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Developing Shona-Physics Diction for Possible use in the Teaching of Forces at Ordinary Level Physics in Shona

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Abstract
Several local researchers advocate for indigenous languages to be used as media of instruction in different subject areas to prevent misconceptions and ambiguities. Justifiably, Zimbabwe has sixteen indigenous languages but physics is still being taught in English. Local craftsman and innovators are still writing their instruction manuals for their products in the English language even for the local consumers. This paper was aimed at developing a Shona-Physics text that will be used in the teaching and learning of Forces at Ordinary level physics. The corollary of this aim was to promote deeper understanding of Forces while developing an indigenous language diction that would help in the industrialization of products. Focus group interviews were conducted in two high schools in the Chiweshe area under Mazoe District, in Mashonaland Central province of Zimbabwe to obtain Shona-Physics diction necessary to write a text that could be used in teaching and learning of forces at ordinary level. Twenty-five learners, three physics teachers, two language specialists and a retired head teacher purposively drawn from the local community participated in the research. The obtained diction was cleaned through gleaning of pertinent literature and consultation with Shona speakers who are physics teachers. A Physics text in Shona for ordinary level Forces was developed after a qualitative document analysis of the Ordinary level Physics syllabus. The findings indicate that content on Forces is sequenced from simpler skill to higher order skill and the evaluation of the text made indicates that it is now easier for the physics educators to explain physics concepts using the current text. We recommend that more studies be done to cover all physics topics at Ordinary level. This would make it easier for the nation to offer physics at junior primary school level.

Keywords: Medium of instruction, Shona-Physics diction, Indigenous languages, Chiweshe

Introduction

Experience has taught us that the medium of instruction anchors the comprehension of any physics concept at ordinary level. The new Zimbabwean curriculum is pivoted on ideals of Ubuntu, context specific heritage and competence based. Whilst researchers do not harbour emotions on the use of English as a language of instruction, there is need to develop localised media of instruction for the teaching and learning of Ordinary level Physics over time. The undercurrent Zimbabwean Education Act of 2022, section 62.1, states that:

every school shall endeavour to;

a) teach every officially recognized language;

b) ensure that the language of instruction shall be the language of examination; and
c) ensure that the mother tongue is used as a medium of instruction at early childhood education.

As a result of the Education Act of 2022, all the sixteen indigenous languages are now being taught in schools. However, there has been reluctance in adopting these local languages as media of instruction in ordinary level Physics. The resistance is also emanating from the Education Act, since the readily available resources are in English which is the medium of instruction and automatically becomes the language of examination. Various researchers advocate that sciences should be taught in the language the learner is proficient in to avoid misconceptions and ambiguities (Jegede, 1995; Jegede & Aikenhead, 1999). Thondhlana (2005) recommended that indigenous languages be adopted as a media of instruction in other subjects from grade 3 to grade 7 because learners already understand the language. Although (Thondlana, 2005) made an argument based on learner proficiency and concept comprehension, our contribution extends to innovation and industrialization. This research paper develops indigenous words that could be incorporated into the actual teaching and learning of selected concepts at ordinary level physics.

Like Zimbabwe, Ghana is a multilingual country, with English as the official language of instruction in Physics because of her ties to Britain. A study carried out in Ghana reported that instructional materials are made in English, although Ghanaian languages are official in schools (Owu-Ewie & Eshun, 2015) leading to instructional dilemas in educators. Another study carried out in Tanzania indicated that Secondary school learners struggled with English as a language of instruction in science, and as a result, most teachers used Kiswahili to complement the English language (Mwinsheikhe, 2009).

Teaching and learning materials should be in languages pupils are proficient in so that they focus their attention on mastering of the science content rather than English language. Rwambiwa (1996) argued that a complete switch from mother tongue to a second language as a medium of instruction in secondary school physics, results in African children lagging behind their English-speaking counterparts by nine years. Indigenous Zimbabwean children waste time trying to learn a language which they do not need for them to master the content given that there are vernacular languages such as Shona, Ndebele, Kalanga, Venda, Tonga and Shangani which people can speak more fluently.

Science knowledge plays a crucial role in a country's industrialization drive through development of technologies. We found it odd that Zimbabwe does not have an indigenous national language, a country with 16 indigenous languages which gives the government an alibi to neglect positive policies in the language of instruction. Justifiably, local Zimbabwean craftsman and innovators end up developing instruction manuals for their products in the English language even for the local consumers. Developing indigenous diction in forces at ordinary level will lessen the burden to local innovators in their instruction manual, maintains the instruction without losing the context and creates a foundation in which indigenous languages are used as languages of instruction and examination thereof.

Statement of the Problem

From our experience in the teaching and learning of Physics at Ordinary level, we observed that many students in Zimbabwe do not comprehend concepts under Forces because they are not proficient in the

English language. Inexperienced educators struggle to explain the concepts of Forces in simpler English. Some educators end up explaining these concepts using wrong local language terms resulting in misconception of Forces. Justifiably, there are no materials produced in indigenous languages yet to aid the teaching and learning of Forces to students who are not proficient in English but proficient in local languages. As a result, there is need to develop Shona-Physics diction so that content and context is not lost by making it easier for educators to find the correct text and our potential innovators are not neglected at Ordinary level Physics.

Purpose of the research

This research is aimed at developing Shona-Physics text that will be used in the teaching and learning of Forces at ordinary level physics. By necessity Shona-Physics diction had to be developed before the text could be written. The Shona text will be piloted and fine-tuned as other indigenous language texts are developed thereof. The corollary of this aim is to promote deeper understanding of Physics, develop an indigenous language diction that would help in the industrialization of products.

Research Objectives

The research paper has the following objectives:

1. To find Shona-Physics words that can replace the English-Physics words in the teaching and learning of Forces at 'O' Level.
2. To develop a Shona-Physics text for the teaching and learning of Forces at 'O' level
3. To develop a test measure in Shona for evaluating learner understanding of Forces at 'O' Level.

Theoretical Framework

Jean Piaget (9 Aug 1986 – 16 Dec 1980)

This research was pivoted by Piaget's cognitive development theory which suggests that human minds construct new knowledge on previously acquired knowledge (Nkonde, Siluyele, Mweemba, Kaluba, & Zulu, 2018). The Zimbabwean curriculum is spiral in nature such that Ordinary level physics learners construct complex knowledge and experiences on Forces based on simpler prior concepts and activities on Forces learnt from junior secondary school. Although Baiju(2010) did not found the effect of language in developmental thinking but as a learner's way of representing and reflecting their thought, we reiterate that language is an integral part of intellectual development. Therefore learners who are not proficient in English will not leverage their prior knowledge and will therefore be unable to construct new knowledge in Forces. Developing a Shona-Physics text is critical for concept development by the educator and conceptual and logical understanding of Forces by the learner.

Lev Vygosky (1896 – 1934)

This paper is also guided by Vygotsky's socio-cultural constructivism learning theory in several ways. The Physics learner's cognitive and behavioural development is imparted through social interactions with educators and fellow learners during the teaching and learning process. As a result, the indigenous language is a tool and a vehicle for effective learning (Mcleod, 2022). It is imperative that an indegenous language be developed to augument english in the teaching and learning of forces at Ordinary level Physics. Since the Zimbabwean curriculum is heritage based to instill social values of Ubuntu, we found that Vygotsky's constructivism learning theory stresses that effective teaching and learning only occurs when there is a first language for discussing ideas and clarifying thoughts (Mcleod, 2022).

Avram Noam Chomsky (December 7, 1928)

Chomsky perceives fluency and understanding of language as the driver for comprehension and ability to clearly communicate ideas. We found treads that connect the present study to Chomsky's discovery in that the teaching and learning process only occurs when there is a homogenous and fluid flow of speech that is unaffected by language and memory limitations (Baiju, 2010), technical shifts and misconceptions. As raised in the research problem, researchers were not worried with familiarization with English language during the teaching and learning process, but with: when a question is posed in English to the native Shona speaking learners, do they have authority over English to express their ideas. Developing a Shona-Physics Text would construct and generate creative ideas in the learner's mind (Baiju, 2010) that will promote ideals of innovation and industrialization.

Unlike Chomsky, Piaget and Vigosky whose central concern was on the relationship between the development of physics thought and that of language our principal anxieties are on internalization of knowledge and development of services and goods through innovation. The cited autors were interested in the ways in which language might impact on how Physics learners think and they emphasized that thought finds reality in the form of speech (Baiju, 2010).

Conceptual framework

Whilst Kufazvinei, Mukaro & Gasseller (2002) attributed lower performance in Physics performance in Zimbabwean schools towards poor facilities and infrastructure, Zivanayi (2003) reported a significant improvement in Gweru Urban schools where learners were taught Physics in Shona. Unlike Gweru urban schools where learners are exposed to various languages including English, our contribution was in the Chiweshe rural set up where Shona is the predominant language. There is no similar research conducted in the Chiweshe area at the same time this research was conducted. We have reasons to believe that developing a Shona-Physics diction will have a significant role in the development of learner thought (Shumba, 1995) and effective communication of ideas (Reinhard, 2003). The Zimbabwean education sector is anchored on the education 5.0 Philosophy in which the teaching and learning process is expected to generate services and goods consumable to the society. Therefore increased chances of understanding of Physics concepts will propagate the desire for innovation and industrialisation.

Document analysis of the syllabus

In their paper, Witring, Chen, & Fraser, (2021) proposed a model, shown in Fig 1, of analysing the school syllabus in the English language Teaching (ELT). The content should be appropriate for the age and level it is intended. The design of syllabus content is informed by the theoretical underpinnings through which the learner's needs are pecieved (Witring, Chen, & Fraser, 2021).

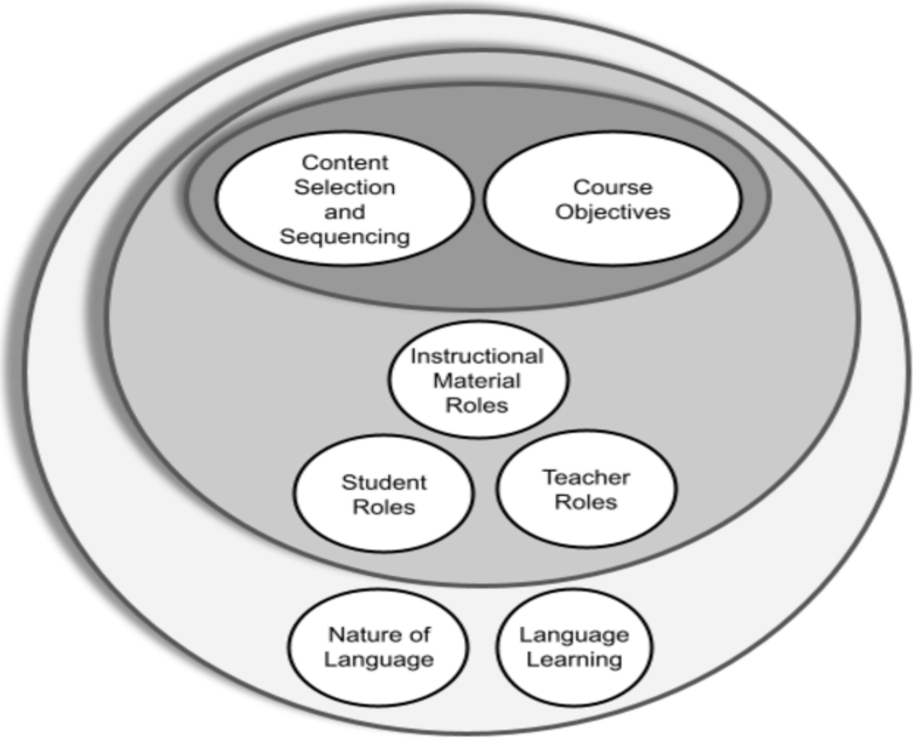

Fig. 1. Analytical Framework for Syllabus Document Analysis (Witring, Chen, & Fraser, 2021)

As shown in Fig. 1 the instructional materials play a pivotal role in aligning student and teacher roles derived from syllabus content and objectives (Moodie & Nam, 2016). As raised in the problem statement, designing a Shona-Physics text provides reconceptualization of the syllabus content which is impetus for adopting a learner centred communication from teacher centred communication (Moodie & Nam, 2016).

Research Methods and Materials

Focus group interviews were conducted in schools from Chiweshe area under Mazoe District, in Mashonaland Central province of Zimbabwe to obtain Shona-Physics diction that could be used to write a text in Shona for teaching and learning of forces at ordinary level. A non-random purposive sampling was carried out to select experienced physics teachers with in-depth knowledge in most Shona dialects in which two experiments were designed for discussion as interview guides. In total, 25 learners and five teachers from two schools from Mazowe District participated in the research. Among the 5 teachers, two were language specialists and one was a retired head teacher now living within the community. The research was carried out in three phases.

First phase: *Systematic analysis of syllabus content*

This was done by the researchers to determine the suitable content under Forces using the Ordinary level syllabus, various text books and experience from service. This phase was important in order to identify English physics terms that require translation to the Shona-Physics text.

Second Phase: *Modalities of developing Shona-Physics text and test measures*

The researchers relied on the following language techniques for developing words or phrases to express a given phenomenon.

Adaptation: This is when a word from a foreign language (English in this case) is modified through various ways like pronunciation to fit the local language phonology.

Adoption: The wholesale expropriation of a foreign word into the local language

Nominalisation: This is a technique of creating a noun from a verb. We realised that many of the physics terms or words are nouns which are derivatives of verbs. In the Shona language, a verb is converted to a noun by terminating the verb with the letter ‘o’. Hence the major task was the identification of the verb in Shona which matched the targeted English-Physics term.

Final Phase: *Pilot testing and evaluation of Shona-Physics text and test measures*
The developed test measures and Shona-physics text were sent for evaluation by administering it to Ordinary level Physics learners in the Chiweshe area.

Results

First phase: *Systematic analysis of syllabus content*
It has been long acknowledged in the introduction to this paper that effective innovation and industrialization depends upon syllabus alignment of content, pedagogy and assessment to the Education 5.0 philosophy. A closer analysis of the Ordinary level ZIMSEC Physics syllabus document using Qualitative Document analysis (QDA) methodology (Bowen, 2009) reflects that there are a number of nomenclature (mathematical operations) important to be included in the Shona-Physics text in order to develop a universal instructional language for assessment of Forces in Physics at Ordinary level.

Table 1.1 Mathematical Operational Signs

Operational name	Sign	Shona-Physics Text
Addition	+	Sanganiso/Wedzero
Subtraction	-	Bviso
Multiplication	×	Batanidzo/Unganidzo
Division	÷	Govaniso/rupatsanuro
Proportional	$\propto$	Enderano
Raising to a power	a^x	Virikidzo
Equal	=	Tsazaniso/ enzaniso
Equation		Enzano
Figure (Fig.)		Mufananidzo (Muf.)

The developed nomenclature translations were used in the development of class activities and test measures to assess how learners and educators would understand and use them without cases of ambiguities. The findings have shown that tsazaniso was used by some members of the community but was not part of this community vocabulary although enzaniso was generally used. Findings also revealed that the term centripetal force had many translations like manikidzo yerudzivapakati or yerutondapakati or yehweverapakati. Our findings contradict Reinhard (2003) cited in Zivanayi (unpublished dissertation), who argued that vernacular languages lack technical terms and that scientific terms are too difficult to translate into vernacular languages. Our undercurrent study has contradicted

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Reinhard (2003) by establishing that Shona language is very rich in scientific terms to produce a Shona-Physics text.

Analysis of the ZIMSEC Ordinary level Physics syllabus has shown that there are 30 objectives under the concept of forces. The syllabus specification grid classifies these objectives into four skills indicated in the screenshot captured in Table 1.2.

Table 1.2 Ordinary Level Physics Specification grid (ZIMSEC, 2015)

SKILL	Paper 1	Paper 2	Paper 3	Paper 4
1.0 KNOWLEDGE AND UNDERSTANDING	15%	15%		15%
2.1 COMPREHENSION, PROBLEM SOLVING	40%	50%		40%
2.2 ANALYSIS, SYNTHESIS AND EVALUATION	45%	45%		45%
3.0 PRACTICAL			100%	
TOTAL	100%	100%	100%	100%

As shown in Table 1.2, these skills are distributed across all papers assessed. The Qualitative Document Analysis done by researchers reviewed that these objectives are arranged from simple to complex sequence as represented in Fig 2. Interpretation of the illustrative Fig 2 shows that skill 1.0 contributes 30%, while effective skill 2 has 53% and skill 3.0 has 17%.

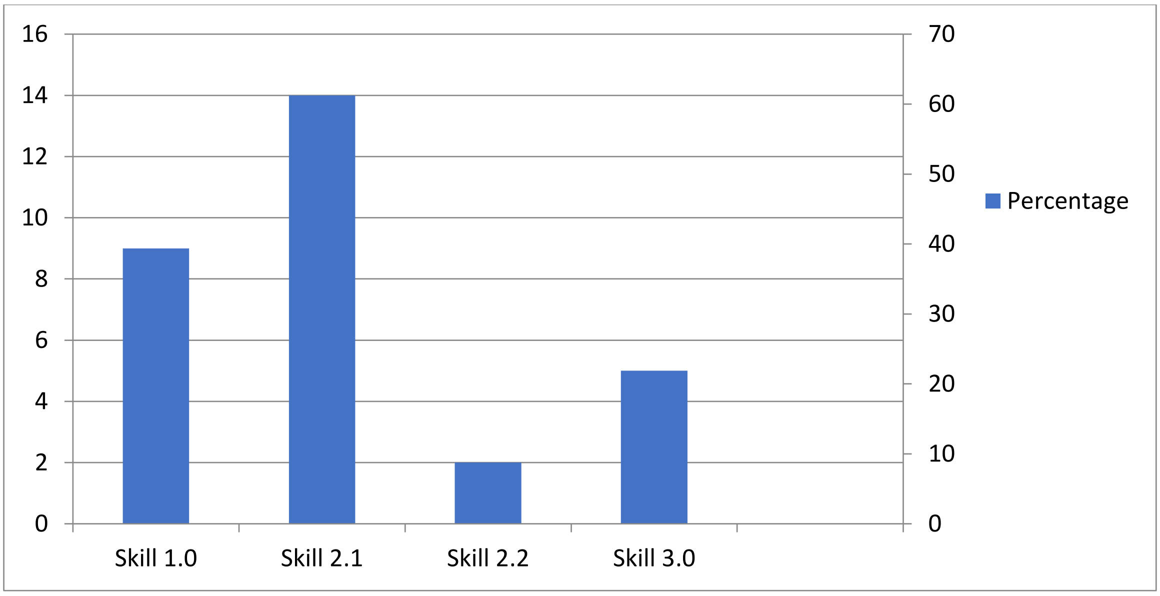


Fig 2 Skills distribution

Reference from Table 1.2 and Fig 2 follows that learners who got less than 30% would not have understood and have no knowledge of the concept of forces. As a result, developing a Shona-Physics text is aimed at increasing skill 1.0 in all the ordinary level Physics learners. The syllabus is designed in such a way that it is competency based anchored under higher order skills 2.2 and 3.0.

Shona-Physics text and test measures

It has been raised in the research methods and materials that Shona-physics diction was developed based on the systematic review of the syllabus content and instructional materials. There were other terms that the participants could not agree upon which were being used in the day to day language but were not of the standard Shona language. These were masi, fosi, mayunitsi, kutayimiza, kudhivaidha, kusitirecha, giravhiti which were derived from direct translation from English terms mass, force, units, multiplication, dividing, stretching and gravity respectively. The focus group participants were heavily divided over their adoption and subsequent rejection of most of them in the publication. Table 1.3 presents Shona-Physics diction which was then adopted by most focus group members.

Table 1.3 Shona-Physics words

English-Physics Text	Shona-Physics Text
Force	Manikidzo/chisimba/fosekedzo
Acceleration	Hwakuko/Rufasa
Constant acceleration	hwakuko isingasanduke
Deceleration	Hwakuko inopikisa kufamba
Inertia	Chinepfu
Direction	Divi
Velocity	Umhanyotasa (tichikoshesa divi)
Speed	Umhanyo
Weight	Huremu
Mass	Hukuru hwemutumbi/mumhu
Momentum	hungwinyi
Units	Mayunitsi/Rudavidzo
Tendency	Kupota
Pivot	Tsigiro
Moments	Zvinguva
Moment of a Force	Simba rekupota chichida kutendeuka nepatsigiro
Turning effect of a force	Manikidzo/Simba rekukonzera kutendeuka
Distance	Chinhambo
Turning	Kutendeuka
Force of Compression	Manikidzo yedvanyidziro
Force of Stretching	Manikidzo yekakato/nhatamutso
Deformation	Huputano
Gravity	Giravhiti
Force of Gravity	Simba regiravhiti (Manikidzo inokwevera mitumbi yezvinhu pasi)
Area	Nzvimbo
Gravitational field	Nzvimbo inowanika simba regiravhiti
Friction	Mukwizirwa
Force of friction	Manikidzo yemukwizirwa
Coefficient of Friction	Hwiziro
Force of Action	Manikidzo yeitiro
Force of Reaction	Manikidzo yedzorero

Circular Motion	Mafambiro edenderero
Centripetal Force	Manikidzo yehudzivapakati/ Manikidzo yerutondapakati/ Manikidzo yehweverapakati
Spring	Sipiringi (Duramanzwi Guru reChishona. P.940)
Horizontal	Uchinjiko
Spring constant	Sindimaro yesipiringi
Angle	Gonyo

Resource, materials and Test measures

All the Physics learners who participated in the pilot testing of test measures had covered forces before although they could face challenges with sub-concepts like mass, momentum, inertia, stretching, deformation, friction and centripetal force. Test measures for two laboratory experiments were developed in the Shona Language to assess the experimental competences and learner comprehension of the instructions in the teaching and learning of Forces at Ordinary level.

Resource one: Notes

Manikidzo

Manikidzo inoreva kusunda kana kukakata.

Manikidzo inoonekwa nemabasa ayo anotevera:

1. Manikidzo ikashandiswa pamutumbi inoshandura mafambiro emutumbi.
2. Manikidzo mbiri dzikashandiswa pamutumbi mumativi akasiyana dzakatarisana, mutumbi unodzvanywa uye ukakurirwa unoputana.
3. Manikidzo mbiri dzikashandiswa kumativi akasiyana emutumbi dzakafuratirana, mutumbi unotatamuka.

Mayunitsi emanikidzo anonzi manewtons (N). Kuti unzwisise zvinoreva newton rimwe chete (1N), simudza chinhu chinorema 100g, manikidzo yawashandisa ndiro newton rimwe chete.

Manikidzo, Hukuru Hwemutumbi ne Huremu

Vanhu vakawanda kwazvo vanovhiringidza mashandisiro emazwi ekuti huremu nehukuru hwemutumbi/mumhu vachiita kunge zvinhu zviviri izvi zvakafanana asi handizvo. Hukuru hwemutumbi/mumhu zvinoreva huwandu hwezvinovaka mutumbi. Mayunitsi acho makilograms (kg).

Tinoda kuona kuti Manikidzo, mumhu nehuremu zvine hukama hwakadii: Kana mutumbi uri pedyo nevhu, unokakatirwa kuivhu nemanikidzo inokonzerwa negiravhiti. Manikidzo inokakata iyi ndiyo inonzi huremu. Saka tinoona kuti huremu inotove mhando yemanikidzo saka mayunitsi acho manewtons (N).

Huremu hwakaenzana nekubatanidza Hukuru hwemutumbi nehwakuko inokonzerwa negiravhiti (g). Hwakuko yegiravhiti i9.8ms^{-2} asi nokuda kuti zvireruke pamasvomhu hwakuko yegiravhiti inotorwa se10ms^{-2}

W = mg ----------------------- (1)

Kune avo vaye vanoenda kumwedzi kana dzimwe nyeredzi vanosvika ikoko kune hwakuko yegiravhiti inenge yakadzika izvo zvinoita kuti huremu (W) hwavo hudzikirewo. Semuenzaniso, kumwedzi hwakuko yegiravhiti (g) iduku kanopetwa katanhatu (6), zvichireva kuti hwakuko yegiravhiti kumwedzi inenge iri duku kakapetwa katanhatu pane yepano pasi ($g_m = \frac{g_e}{6}$). Saka Huremu kumwedzi pamunhu ane 80kg hunenge hwave

$$W = 80 \text{ x } \frac{10}{6} \quad = \mathbf{133.33N}$$

Hukama uhu hwataona paenzano 1 ndihwo hunotipa nzira yekuyera maremero emitumbi tichishandisa marongerwo ezvinoshandiswa zviri paMuf. 1:

Muf. 1 Kuyerwa kwehuremu hwezvinhu(Mushore, 2022)

Mutumbi ungade kuyerwa muremero wawo unorembedzwa pachikachikiro chechiyereso zvakataridzwa paMuf.1 apo. Chiyereso chemanikidzo chichatatamuka chosvika pachinoperera. Huremu hunenge huri mumanewtons. Tawana huremu hwemutumbi, tinoshandisa enzano 1 towana hukuru hwemutumbi iwowo seizvi:

$$\mathbf{w = mg}$$

$$\mathbf{m = \frac{W}{g}} \quad \text{-----------------------------------} \ \mathbf{2}$$

Muenzaniso wekutanga

Tichishandisa hurongwa huri paMuf.1 wechiyereso chemutumbi, mutumbi warembedzwa pachiyereso chehuremo tinoona kuti unorema 6N, tsvaga kuti hukuru hwemutumbi hunenge huri chii. (g = 10ms^{-2}).

Tichishandisa enzano 2,

$$m = \frac{W}{g}$$

Takapiwa kuti W = 6N nekuti g = 10ms^{-2}

Tobva taita tsivo muenzano 2

$$m = \frac{6}{10} \frac{N}{ms^{-2}} \qquad \text{asi } 1\frac{N}{ms^{-2}} = 1\text{kg}$$

$$\underline{\mathbf{m = 0.6kg}}$$

Garoziva

Kana tichiita tsivo hatinyori mayunitsi ezvinhu zvatiri kutsiva asi kuti tinonyora mayunitsi echinhu chatiri kutsvaga kunze ndokunge tashandisa tenderano yemayunitsi yepasi rose. Sepamuenzaniso wedu, $m = \frac{6}{10}kg$.

Saka tisati taita tsivo zvipimwa zvese zvakapiwa mumubvunzo zvinoiswa kumayunitsi etenderano yepasi rose. Gumisiro yedu ine mayunitsi etenderano. Izvi zvinoitirwa kuti tisadzonyongedza zvinyorwa zvedu tozotadza kutumburanisa mayunitsi ari pasi nepamusoro

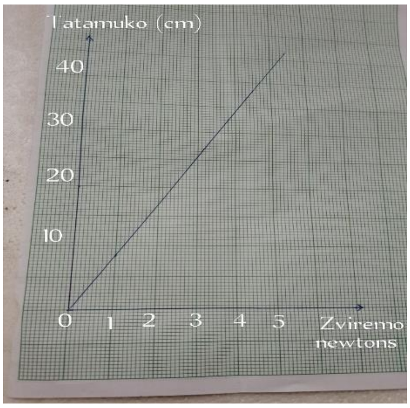
Kutatamuka kweSipiringi

Mukabasa kari paMuf. 2 ngatitorei zvinhu zvine huremu hwatinoziva tichirembedza pasipiringi sezvakataridzwa pamufananidzo. Panguva yega yega patinoisa chiremo tichiona panosvika kutatamuka kwesipiringi apo tichange tichiyera nechiyereso chehurefu.

Muf.2 Enderano yetatamuko yesipiringi nechiremo (Mushore 2022)

Tafura 1. Zviverengwa

Huremu (N)	Pakanongedzwa nechinongedzo (cm)	Tamuko (cm)
0	11.2	0
1	19.7	8.5
2	28.1	16.9
3	36.8	25.6
4	45.5	34.3
5	53.8	42.6



Muf. 3 Hukama pakati pehuremu netatamuko (Mushore, 2022)

Kubva pagirafu reMuf.3 tinoona kuti Huremu hunoenderana netatamuko

$$\mathbf{F} \propto \mathbf{x} \text{ -------------------3}$$

Zvoreva kuti **F = kx** ----------------------4

apa k = isindimaro yesipiringi, F = huremu na x = tatamuko.

Saka pagirafu retatamuko nehuremu, k inenge iri muteru wegirafu

Tichitarisa pagirafu reMuf. 3, tinosarudza nzvimbo mbiri dzatinoda kuverenga zvipimwa.

$$k = \frac{5-1}{(42.6-8.5).10^{-2}} \text{ Nm}^{-1}$$

$$k = 11.73 \text{ N}m^{-1}$$

Zvichireva kuti sindimaro yesipiringi yedu inoita **11.73 Nm^{-1}**

Muenzaniso

Kana sipiringi yakareba 10cm ikatatamutswa nehuremu hunoita 5N yotatamuka kusvika pa 45.5cm tsvaga sindimaro yesipiringi iyi.

Tatamuko yesipiringi = (45.5 - 10)cm = 35.5.cm

Kubva enzano 4, F = kx,

$$\therefore \quad k = \frac{F}{x}$$

$$k = \frac{5}{(35.5).10^{-2}}$$

k = 14.08Nm^{-1}

Manikidzo neMafambiro

Kana chinhu chikasundwa chiri chakagara pamusoro pangava petafura, chinhambo chinofambwa chinoenderana nekukutsvedzerera kwepamusoro petafufura yacho. Kukwasharara kwepamusoro pacho zvinoita kuti chinhambwe chinofambwa chiite chidoko. Kune nzira dzatinogona kushandisa kuti pamusoro petafura patsvedzerere dzinoti:

1. kupukuta pamusoro pacho kuti papenye
2. kushandisa zvinotsvedzerera zvakaita semafuta, nhanzva kana mazaya echando.

Tinoona kuti pane manikidzo inorwisana nekufamba kwechinhu chakagara pasi. Pasi pari kufambwa nechinhu kana pakakwasharara, manikidzo yekurwisa iyi inokura. Zvoreva kuti
manikiidzo yekurwisa mafambiro inoenderana nemamiriro akaita pasi pari kufambwa apa. Iyi manikidzo inopikisa mafambiro ezvinhu zvinokwizirana inonzi iyo **manikidzo yekwiziro** nekuti inounzwa nekukwizirana kwezvnhu. Hukuru hwemanikidzo yekwiziro hunosiyana nekusiyana kwemhando yezviri kukwizirana. Saka chimwe nechimwe chinokwizirwa chine yatinoti **Hwiziro** inorakidza mhando yezviri kukwizirana zvacho.

Nzira Dzinoderedza Manikidzo yekwiziro

1. Kupukuta mativi ari kukwizirana acho kuti apenye agotsvedzerera
2. Kushandisa zvinotsvedza pakati pemativi ari kukwizirana. Zvinotsvedza zvinosanganisira mafuta kana nhanzva
3. Kushandisa mavhiri
4. Kwava nenzira zvakare dzekufuridzira mhepo inosimudza chiri kufamba chofamba chisina kutsika parikufambirwa.

Zvaonekwa kuti manikidzo ikangoshandiswa pekutanga handiyo inoita kuti chinhu chirambe chichifamba kana kuti chinhu chishandure mafambiro kana kuti chinhu change chakamira chitange kufamba. Izvi ndizvo zvakaita kuti Isaac Newton agadzire mutemo wake wekutanga maererano nekufamba kwezvinhu uyo unoti:

Chinhu hachikwanise kushandura mafambiro acho, kana kungotanga kufamba choga pasina manikidzo yashanda pachiri.

Kubva mumutemo uyu tinoona kuti manikidzo ikashandiswa pamutumbi inokonzera zvinhu zvitatu zvinotevera:

- Mutumbi unomakidzwa kukwakuka wotanga kuwedzera umhanyo.
- Manikidzo inogona kudzikisa umhanyo hwemutumbi (Hwakuko inopikisa mamhanyiro echinhu)
- Manikidzo inogona kushandura umhanyotasa hwemutumbi.

Musanganisirwo weManikidzo dzakawanda dziri kushanda pamutumbi kuti tiwane Mhedzisiro dzeManikidzo

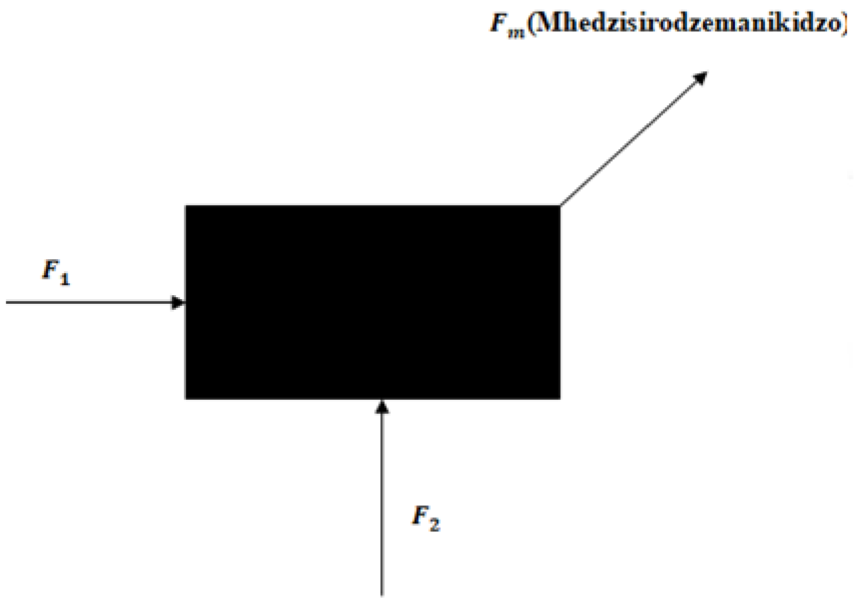
Manikidzo dziri mumutsetse umwe

Mutumbi ukashandisirwa manikidzo dzinopfuura imwe chete, tinosanganisa manikidzo dzose kuti tiwane mhedzisiro dzemanikidzo idzodzo. Kana kuine dzakafuratirana, imwe inopiwa munongedzo weBviso (-) semuenzaniso uri pasi:

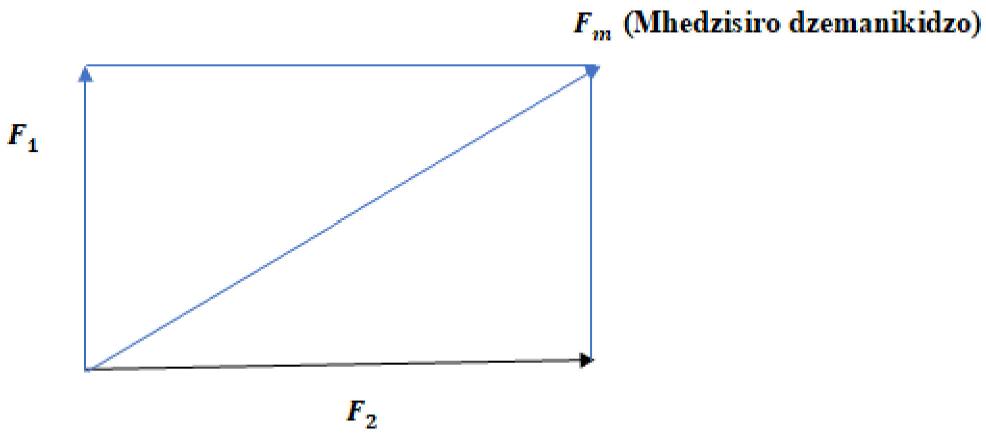
Varume vari kukakatana tambo. Vamwe vari kukakata vachishandisa manikidzo ye 2000N vamwewo vanopikisa vari kukakatirawo rimwe divi ne 1800N. Mhedzisiro yemanikidzo tinoiwana seizvi

Mhedzisiro yeamnikidzo = 2000N – 1800N = 200N. Mhedzisiro yemanikidzo idzi inenge yakananga kudivi revarume vari kushandisa 2000N.

Tomboti manikidzo mbiri hadzisi mumutsetse mumwe chete sezviri paMuf. 4



Muf. 4: Mhedzisiro dzemanikidzo dzisiri mumutsara umwe.



Muf. 5. Chitarwa chematsvagirwo eMhedzisiro dzemanikidzo

Kana manikidzo mbiri idzi dzakatarwa zvichienderana nekukura kwadzo zvinoreva kuti mhedzisiro yemanikidzo mbiri idzi inowanika nukuyera hurefu hwemhedzisiro yemanikidzo iri kuratidzwa paMuf. 5.

4.2.6 Kuyerwa kweManikidzo

Manikidzo ikashandiswa pamutumbi tinoona kuti kukura kwemanikidzo ndikowo kukura kwehwakuko yemutumbi. Manikidzo inoenderana nehwakuko inokonzereswa. Kana mutumbi waramba uri mumwechete apo panoshandurwa manikidzo zvoreva kuti hukuru hwemutumbi ndihwo uri kuramba husingashanduke zvichizoshandiswa pakushandura nongedzo yeEnderano tichiisa nongedzo yeEnzano

F = ma------------------------5

Pakushandisa enzano iyi, Manikidzo (**F**) inenge iri kuma N ndokunge hukuru hwemutumbi (**m**) huri muma kg uyezve hwakuko (**a**) iri muma ms^{-2}

Saka 1N = 1kg x 1ms^{-2}

Muenzaniso

Manikidzo ye 4.9N yakashandiswa pahukuru hwemutumbi unoita 1.4kg, Tsaga kuti hwakuko yakakura sei.

$$F = ma \qquad \Rightarrow \qquad a = \frac{m}{F}$$

Toita tsivo $a = \frac{4.9}{1.4}$ ms^{-2}

a = 3.5 ms^{-2}

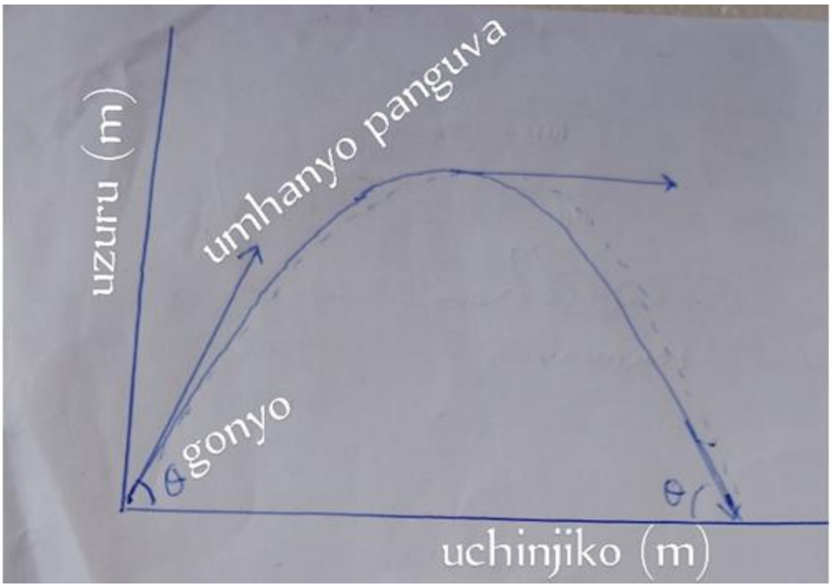
Chinepfu chemutumbi

Hukuru hwemutumbi hunokonzera chinonzi chinepfu chemutumbi. Chinepfu kuramba kunoitwa nemutumbi kushandurwa mafambiro awanga uchiita.

Izvi tinozviona kana uri mubhazi/dutavanhu rinenge richimhanya asi rongomira chiriporipo. Vanhu vari mukati vanoita kunge vasundirwa mberi. Uku kuda kwechinepfu chomutumbi.

Manikidzo isiri kurutivi rwemafambiro

Ngatitarisei mafambiro edombo rinokandwa mudenga sezviri pachitarwaMuf. 6



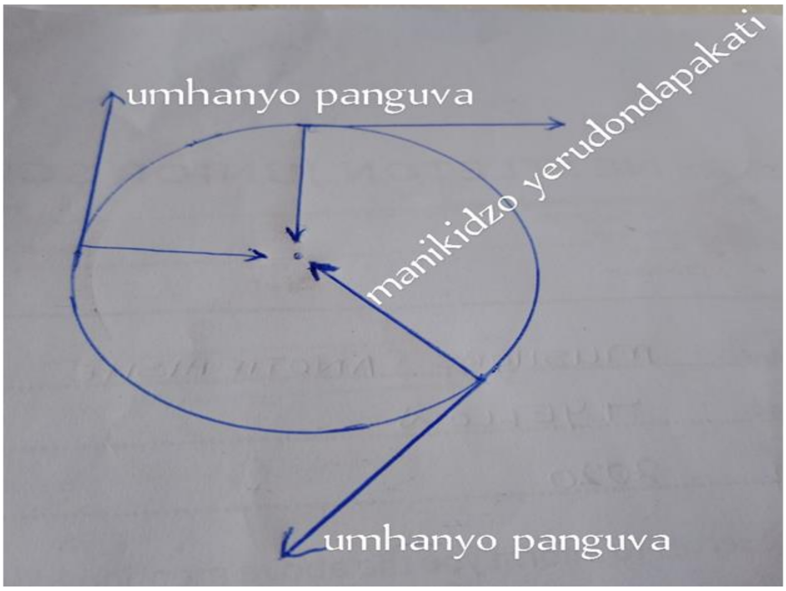
Muf. 6. Nzira inofambwa nayo nedombo rakandwa mudenga

Pachitarwa chiri paMuf. 6, dombo panguva yekutangisa rwendo, umhanyo hwedombo hunenge huri v_1 panguva t_1 tichitarisawo divi sezvakaratidzwa.
Dombo rakandwa kana richikwira mudenga, pane manikidzo ichange ichirwisana nekufamba kwedombo. Manikidzo iyi ndihwo huremu hwedombo (W = mg) inenge yakaringa pasi nekuti manikidzo iyi isimba regiravhiti. Huremu hwedombo hucharamba huchirwisana nemafambiro edombo kusvika rasvika parinoguma kuenda mudenga. Asi nekuda kwehuremu, richatanga kukakatirwa pasi rotangazve kufamba kutanga zvishoma zvishoma richiwedzera mamhanyiro aro kusvikira rarova pasi.

Mamhanyiro arinokwakuka nawo pasi ndiwho mamhanyiro arinorova nawo pasi. Tisingatarisire hwiziro yemhepo muchadenga, dombo rinosvikorova pasi negonyo yakaenzana neyarasimuka nayo pasi. Kana tichitarisa mafambiro zvinoenderana nepahuchinjiko hunovambirana nepasi, dombo harisandure mamhanyiro aro anoramba ari mamwechete sezvakaita arinenge ratanga naro kurutive rwehuchinjiko uhu.

Mafambiro Edendererero

Ngatitorei muenzaniso wemunhu akasunga dombo duku patambo wotanga kuritenderedza. Dombo rinotenderera harikwanise kuenda nekuda kwemanikidzo iri mutambo. Ukawedzera mamhanyiro edombo mudenderedzwa umu unonzwa ruoko kukakatwa nedombo kuchiwedzerawo. Izvi zvinorakidza kuti kune manikidzo inenge iri mutambo umu yatinoti Manikidzo yeHudzivapakati/yeRutondapakati inokwevera dombo mukati zvichirwisana nekumhanya kwedombo. Manikidzo iyi inenge ichikwevera dombo kuruoko rwako urwo runenge ruri pakati pedenderedzwa iri. Ukuru hweumhanyo hwedombo haushanduke asi chinoshanduka rutivi runenge rwakatariswa nedombo apo rinenge richimhanya mudenderedzwa. (tarisa chitarwa chiri pMuf 7.). Tinoziva kuti manikidzo inokonzeresa hwakuko. Saka Manikidzo yeHudzivapakati/yeRutondapakati iyi inokonzera hwakuko yedenderedzo.



Muf. 7. Chitarwa chinotaridza mafambiro edenderero.

Manikidzo yehudzivapakati/yeRutondapakati inoramba yakanongedzera pakati pedenderedzwa mukutenderera kwose kwedombo.

Manikidzo yeDzorero

Pamanikdzo yoga yoga yekuitira kune manikidzo yedzorero yakaenzana nayo asi yakatendeka rutivi runopikisa manikidzo yekuitira iya. Munhu akasunda chinhu, zvakaonekwa kuti chinhu chasundwa chiye chinodzorerawo nemanikidzo yakaenzana neyashandiswa nanyakusunda uye, asi manikidzo iyi inenge yakatendeka kurutivi rwunopikisa mankidzo yekuitira iya. Chinhu chakatsika pasi chine manikidzo yekuitira inokonzerwa nehuremu hwacho. Saka huremu hunokonzera manikidzo yekuitira pasi pakatsikwa, ipo pasi paye panoshandisawo manikidzo yedzorero inenge yakaenzana nehuremu hwechinhu chacho yakatendeka mudenga kupikisa huremu hunotendeka pasi. Tikatarisa motokari iri kumhanya pagonyo remugwagwa, mavhiri emotokari anenge akatsika pasi. Nekuda kwegonyo neumhanyo hwemotokari, tinoona kuti zvinokonzera manikidzo yerudzivapakati inenge ichikwevera mukati pakati pegonyo remugwagwa uya. Manikidzo yerudzivapakati iyi inokonzerwa nemavhiri emotokari ayo anotsika pasi mumugwagwa nekuda kweumhanyo hwemotokari uye huvepo hwehuremo nekuda kwekuchinjika kwemugwagwa (Wsinə) zvogadzira manikidzo yedzorero inobva pasi. Izvi zvakakosha kune vanogadzira migwagwa kuti pagonyo mugwagwa unge wakachinjika zvinoita kuti manikidzo yerudzivapakati iyi inongedzere mukati pakati pegonyo. Izvi zvinoita kuti mutyairi wemotokari akwanise kutevera gonyo pasina kukonzera tsekwende.

KaBvunzo

1. Chii chinonzi Manikidzo?
2. Nyora mutemo wekutanga waNewton
3. Tsanangura kuti sei dombo duku nedombo guru zvikadonhedzwa panguva imwe chete achibva pazvinhambwe zvakaenzana kubva pauzuru pevhu anosvikirana paivhu.
4. Tsvaga manikidzo ingakonzeresa dombo rinorema 4.5kg hwakuko ye 6.0 ms^{-2}
5. Mukomana arikusunda chidhinha nemanikidzo inoita 200N icho chinoonekwa chichifamba

neumhanyo husingashanduke patafura.. Ko tikaudzwa kuti manikidzo yekwiziro pakati pechidhinha netafura i125N, tiudze kuti mhedzisiro yemanikidzo ingaite chii?
6. Wapiwa iwe mukomana ari kutenderedza dombo rakasungirwa patambo. Tara mufananidzo unorakidza manikidzo nemamhanyiro edombo pakanguva kaduku.
7. Tomboti wapihwa sipiringi nezviremo zvausingazive huremu hwazvo kunzi uongorore matatamukiro esipiringi kana ichinge ichikakatwa nezviremo. Tiudze zvimwe zvokushandisa zvaungade pakabasa aka.
8. Tara mufananidzo wemotokari iri kumhanya pagonyo remugwgwa. Pachitarwa chako ratidza manikidzo dziri kushanda pamotokari uye umhanyo pakanguva kainenge yave mugonyo umu.

Using the Shona-Physics words obtained from interviewing people, the researchers were able to write the Shona Physics text which could be used to teach Forces. The Shona-Physics words fitted quite well in the translations and would make the texts easier to understand since the Shona-Physics words are familiar to the Shona speaking people.

Conclusion and Education 5.0 Compliance

The research paper was conducted to develop Shona-Physics texts to teach Forces at Ordinary level Physics. The results obtained showed that indigenous languages are rich in Physics technical terms which could be used by craftsman, educators, learners and examiners. The study therefore appeals to policy makers to consider a review of the Zimbabwean education act to adopt all indigenous languages as Media of Instruction in the teaching of Sciences up to ‘O’ Level. This will go a long way in helping local students understand and communicate Physics better and institute a heritage based curriculum. Although more effort is needed to develop Science textbooks in indigenous languages, our study has shown that it is achievable hence, policy makers should influence the use of indigenous languages as media of instruction in the teaching and learning of Physics in local schools. Consequently, authors must develop some teaching and learning materials aimed at assisting teachers and learners in the teaching and learning of Physics.

Reference

1. Baiju, K. N. (2010). Major Language theorists influencing Learning of Mathematics. *Springer*.
2. Bowen, A. (2009). Document analysis as a qualitative research method. *Qualitative Research Journal, 9*(2), 27 - 40.
3. Jegede, O. T. (1995). Collateral learning and eco-cultural paradigm in science and Mathematics education in Africa. *Studies in Science education*, 97-137.
4. Jegede, O., & Aikenhead, G. S. (1999). Transcending cultural boaders: implications for science teaching. *Journal for Science and Technology Education*, 45-66.
5. Kufazvinei, C., Mukaro, R., & Gasseller, M. (2002). An Overview of Physics instruction in Zimbabwe. *The Physics Teacher*, 336-338.
6. Mcleod, S. (2022). Vygotsky's social cultural theory of Cognitive Development. *Simply Psychology*.
7. Moodie, I., & Nam, J. (2016). English Language Teaching research in South Korea: A review of recent studies . *Language Teaching*, 63-98.
8. Mushore, J. (2022). Shona-Physics Text. *Unpublished work*.

9. Mwinsheikhe, H. M. (2009). Spare no means: Battling with the English/Kiswahili dilemma in tanzanian Secondary schoo Classroom. *Languages and Education in Africa*, 223-235.
10. Nkonde, E., Siluyele, N., Mweemba, M., Kaluba, J., & Zulu, C. (2018). Evaluating the impact of Teaching and Learning Mathematics and Science Using local Language (language of play) in Primary schools in Muchinga Province, Zambia. A case study of Chinsali District. *American Journal of Education Research*, 1153-63.
11. Owu-Ewie, C., & Eshun, E. S. (2015). The use of English as Medium of Instruction at the Upper basic level (Primary four to Junior High School) in Ghana: From theory to Practice. *Journal of Education and Practice*, 72-82.
12. Reinhard, B. (2003). How does the medium of instruction affect the leaning of Chemistry? . *Science Education International*.
13. Shumba, O. (1995). Indigenous Zimbabwe Science Teachers' understanding of the nature of science relative to the models of the nature of science and relative to profiles of teachers in two countries. *Zimbabwe Journal of Science Education*, 115-159.
14. Thondlana, J. (2005). Lanuages for teaching and using indegenous and learning in Zimbabwe.
15. Witring, A., Chen, H., & Fraser, M. (2021). Exploring curriculum alignment through syllabus Document Analysis: From National Language policy to local ELT practice. *Iranian Journal of Language Teaching Research*.
16. Zimbabwe Schools Examination Council (ZIMSEC). (2015). *O level Physics Syllabus.* Harare: Ministry of Primary and Secondary Education.
17. Zivanayi, W. (2003). The effect of the Mother Tongue (Shona) as the medium instruction in the learning of Physical Science. A study of Gweru Urban secondary schools.