been lost.
- Basic primary education as offered in these populations may be an active agent that contributes to the revitalization of tu'un savi while recognizing the teaching of the oral Mixtec system within the mathematics curriculum, in addition to teaching the Indo-Arabic system.

Conclusions

- Numeral systems are part of indigenous languages. As national languages these are part of the national cultural and linguistic heritage of Mexico (under Mexican law).
- Indigenous peoples have the right to autonomy to preserve and enrich them.
- The Mexican State is obliged to recognize and protect them and to promote their development through the bilingual intercultural education system.

Conclusions

- The Mixtec vigesimal oral system, compared with the decimal system, has different ways of grouping quantities. Providing rural schools in Mexico with a place to reflect and teach this numbering system would be an opportunity both to develop mathematical thinking and to prevent the quantitative loss of indigenous languages.
- It is unacceptable that the disuse of numbering systems is tolerated. Doing so contributes significantly to the displacement of native languages and cultures.

References

- Barriga, F. (2005). Natural History of number systems. In: M. Alvarado and B. M. Brizuela (Eds.). By numbers: numerical notations views from the educational psychology and history. Mexico: Polity Press.
- Caballero, G. (2005). The numbering of Tu'un Savi. Savi Tu'un magazine. Numbers 7.8 and 9. Huajuapán de León, Oaxaca.
- De Bengoechea, N. (1997) The numbering Indians of Mexico. Mail Master. 12. May, p. 21-36.
- Micalco, M. (2009). Uses vigesimal number system and its interface with the decimal number system in the practices of young Mayan community: an ethnographic study region located in the Tzeltal of highland Chiapas. Paper presented at the Tenth National Congress of Educational Research. Veracruz. Mexico.
- Zhang, J. and Norman, D. (1995). Representational analysis of numeration systems. Cognition. 57. pp. 271-295.
- Cruz, F. A. and Butto, C. (2010). The numbering system vigesimal Mixtec. A didactic study with students of 2nd and 3rd grade of primary education in a public school in Oaxaca. Paper presented at the XLIII Congress of the Mexican Mathematical Society. Tuxtla Gutiérrez, Chiapas.
- Cruz, F. and Cortina, J. L. (In press). The numbering system teaching in native languages. The case of tu'ún savi.
- INALI (2003). General Law of Linguistic Rights of Indigenous Peoples.
- General Law of Education. (2003). Retrieved from: http://www.sepbcgs.gob.mx/legislacion/ley_general_educacion.htm
- Ve'e Savi Tu'un "Academy of the Mixtec language." (2007). Basis for writing tu'un savi, CNCA-DGCPI, Secretary of Culture, Government of Oaxaca. Others
- De los Reyes, A. (1593). Art of the Mixtec language. Casa de Pedro Balli, Mexico. Retrieved from: userpage.fu-berlin.de/mduerr/More/Reyes_1890.pdf
- Hollenbach, Bruce and Barbara Hollenbach. (2000). The numbers of ancient Mixtec: Magdalena Peñasco Mixtec. Summer Institute of Linguistics. 12 p. Mexico, D. F.

Websites:

<http://eib.sep.gob.mx/> <http://www.inegi.gob.mx>

TATSAVI NI

THANK YOU