

# Evaluating the Impact of Teaching and Learning of Mathematics and Science using Local Language (Language of Play) in Primary Schools in Muchinga Province, Zambia, a Case of Chinsali District

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**Abstract** One of the factors blamed for poor academic performance in the Zambian primary Schools has been the use of English in place of mother tongue as a medium of instruction. In 2013, the government replaced English with a familiar local language in teaching grade one to four. The aim of this paper was to make a preliminary evaluation of the impact of using a local or familiar language as a medium of instruction for teaching and learning mathematics and science in Muchinga province of Zambia. Taking Chinsali district of Muchinga province as a case study, the research sampled 4(30%) of the 13 zones in the district. Schools within the sampled zones were randomly picked and questionnaires were administered to lower primary school teachers. The research findings show that, firstly, while teachers supported and appreciated the efficacy of the pedagogy, they also faced challenges in using it to teach mathematics and science. Secondly, teachers reported that using a local language as a medium of instruction freed pupils from timidity. There was tremendous class participation during lessons. Thirdly, the pedagogy reduced rote learning and increased concept assimilation of mathematics and science concepts. The major recommendations are that the ministry in charge of education should embark on many longitudinal studies in the province to see how the policy is working. A look at countries where using mother tongue to teach mathematics and science has succeeded, shows that it has gone through many years of evaluations. It is these several years of monitoring that lead to its success.

**Keywords:** *mother tongue, language of play, medium of instruction, pedagogy and zones*

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## 1. Introduction

In Zambia, one of the biggest concerns of the ministry of education has been to come up with suitable pedagogical interventions in teaching of mathematics and science. Performance of the pupils in the two subjects has been very unsatisfactory as reported by the 1996 Educating Our Future education policy document, [1] and later reiterated by the 2013 Education Curriculum Framework [2](MOESVTEE, 2013).

In the Educating Our Future policy document, the ministry of education stated that "the difficulties of many pupils with mathematics and science go back to the way in which the pupils are introduced to these areas in primary school", ([1]:55).

In Zambia one of the pedagogical weaknesses in schools has been the wrong choice of the medium of instruction especially in lower primary schools. Although

English has been jostling with indigenous languages for the role of medium of instruction, it has been the main language used in teaching from grade one to end of tertiary education.

For many years Zambian linguistics argued that the use of English as a medium of instruction was not serving the country well [3]. In an earlier document, the ministry of education admitted that it was generally accepted by educationists that learning was best done in the mother tongue [4].

Several other scholars in the world have alluded to this conclusion as will be discussed later. They include: Nyika [5], Hynsjö & Damon [6], Awopetu [7] and Buhmann and Trudel [8].

Ball [9] asserts that the United Nations through its UNESCO unit has since 1953 been advocating for the use of mother tongue as a medium of instruction in early childhood and primary education. The benefits include freeing children from poor families from timidity during class discussions and removing rote learning.

Consequently, the pedagogy encourages schooling among children especially from rural areas who become badly disadvantaged when English is used as a medium of instruction [10] echoed by Ball [9].

Research by various scholars like Montaque [11], Cole and Gay (1983), echoed by Ojose [12], Hafik and Farik (2016) indicate that there is a direct relationship between culture and cognition. These scholars allude to the fact that one's way of life has a tremendous impact on how they think or reason and how they do things. The things that a child is in constant contact with most of the time are likely to influence their thinking and general outlook of the world. Children try to make sense of their environment using language of play.

In recognition of the importance of language on the child's cognition, the Zambian government replaced English as a medium of instruction with local familiar language in teaching grade one to four. In the new policy which was implemented in January 2014, the familiar language will be identified by the local community.

The language would be used as a medium of instruction in all subjects including mathematics and science in all lower primary schools, government, private, or community [13]. It is against this background that it was necessary to establish the impact of this new pedagogy of using a familiar language in teaching and learning of mathematics and science in Chinsali district of Muchinga province. The aim was to evaluate the impact this paradigm shift has had on pupils learning and understanding of mathematics and science since its introduction in 2014.

## 2. Lessons Learnt From The International Scene on Using Mother Tongue as Medium of Instruction

Ball [9] asserts that many children speak a home language that differs from the language of instruction in education programmes. Consequently, when educationists discuss a child's home language it may be the learner's mother tongue or it may be the language the learner has learnt first and knows best. It can also be the language one uses often or most. In this literature review and the research discussions the term familiar language will mean any of these.

Several studies have been conducted on using the mother tongue or familiar language as a medium of instruction for the early primary education. These include studies conducted by Hazik and Farik [14], Beka [15], Kazima, [16], and Mashegoane, [17]. From these, two schools of thought can be discerned: One asserts that teaching mathematics and science in a home language (language of play) enhances learner performance and reduces school drop outs while the other condemns the pedagogy because it assumes that most local languages have limited mathematical and science vocabulary.

### 2.1. Argument for Using Mother Tongue as Medium of Instruction

In the first school of thought the different studies conducted in Latin America, Fiji, Ethiopia, Malawi, Zimbabwe and Papua New Guinea are instructive.

In Latin America, in a study conducted on Peruvian Indigenous Children's academic achievement Hynsjö & Damon [6], report that when children are taught content subjects in mother tongue their test scores are higher than when a second language is used. In addition, children engage more with their teachers compared to the children that are not taught in their familiar language.

UNESCO supports the first school of thought as reported by Khajeri ([18]:75) who says "in the area of Education, UNESCO (1953) recommends the use of vernacular languages in education on the ground that for a child's socialization and cognitive development he needs his mother's tongue". This was followed by other United Nations (UN) declarations' on the need for mother tongue to be used as a medium of instruction in the early years of children's school. For instance the 2001 UNESCO report cited by Ball, says "it is increasingly obvious that the language of instruction at the beginning of one's education at such a crucial moment for future learning should be the mother tongue" ([9]:10).

In Fiji, Hazik and Farik [14] assert that children learn mathematical concepts better using their home language. This is because teachers relate the concepts to children's everyday environment. In a study involving six year old children, the researchers validated what many scholars have hypothesized. They found that children learnt mathematical concepts better using their home language and when teaching and learning was mediated by cultural tools. Children enjoyed learning mathematics when the teaching aids used by the teacher were familiar to the children. By incorporating knowledge from children's cultural background the mathematical ideas and concepts were very well grasped.

In Ethiopia, Beka [15] found that learning in a mother tongue or home language boosted learners' self-confidence, psychological stamina, self-expression skills, and clarity of classroom communication of abstract concepts. Above all it enhanced quality of learner's education.

In Zimbabwe a study conducted by Viriri and Viriri [19] on the use of Shona as a medium of instruction in Behera district in Zimbabwe, report that pupils understand mathematics and science better in Shona. When learners failed to understand certain mathematical and science concepts, teachers' code switched to English.

In Papua New Guinea, Buhmann and Trudell [8] conducted a research on the effectiveness of a home language as a medium of instruction in literacy and numeracy. Community based non-formal run pre-schools experimented with the use of a local language (L1) as a medium of instruction for over 20 years (1970- 1991). By 1991 an evaluation of this pedagogy had shown that children who became literate in local language before entering the formal education system had learning advantage over their classmates who had been using English. Citing Selati (2008, 2005), Bose and Choudhury [20] assert that it is widely accepted that language plays an important role in thinking and learning. This is central to learning and teaching school mathematics.

In Europe, North America, USSR and China the child goes through their primary, secondary and tertiary education through their mother tongue. Lamenting about this fact Adesula [21] reports what the late educationist professor Babatunde Fafunwa by saying that "of all the continents and the peoples of the world it is only in

Africa and a few ex-colonial countries that use a foreign language as a medium of instruction for their children”.

In Malawi a study conducted by Kazima [22] on the challenges of using mathematical terminologies when teaching second language users of English revealed that English uses mathematical terminologies that are not understood by many learners. Familiar English words are used in unfamiliar ways. An alternative to this is the use of home language. However Kazima, [22] brings out a dilemma as she cites Kashindo [23], Kishindo and Chiotha, [24], Kishindo and Kazima, [25] who assert that using home language in Malawi as a vehicle of scientific information is big challenge. Chi Chewa, the main local language of instruction like many African languages does not have appropriate mathematical terminologies.

## 2.2. Argument against the Use of Mother Tongue as a Medium of Instruction

The major proponent of the second school of thought is Mashegoane [17], who asserts that it is a fallacy to think that teaching mathematics and science in mother tongue or local language will improve children’s learning of these subjects. Firstly, this is because “the inability of hundreds of languages around the world who have no direct translation of core scientific and mathematical terms” ([17]:1).

Secondly, Mashegoane ([17]:1) argues that it is a waste of learners’ time to demand that they learn mathematics and science in a local language in their first four years when for the rest of their lives they will be learning these subjects in English. The strength of his argument is that although children learn mathematics in their local language for a few years, they rarely master their content. Consequently, the policy creates remedial problems for teachers who later take over these classes and re-teach in English. He says “why don’t we spend time and money to let children learn basic concepts, especially mathematics in English from the earliest grade”.

Mashegoane’s [17] second argument against using local languages as medium of instruction would be favoring the elite. English is a language of the elite spoken almost as a mother tongue in families of the affluent in countries that were once colonized by Britain. To suggest that African local languages should not replace it as medium of instruction in primary schools would be detrimental to the marginalized groups which include rural children and those from less privileged in urban areas.

Rural children and children coming from poor urban families encounter English for the first time when they are seven years and above. In the Piaget’s theory, these children already have built some mathematic in their mother tongue or home language during their first development stages. Validating Jean Piaget’s learning theory, Ojose [12], states that numbers and quantities used to teach the children mathematics should be meaningful. During the Piaget’s pre-operational stage, children are able to conceptualise activities creating mathematical verbalization in their first language.

Another argument against adopting a local language as a medium of instruction is postulated by Munachiya and Munachiya, [26]. In Zimbabwe, Mufanechiya and Mufanechiya [26], observe that using a home language as

a medium of instruction may not be attainable if negative stakeholder’s attitude towards the pedagogy does not change. In their research they noted a lukewarm attitude of teachers towards the use of Shona a local language, as a medium of instruction in lower primary schools. In Nigeria, Awopetu, [7] points out that there are several studies pointing out that it is still unclear whether schooling in children’s native language is an effective approach to improve their learning ability.

## 3. Theoretical Framework

Several learning theories in one way or the other have influenced educationist to fiercely advocate for the use of children’s local languages as the medium of instruction in their first years of primary school. These include B.F Skinner’s operant conditioning, Jean Piaget’s cognitive development theory and Levy Vygotsky’s constructivism learning theory. These theories have influenced changes in the teaching of mathematics and science [12,27]. Conditioning theories for instance consider learning as a habit formation and based on the principle of association and substitution. They believe there must be a perfect association between the two types of stimuli presented together. In this way learners would be trained to fear, love or hate something. Using conditioning theories which are largely behavioral in nature a mathematics or science teacher would change the negative attitude of slow learners that usually suffer ridicule and eventually hate school and decide to remain withdrawn in class discussions to being positive and outgoing. One way to reduce ridicule on learners is to use a mother tongue or familiar language as a medium of instruction. Cognitive theories on the other hand largely take the position of constructivism as expounded by Jean Piaget’s cognitive development theory and Levy Vygotsky’s theory of constructivism. They contend that the human mind is different from that of B.F Skinner’s pigeons or cats used in his operant conditioning research. Cognitive development and constructivism proponents argue that human beings build (construct) new knowledge upon their previous one. Ojose [12], a mathematics Professor in California supports the contribution of Piagetian theory concerning the development stages of children’s cognition. He asserts that Piaget’s development theories have provided mathematical educators with crucial insight into how children learn mathematical concepts and ideas. In discussing the theory Ojose [12] states that according to Piaget, children develop their reasoning throughout their varying stages and that there is a link between the current and the next. So when children enter school, they already have mathematics in them couched in their mother tongue or a language of play. So to continue learning in that language is the best option.

In Kenya, Kioko [28] supports these findings by asserting that children’s learning does not begin in school; learning starts at home in the child’s home language. Consequently, if teaching in school uses the children’s language, learning becomes fun and interactive. The pedagogy becomes learner centered as the teacher can easily use group work.

In Nigeria, a study conducted by Awopetu [7], states that a child's mother tongues is important because the child conceptualizes a large part of their environment in that language. The child has names, for most objects, actions, ideas, attitudes and other things that are important to a human being in local language.

## 4. Research Methodology

This study used a mixed method design combining quantitative (survey) and qualitative (interviews and focus group discussion). A combination of purposively and random sampling to gather information relevant to the research was employed. Primary schools were chosen randomly from the purposively selected zones in Chinsali district the administrative center of Muchinga province where Icibemba is used as a medium of instruction. The purposively sampled zones out of the 13 zones of Chinsali district were Chinsali Zone, Kapwepwe Zone, Lubwa Zone and Mulakupikwa Zone. These consisted of 21 government schools, 11 private schools and 7 community schools. 10 percent of each school category namely, government schools, private schools and community schools were randomly selected to be part of the sample, from which data was collected through the use of a questionnaire consisting mainly of closed ended questions and focused group discussions. The targeted respondents were primary school teachers, to give data on the current pedagogy of using the local language as a medium of instruction from grade one to four. The teachers were conveniently sampled. In the sampled schools, all available teachers were given the questionnaire and involved in the focused group discussion. 30 teachers from three government schools, one private school and one community school were involved. The data collected were analyzed qualitatively and quantitatively using statistic package for social sciences (SPSS) version 20 IBM. In addition to descriptive statistics, a generalized linear model (GLM) of a quasi-logistic regression was used to examine the impact of teaching and learning mathematics and sciences using local languages.

### 4.1. Generalised Linear Model (GLM)

An approach of generalized linear model was used to examine the socio- economic factors in influencing the teaching and learning of mathematics and science using local languages.

Data analysis was carried out with a generalized linear model (GLM) to investigate factors affecting the teaching and learning of mathematics and sciences using local languages. Since the response variable of interest is dichotomous, yes or no, it may not be reasonable to assume that data are normally distributed. As a result the classical linear model is not applicable. A generalized linear model extends the traditional linear model to a wider range of data analysis problems and a function can be used to link the expected responses mean and a linear function of the explanatory variables. Accordingly the GLM model is used by choosing an appropriate link function and response probability distribution, Agresti [29].

The model which was used for this study is called the logistics regression model. Logistic regression model describes the relationship between the dichotomous response variable and a set of explanatory variables. The explanatory variable may be quantitative or qualitative. The logistic regression model overcomes the problem of linear regression for binary data by linking the binary responses to the explanatory variables through the probability of either outcome which does not vary continuously from 0 to 1. The transformed probability is then modeled linearly with the explanatory variable.

## 5. Presentation of the Findings

### 5.1. Quantitative and Qualitative Results

The results regarding the impact of teaching and learning of mathematics and science using local language in primary schools in Chinsali district are presented below in two stages. The first stage summarizes the results using descriptive statistics and in tabular form and therefore, the impact of teaching and learning Mathematics and Science using local language based on the findings of the Quasi logistic regression model are presented.

#### 5.1.1. Descriptive Statistics

In this study teachers were randomly drawn from each school. About 53% from government schools, 37% from private schools and 10% from community schools.

The socio-demographic variables as predictors are coded as Sex (Male, Female), type of school, challenges explaining concepts in local language (Yes, No), Difference in assimilation of concepts (Yes, No), community involved in language conveyance (Yes, No). The response variable of interest is whether the language of play is achieving the purpose or not.

The results on Socio- Economic attributes of the teachers are summarized in Table 1 below.

Table 1. Socio- Economic attributes

	Frequency	Percentage
<b>School Type</b>		
Government	16	53.3
Private	11	36.7
Community	3	10
<b>Gender</b>		
Male	15	50
Female	15	50
<b>Age Group</b>		
20 – 30	7	23.3
31 - 40	18	60
41 – 50	5	16.7
<b>Grades Taught</b>		
1 to 4	7	23.3
5 to 7	4	13.3
1 to 7	19	63.3

Most of the teachers that participated in this study (53.3%) came from government schools, 37.7% of the teachers come from private schools and 10% came from

the community schools. With regard to gender, there were equal members of male and female teachers (50% respectively).

The highest number of teachers came from the age groups 31 – 40 (60 percent), whilst the representation from 20 – 30 and 41 – 50 age groups was 7% and 5% respectively. As far as grades taught is concerned, 63.3% of the teachers taught 1 – 7 while 23.3 percent and 13.3% taught 1 to 4 and 5 to 7 respectively.

Respondents were asked various questions regarding their involvement in implementing the policy on the language of play. Results to the questions of interest are presented below.

## 5.2. Teachers Support for the Policy of Using Local Language in Teaching and Learning Mathematics and Science

In managing crucial education change or innovation in education, it is important to evaluate the views of the implementers of the change. In change management, three categories of stakeholders are at play. The first one is those that are important and influential; the second one is the ones that are important but less influential and the third one is that of stakeholders that are less important and less influential. In the language policy under discussion teachers belong to the first group while pupils belong to the second one, so the research team sought the views of the teachers on the policy of teaching content subjects like mathematics and science in the child local language. In responding to this question,

When asked whether or not they supported the policy of using local language as a medium of instruction for teaching mathematics and science, most teachers 18 (60%) indicated that they supported it. 12 (40%) did not support the policy. When asked to state the reasons why they supported the language various reasons were given both in the questionnaire and during the Focus Group Discussions. The reasons included increased freedom among pupils in class discussions, teachers finding it easier to explain some mathematics and science concepts, reduced rote learning and increased interest in school in general. Table 2, box 1 and 2 reflects these reasons.

- When children use familiar language they freely express themselves during class discussion.
- When English is used it only favors children from well to do families who already use English as the mean of communication in their homes.
- The approach enhances fast literacy by the learners. Consequently this speeds up learning of content subjects like mathematics and sciences.
- Learning becomes enjoyable and so increases desire in learners to stay in schools – reduces drop outs.

**Box 1.** Reasons given by respondents for supporting the policy

In focus discussions, respondents stated four advantages of using a local language in teaching content subjects like mathematics and science. Box 2 below reflects these advantages.

- Teachers did not struggle to explain mathematics and sciences concepts.
- Learners easily remember what teachers have taught because there is no rote learning, learning is real, and therefore good memory is assured.
- There is tremendous class participation.
- Learning becomes fun.

**Box 2.** Advantages of the policy in the eyes of respondents

The findings of this research show that while respondents have reported a number of advantages of this pedagogy, as cited in box 1 and box 2. They feel much more could be done to make it more effective.

Among the advantages of this policy is the reported tremendous class participation. There is more pupil participation in class discussion. Learning in lower primary school education must be fun. Consequently, as pupils become free to fully express their thoughts in a language they know best, the learning becomes learner centered. There will be less lecture method which stifles cognitive skills among learners.

Another reported finding in this study was that rote learning has now been replaced by real learning. This is not difficult to understand. Rote learning is learning in which the learner cram content material for the sake of passing assessment especially final examination. They memorize material which they have not really understood because they expect such content to be in an examination.

However, some respondents disagreed with the policy and gave the following weakness of this pedagogy.

- In heterogeneous population like Chinsali central zone the policy poses big challenges. Many ethnic backgrounds do not it makes it easy to use one local language.
- Some teachers come from different backgrounds. Consequently they do not have sufficient proficiency in the language of instruction.
- Some concepts are not easy to teach in local languages e.g. reproductive organs of man in sciences

**Box 3.** Reasons for respondent's rejection of the policy

These views were similar to the disadvantages expressed by some respondents.

- Local language has limited vocabulary for mathematics and science terminologies.
- Some science topics are embarrassing to teach in local language e.g. reproduction in human beings.
- In heterogeneous communities using one local language disadvantages other ethnic groups.
- Teachers who are not familiar with language face the big challenges.

**Box 4.** Disadvantages of using local languages as a medium of instruction

### 5.3. Teachers and Learners Familiarity with the Language of Play (Mother Tongue)

Familiarity of the language of instruction is a very crucial variable in teaching and learning. Both the teachers and the learners must be proficient at a cognitive level in the medium of instruction. Nyika [5], has emphasized the fact that language of instruction can affect comprehension of content and hence the performance of students in their learning. When we use the children's familiar language or language of play we have provided a very important intervention in their learning. However if their teachers are not familiar with that language, then we have just shifted the problem from the left hand to the right hand.

In this research, therefore one of the questions researched addressed was teacher's familiarity with Bemba, the language of instruction in Chinsali district. When asked if they were familiar with the language, 24 (80%) were familiar with the language of instruction, 6 (20%) were not familiar with the language of play being used at the school they taught.

### 5.4. Challenges Faced in Explaining Mathematical and Science Concepts in a Local Language

When a new policy is introduced it is never plain sailing in implementing it. It may have its own strengths and weaknesses, advantages and disadvantages. In this research respondents were asked if they faced any challenges as they were implementing the 2014 (MOE) language policy. 22 (73.3%) affirmed that they had challenges, 8 (26.7%) said they had no challenges. In focus group discussion, the common challenges teachers had were embarrassments in translating human reproductive concepts. It is easier to teach human reproduction in English than a in local language because it is a taboo to mention reproduction organs in Zambian vernacular language. The other challenge was for teachers who come from other ethnic backgrounds. Some of them were just learning Bemba from the local community.

### 5.5. Teachers Views on Availability of Teaching Materials Using Local Language

The availability of relevant teaching materials can motivate teachers or demotivate them when these were not available. Consequently, researchers sought to find out if these were available. 19 (63.4%) reported that teaching materials were available while 11 (36.6%) said they were not available. A question on community participation in the implementation of local language as a medium of instruction was discussed in the focus group discussion. It was reported that when teachers came across a Bemba word in the teaching material that was too difficult for them to understand they consulted some people in the local community.

The research also inquired if the community was helping practicing language of play. In a focused discussion it was reported that teachers who are not very proficient in Bemba were asking for appropriate words to use from the

local community. It is worthwhile noticing that 21 (70%) of the teachers acknowledged that the community was participating in helping with the language of play, and 9 (30%) said their community was not helping.

### 5.6. Pupils Participation in Class Lessons when Local Language is Used as Medium of Instruction

In a good class lesson, learners should take centre stage. A teacher should merely be a moderator or facilitator. When the pedagogy allows this approach it is the most desirable. When asked if using Bemba (language of play) lead to increased participation during lessons 26 (86.7%) affirmed that the pedagogy freed pupils from timidity. It led to active and live pupil participation. 4 (13.3%) said it did not improve pupil participation.

### 5.7. Comparison in Learners Concept Assimilation of Mathematics and Science when English or Bemba was Used as Medium of Instruction

When asked if they noted a difference in concept assimilation when Bemba or English was used as medium of instruction most respondent affirmed that there a notable difference. 25 (86.2%) said there was increased assimilation of mathematics and science concepts when home language was used as a medium of instruction. 5 (13.8%) indicated that they did not notice any improvement in the assimilation.

**Table 2. Summary for Descriptive Statistics Showing Teachers Responses**

Parameter	Frequency		Percentage
	Yes	No	
Teachers' support for the policy	18	12	60
	12	18	40
Familiarity with Bemba as medium of instruction	24	6	80
	6	24	20
Challenges in explaining mathematical and science concepts in Bemba	22	8	73.3
	8	22	26.7
Availability of teaching and learning materials in Bemba	19	11	63.4
	11	19	36.6
Learners activeness when Bemba is used in the teaching of mathematics and science	26	4	86.7
	4	26	13.3
Increase in pupils assimilation of concept when a local language is used	25	5	86.2
	5	25	13.8
Community supporting local language	21	9	70
	9	21	30

### 5.8. Logistic Regression Results

Table 3 shows the results of the logistic regression fit statistics in explaining whether the language of play is achieving the intended purpose in the teaching and learning of mathematics and sciences.

**Table 3. Goodness of Fit statistics for logistic Regression**

Criteria	df	Value	Value/df
Deviance	27	28.107	1.041
Pearson chi square	23	31.113	1.353

**Table 4. Results of the logistic regression with estimator of odds ratios (OR) and 95% confidence interval (C.I)**

	Coefficient	95%	CI	OR
School type (reference= community school)				
Government	-0.9106*	-1.7334	-0.1184	0.402283*
Private	-0.7826	-1.5959	0.0039	0.457216
Support for policy (reference= No)				
Yes	0.7615*	0.1027	1.4415	2.141986
Familiar with language of play(reference= No)				
Yes	0.9883*	0.2968	0.812569	1.110711
Challenges faced in explaining concepts (reference= No)				
Yes	0.1050	-0.5711	0.7873	1.110711
Availability of materials (reference= No)				
Yes	0.3912	-0.2660	1.6598	1.47874
Community helping practicing language of play (reference= No)				
Yes	-0.0005	-0.81357	0.812569	0.9995
Difference in assimilation of concepts (reference= No)				
Yes	0.2120	-0.8766	1.2190	1.2361

Based on the result of Table 3, the model fits the data well as the values of Pearson Chi-square (31.113) and deviance divided by degrees of freedom (23) are significantly larger than 1. The results of the logistics regression analysis are presented in Table 4.

If the confidence interval includes an exact value of 1, then the results is significant and can be interpreted as there being no difference at 5 percent level (having no impact on the teaching and learning of mathematics and sciences) between a particular category and reference category. This means that there is no significant difference in the probability of language of play achieving its intended purpose between specified levels of different explanatory or dependent variables and the reference category. Otherwise the chance of language of play achieving its intended purpose for a given category is OR times that of the reference category.

In Table 4, if we look at the type of school and using community school as a reference, government schools are 0.402 (= exp (- 0.9106)) times more likely to achieve the intended purpose of language of play. To the contrary, private schools achievement of the intended of the language of play is not significantly different, at 5% level, from that of the community school. With regard to support for the policy, the result indicate that if there is support for the policy, then the policy is 2.14(= exp (0.7615)) times more likely to achieve the purpose of the language of play. Those teachers that feel that they are familiar with the language of play are about 2.68(=exp (0.9883)) times more likely to push for the agenda of the language of play to achieve its intended purpose.

## 6. Discussion of the Findings

### 6.1. Teachers Support for the Policy of Using Local Language in Teaching and Learning Mathematics and Science

Fullan, one of the renowned scholars in management of innovations in education says there are many factors that influence a teacher's decision to support or reject a proposed educational pedagogy, "both individual teacher characteristic and collective or collegial factors play roles in determining implementation" Fullan ([30]: 77). In this

research some of the collected bio data of the teachers was age groups. Among the respondents, 7 out of 30 sampled teachers aged between 20 to 30, 18 aged between 31 and 40. The rest 5 were older teachers aged between 41 and 50. The highest number that supported the policy was the category 20 to 40 age group.

From these findings we can discern a lukewarm support of the policy by older teachers and a good support from the younger ones. This brings hope of feasibility of the pedagogy. The younger teachers might stay longer in schools and as other new teachers come in schools they may influence positive attitude. Fullan ([30]: 71) says "since interaction with others influences what one does, relationships with other teachers is a critical variable. Change involves learning to do something new and interaction is the primary basic for social learning".

In other countries this pedagogy is working after years of testing it. In Mali the method of teaching mathematics and other subject in children mother tongues in their early years of schooling was tested after six years. The method was successful and extended to other schools in the nation from 1994 to 2000. Tests show that where mother tongue was used as a medium of instruction learners were enthusiastic, active and freely communicated in class lessons, Buhmann and Trudel [8].

In Papua New Gunea, using mother tongue or familiar language was tested through a community based non-formal pre-school system for 20 years, Buhmann and Trudel [8]. Mother tongue or familiar language was used to teach literacy and mathematics from grade one to three. After the assessment it was concluded that the pedagogy was a success and adopted by government schools. Teachers who were involved reported that dropout rates for the pupils had gone down, there was great classroom participation. Pupils were also more active and confident about learning (Ibid).

Apart from monitoring the pedagogy for several years UNESCO cited by Ball [9], says the transition from mother tongue to the second language should not be rushed. If the period of learning through mother tongue is less than six years the impact is not much. Mashegoane [17] argues that teaching children mathematics in their mothers' tongues for four years is wasting their time because they hardly master anything in that short period. We end up creating remedial problems for teachers who

take over to re-teacher them in second language. This is an observation Zambia, Malawi, Zimbabwe and Nigeria should look at seriously. In these countries the mother tongue or home language is only used for less than six years. There after the child begins learning through second language. In the USA, a study conducted from 1985 to 2001 by Thomas and Collier cited by Ball [9] found that children who were taught in their mother tongue for six or more fared the best.

## 6.2. Teachers and Learners Familiarity with the Language of Play (Mother Tongue)

Although most teachers in this research indicated that they are familiar with the local language (Bemba) used as a medium of instruction it was necessary for them to go beyond mere familiarity. In focus group discussion it came out clearly that some teachers came from other ethnic background and they confessed that their competencies in Bemba were not deep enough. Therefore it is possible to be familiar with a language but not competent enough to use it cognitively as Thomas and Collier recommended [8].

The solution is what Ball [9], proposes. She says teachers should be trained in handling local language as a medium of instruction where there are no trained practitioners who are fluent in the mother tongue(s).

In managing education change one major concern should be the attitude and support of stakeholders. There are three categories of stakeholders. The first one is those that are important and influential; the second one is the ones that are important but less influential and the third is that of the stakeholders that are less important and less influential. In the policy under discussion teachers belong to the first group while pupils belong to the second. In Chinsali district the policy of using local languages to teach mathematics and science has received tremendous support from teachers.

This promises feasibility of the pedagogy in the district. However what should be noted by the ministry of general education is the finding that although most teachers support the pedagogy and are familiar with the local language (Bemba) used in the teaching mathematics and science, a large number (73.3%) in this research reported that they had challenges in explaining mathematical and science concepts. These challenges should be addressed.

The problem of proficiency in language of instruction can be quite serious especially in urbanized areas. Soon Chinsali district will have some schools flooded with teachers and children from other tribes. The small town has been made a provincial Headquarters for Muchinga province. Senior civil servants are being transferred from big cities to Chinsali district. Their children are attending schools within the district. The policy of using Bemba in all government, private and community schools in teaching lower grades will soon be a problem.

In Kenya, Kioko [28] reports that using mother tongue is avoided in urban areas. It is only used in rural areas where it is easy to identify a familiar language that covers a catchment area. The Kenyan model might be worthy considering in future.

Ball [9] recommends that for the language policy to succeed, government should recruit teachers who are

fluent in language of instruction at the level of cognitive development in reading, writing and speaking. For the children to reach that competency they should be taught in their mother tongue for 6 to 8 years.

In the USA, a study conducted from 1985-2001 by Thomas and Collier found that children who were taught in their mother tongue for 6 years or more fared the best.

## 6.3. Challenges Faced in Explaining Mathematical and Science Concepts in a Local Language

In Malawi, Kazima [16] reports that using Chichewa (Mother tongue) as a medium of instruction is easier when the subject concern is one that does not have its highly specialized terminologies. Consequently it becomes complicated when the subject is mathematics.

One would argue that although African vernaculars may currently have problems with mathematics and scientific terminologies, given enough time, these languages would develop the terminologies. After all even the mathematics and science jargons we have now in English have just been developed by borrowing words from Greek, Arabic, French and Latin, Omoniyi and Olabode [31]. Similarly, any African language that has been chosen as a medium of instruction for mathematics and science teaching can evolve terminologies though it may take a long time. A journey of 1000 mile starts with one step.

In some countries the challenges of teaching mathematics and science have been addressed innovatively. Kazima [22] reports that in Tanzania, glossaries of vernacular mathematics terminologies has been developed. Swahili terminologies in subject such as mathematics have been credited. Through swahilisation, a transfer of mathematics concepts aimed at transferring the concepts rather than mere translation has been done. The literal translation of the mathematics terms or registers has been avoided because in most cases it does not convey the meaning of the term.

In Nigerian Kazima (2014) also reports that metal language has been developed. A glossary of mathematics terminologies has been developed in six Nigerian languages namely Edo, Efik, Igobo, Izon and Yoruba citing Bamgbose [32]. Mazima asserts that this innovation is a success teachers find it easier to teach mathematics in vernacular. In Malawi, the strategy involves merely borrowing English mathematics words and spell them in vernacular and Mazima asserts that here too the innovation is successful.

To mitigate the challenges of learners failing to understand science and mathematics concepts couched in a foreign language it is better to code switch. Bose and Choudhury [20], report that recent studies on the theory of using mother tongue as medium of instruction advocate for code switching. "Mere translation is not always beneficial or reliable as it might not reflect the exact meaning". Citing Clackson [33], Bose and Choudhury advise that the exact meaning of concepts cannot replace few words in the foreign language of instruction with the few words in mother tongue. So the use of code switching and mixing enhances better understanding.

Going by this observation, it would be interesting how direct translation is working in countries that are using it. As noted in this research, most teachers indicated that they

are familiar with the language of instruction in lower primary schools in Chinsali district. The paradox here is that most teachers again have indicated that they have challenges explaining mathematical and science concepts; this goes to show that language is a complex phenomenon. It is possible to be familiar with a language and yet struggle to explain its registers. Mill and Walter [34] advise that when scientific or technical concepts are used in communication the instructor should know that familiarity can be at four levels, namely using familiar words for familiar things, familiar words for unfamiliar things, unfamiliar words for familiar things and lastly using unfamiliar words for unfamiliar things. Teaching some content subject like mathematics and science can be tricky if we use words which children know very well in their mother tongue but we use those words in unfamiliar mathematical or science registers. This exacerbates things when he even uses unfamiliar words for familiar things

The best intervention is code switching between the mother tongue and the second language. This makes it easier for both the teacher and the learner because concepts which are difficult to translate can easily be understood if they are taught in either first or second language as reported by Buhmann and Trudel [8] in the Mali's language policy.

The impasse that we see in Malawi reported by Kazima [16] can be resolved using a middle path. In Philippines science and mathematics are taught in English while other subjects taught in Filipino [35]. Tapang, [35] reports that in some countries there are fierce debates on whether or not, mathematics and science should be taught in local language or foreign languages such as English and French. In 2003 for instance Malaysia after some debates re-adopted English as a medium of instruction but in 2009 dropped it and adopted local languages. This is an indecision Zambia should avoid.

It should be noted that although some teachers have challenges in explaining concepts in mother tongue the approach is better than using a second language (English). Bose and Choudhury [20] assert that if the instruction language is foreign to the learners then it becomes a double task of learning the foreign language as well as the mathematics and science that is being taught all at the same time.

#### **6.4. Pupils Participation in Class Lessons when Local Language is Used as Medium of Instruction**

The majority of the teachers (86.7 percent) indicated that learners were active when the language of play was used in the classroom, suggesting that there was more participation from the learners.

Educational psychology encourages more learner centered methods than teacher centered approaches. The findings of this research show that when a local language is used in teaching content subjects. There is more participation in class discussions from the learners (Table 2). This is a conducive learning atmosphere that can easily accommodate group discussion, a learner centered pedagogy. When learners are active in their lesson, learning becomes fun and reduces rote learning. The finding of this research shows that assimilation of science and mathematical

concepts is more when a language of play is used than when a second language (English) is used (Table 2).

#### **6.5. Implication of the Research Findings**

The implication of this research is that although the current cohort of teachers reported that they supported the policy because of noted advantages, there is need for the ministry in charge of education to be conducting formative evaluations. There are challenges that should be addressed if the pedagogy is going to be rooted firmly.

A valuable lesson from Zimbabwe is what Mufanechinya and Mufanechiya, [26] have suggested. According to these researchers one of the major recommendations to address the indecisions on using local languages as medium of instruction is to have a stake holder conference, comprising politicians, academics, language experts, representatives from countries where using mother tongue as a medium of instruction has been successful.

While teachers reported many merits of the teaching approach, they also cited some weakness which included difficulties to teach some sciences topics in local language. Teachers said that the topic on human reproduction was difficult to teach because mentioning the reproduction organ in Bemba sounded obscene to pupils. The suggestion by Tapang [35] to teacher of mathematics and science in English and the rest in mother tongue would address this impasse.

### **7. Conclusion**

This study evaluated the impact of using a local language as medium of instruction in teaching mathematics and science. The findings show that while respondents have reported some positive impacts such as improved participation in mathematics and science in class discussions, reduced rote learning and improved memory, the pedagogy has a long way to go before it achieves its intended goals. The ministry of education will have to work on main factors at play. These include improved supply of mathematics and sciences books in language of play, teacher's proficiency in the language of instruction which may involve careful posting of teachers. Mathematics and Sciences have language registers that are very specific. A teacher who has superficial knowledge of the local language used as a medium of instruction can be a liability in the school where they are posted. To make informed decision or needed adjustments of the policy, there is need for the ministry to conduct periodic evaluations and workshops that will generate data on how the pedagogy is working on the ground. Many countries are using the teaching approach but success stories are coming from places where researches like this one are repeated over a long time.

Teaching some mathematics topics was a big challenge because some mathematical terminologies were not easily translated to bring out the actual meaning. Teachers had no choice but to use a familiar Bemba word for unfamiliar mathematical concepts. Mathematics and science are fields with specialized concepts that cannot easily be translated into Ibibemba.

The finding also showed that in most sampled schools the composition of teachers was ethnically heterogeneous.

This phenomenon compounded the problem of translating scientific and mathematical terminologies further effectiveness in teaching was compromised even if the local community was available for consultation. Learning theories that support this pedagogy assert that for learners to be given more through first language, it must be used at cognitive complex academic level Buhmann and Trudell [8].

## 8. Recommendations

Using mother tongue as an intervention for improving learning where second language has failed as a medium of instruction is not a strait jacket. It is an innovation that must carefully analyse and experiment on various parameters, for years.

Literature review shows that using mother tongue as medium of instruction has succeeded where the pedagogy has been experimented over several years. In Papua New Guinea, a community-based non-formal run pre-schools experimented with the use of local language as a medium of instruction for over 20 years (1970- 1991). By 1991 an evaluation of this pedagogy had shown that using mother tongue as a medium of instruction was better than using second language Buhmann and Trudell [8].

In the USA in a longitudinal study running from 1985-2001 conducted by Wayne Thomas and Virginia Collier reported by Buhmann and Trudell [8], showed that children who had the first six years or more of formal instruction in their own language fared the best in later academic achievement. The researchers concluded after several years of evaluating the approach.

It is against this background that the researchers are recommending several longitudinal studies similar to the ones conducted in the USA, Mali and Papua New Guinea (**Ibid**). The Zambian model has been running since 2014. It is concluded that the finding of this research will be better regard as preliminary. Several additional studies should be repeated over the next several years and should look at many other parameters that can enhance or hinder the innovation.

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