Artigo original

Effect of indigenous knowledge in a physics curriculum on pupils' attitudes towards physics

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ABSTRACT: In education, attitudes work as an internal factor that guides pupils' actions towards certain subject matter. Consequently, it is one factor for prediction of pupils' achievement. Although understanding physics is fundamental to understanding the world around us, results of research carried out worldwide have shown that pupils' success in physics is often lower than in other subjects. The sample of this study consisted of 216 pupils (135 girls, 83 boys) from a secondary school in Chókwé. Grade 9 was chosen because this is when pupils learn thermal phenomena, one of the topics for which physics-related indigenous knowledge (IK) had been identified in an earlier study, during interviews with senior citizens. An experimental approach was used, involving a pre-test, teaching intervention and post-test with experimental and control groups. The attitudes questionnaire consisted of *Likert* scale type multiple-choice questions. The contextualized teaching materials used in the intervention were based on IK and pupils' everyday environment, and the teaching intervention was inquiry-based. The results suggest that pupils who had lessons with contextualized teaching materials based on inquiry approach had more positive attitudes towards physics than pupils who were submitted to a classic teacher centred approach. The Implications for future classroom practice is that teaching materials should take into account the context in which they are going to be used.

Key words: Indigenous knowledge, physics curriculum material, pupils' attitude, teaching strategies

Efeito de conhecimento indígena no currículo de física sobre as atitudes dos alunos para com a física

RESUMO: Na educação, atitudes funcionam como um factor interno que orienta as acções dos alunos durante a aprendizagem de um determinado tema. Consequentemente, são um factor para a previsão de conduta e realização dos alunos. Esta pesquisa relata sobre o efeito de incorporação do conhecimento indígena, relacionado com fenómenos térmicos nos materiais instrucionais de Física da 9ª classe e o seu impacto na atitude dos alunos para com física nesta classe. A amostra é composta por 216 alunos (135 meninas e 83 meninos) de uma escola secundária em Chókwé. A 9ª classe foi escolhida porque é nesta classe que é introduzido a unidade temática que aborda os fenómenos térmicos, um dos temas para os quais o conhecimento indígena apresenta muitos conceitos e fenómenos relacionados com física, e que foram muitas vezes citados durante estudos preliminares realizados com os idosos. Para a realização do estudo foi usada uma abordagem quase-experimental, envolvendo um pré-teste, intervenção e pós-teste baseado em grupos experimental e de controlo. O questionário de atitudes consistiu-se de questões de escolha múltipla do tipo escala de *Likert*. Os materiais de ensino contextualizado utilizados na intervenção foram baseados em conhecimento indígena e ambiente quotidiano dos alunos e o ensino foi baseado em método dialogante com elementos de método expositivo e interrogativo. Os resultados sugerem que o processo de ensino-aprendizagem baseado em materiais instrucionais contextualizados associado ao método inquisitivo promove uma atitude positiva para aprendizagem de Física nos alunos.

Palavras-chave: Conhecimento indígena, materiais instrucionais, atitudes dos alunos, estratégias de ensino.

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INTRODUCTION

Each society has its own culture, which forms the basis of its thinking (BRYCE and BLOWN, 2006; HIGGS, 2006; SNIVELY and CORSIGLIA, 2001). "Western science", which is taught in educational institutions, from schools up to universities, is related to Western culture or Euro-American Culture (AIKENHEAD and OGAWA, 2007). Literature reveals that the science/physics learning achievement in many developing countries is strongly influenced by learners' environment and their attitudes (ADESOJI, 2008; GAUTREAU and BINNS, 2012; KHAN and ALI, 2012). The former is the source of previous knowledge and the latter reflects the motivational stage, the state of readiness of learners to react to a situation. The term "developing countries" is associated with poor and non-western countries. In this paper, knowledge from developing countries is labelled indigenous knowledge (IK), or indigenous knowledge and technology (IKT). Indigenous knowledge and technology as socio-cultural knowledge is acquired as a product of multiple interactions of learners and the environment in which they live, which could be family, ethnic, and/or social group (Das GUPTA, 2011; SHARMA; BAJRACHARYA and SITAULA, 2009). In the literature on science education the concept *attitude* encompasses different perceptions. For instance, attitude towards science/physics is related with interest or feeling towards science/physics (YARA, 2009). Others perceive it as a learning predisposition to evaluate something, be it a proposition, a person, object or action (BROGGY and MCCLELLAND, 2008; GARDNER, 1975 quoted by GEORGE, 2000). Thus, in any situation of learning science, including physics, it is possible to identify individual pupils who generally seem to have a more positive or less positive attitude towards science/physics. For Khan and Ali (2012), attitude is connected with individual likes or dislikes towards something and is an individual temperament, a way to look at things which can attract or not, or even repulse. For George (2000), attitudes are concerned with the way of individual thinking, acting and behaviour which can be stated through favourable or unfavourable reactions to things, places, events or ideas, which are strongly influenced by the culture and beliefs of the learner. It is evident that there is a range of perceptions associated with the concept *attitude*. However, its role in education is central because it is one of the key factors that influence the effectiveness of teaching and learning. Thus, attitude is one predictor of student achievement.

Concerning IKT, although there is a long debate about the definition, nature, epistemology and status that could be incorporated in formal education, many researchers perceive it as a common way to label all valuable, alternative ways to organize knowledge, technology and social experience that is different from Western scientific knowledge or Euro-American knowledge (BAJRACHARYA and SITAULA, 2009; FORREST, 2000). As educators, what we need to recognize and highlight is that indigenous knowledge is a cumulative body of knowledge, practices and representations maintained and developed by people with extended experiences of interaction with the natural environment; based on sophisticated sets of understandings, interpretations and meanings which are part and parcel of a cultural heritage that encompasses language, symbols, designation and classification systems, resource use practices, ritual, spirituality and worldview (CHARLES ROYAL, 2002; RAZA & du PLESSIS, 2001). Furthermore, our challenge as science educators is to emphasize the socio-cultural usefulness of any indigenous knowledge.

Relating IKT and education, one of the main objectives of the latter is to pass on social-cultural values, including IK, from senior generations to youths as a way to socialize the new generations with their culture. As for its label, in this study all non-western knowledge or science, independently of its origin, such as, ecological knowledge, indigenous knowledge system, African science, traditional knowledge, local knowledge, familiar knowledge and so on will be called indigenous knowledge.

As for formal education, the inclusion of previous knowledge based on indigenous knowledge and pupils' environment should contextualize the science classroom and, consequently, bring pupil's background knowledge into the classroom, which should help them to relate their culture and scientific culture. Science/physics taught in conjunction with local traditional knowledge brings not only a sense of place, for non-western pupils, but also helps them to make science more universal and less strange to pupils (KASANDA et al., 2005). In addition, the contextualization of teaching materials and the science classroom should give pupils opportunities to develop critical thinking and promote positive attitudes and, consequently, stimulate their participation in the classroom.

Concerning achievement in science, a range of literature links success at school with the school context, e.g., a good teaching and learning environment and involvement of parents and teachers' experience (YARA, 2009) and achievement with positive attitudes towards subject (ANWER, IQBAL and HARRISON, 2012).

In trying to address these and other concerns related to pupils' performance, there has been considerable research carried out in different countries, some of which is showing the pertinence of incorporating pupils´ previous knowledge, including pupils' environment, in the science/physics classroom (COŞTU and AYAS, 2005; DENZIN and LINCOLN, 2011). Others suggest that curriculum innovation in non-western countries should not only emphasize Eurocentric philosophy during science curriculum design, but also contextualize the curriculum materials through the incorporation of students' environment and IKT (VOS, DEVESSE and PINTO, 2007). The statements above raise three ideas: (i) the need to explore indigenous knowledge in science teaching and learning; (ii) the idea that the inclusion of indigenous knowledge and pupils' environment should stimulate students' interest towards science/physics and, consequently, increase their performance in the classroom and (iii) the existence of factors which interfere with pupils' attitudes. From these points of view, determining pupils' previous knowledge, their environment and knowing the indigenous knowledge that they hold becomes an important starting point in designing a suitable learning environment and developing new teaching strategies to minimize the preconceptions and promote appropriate connections between different worldviews (BAQUETE, GRAYSON and MUTIMUCUIO, 2009). Additionally, Yara (2009) argues that physics as a subject requires a commitment on the part of both teachers and pupils, if they want the process of teaching and learning to be effective, because the teaching and learning of physics is not just a process of transfer from the teachers, and memorization of concepts and formulas by learners, but it is a process of scientific knowledge construction based on scientific understanding of phenomena and concepts.

Other findings from the literature stress the role of the school environment, the teacher, textbooks and pupils' attitudes whether positive, neutral or even negative, for good performance in the classroom (PROKOP, TUNCER and CHUDÁ, 2007). Obviously pupils' background, such as the family as source of previous knowledge, plays an important factor in their positive or negative attitudes towards science/physics

(IPSOS MORI SOCIAL RESEARCH INSTITUTE, 2011).

In this study we investigated the effect of incorporating indigenous knowledge and technologies and pupils' previous knowledge into Grade 9 physics curriculum materials on pupils' attitudes to physics as well as the effectiveness of that material on teaching and learning physics concepts. In this paper we address the research questions: (i) What are pupils' attitudes to learning physics before instruction? and (ii) What is the effect of using contextualized materials and inquiry-based learning strategies on pupils' attitudes to learning Physics?

METHODOLOGY

As mentioned earlier the sample for the study was comprised of 216 Grade 9 pupils (134 girls, 84 boys) from a Junior Secondary School in Chókwé - Mozambique, the same region in which the in-depth and semi-structured interviews with senior citizen on indigenous knowledge related to physics concepts were reported in a study (BAQUETE, GRAYSON and MUTIMUCUIO, 2009). The sample was divided into two groups, control and experimental, comprised of 108 (67 girls, 41 boys, range age 13-17; and 65 girls, 43 boys range age 13 – 22, respectively). It was a convenience sample because, in order to avoid disrupting the normal running of the school programmes, the researchers worked only with those classes whose teachers had indicated that they would compensate the time made available for this research by means of extra lessons. Concerning the socioeconomic status of the respondents, the majority of them were from low to middle class families, whose activities consist mainly of farming, informal employment and public service.

Grade 9 was chosen because the topic is related to thermal phenomena, which is introduced in this grade and was one of the most mentioned by senior citizens, through different examples of thermal phenomena or events, such as the production of African beer, and preference for using clay pots and wooden spoons for cooking rather than metal utensils. These results were obtained through in-depth and semi-structured interviews and have been reported in Baquete, Grayson and Mutimucuio (2009).

The research design used an experimental approach following a pre-test, teaching intervention, post-test with experimental and control groups. The questionnaire used in the pre and post tests consisted of *Likert* scale type questions which was inspired by other instruments used to investigate pupils' attitudes towards science (DEMIRCI, 2004), with strongly agree (1) up to strongly disagree (5) statements. Each statement was followed by a space in which pupils had to fill in a justification of their choice.

A pilot study involving a small group of pupils was conducted in order to assess, among other elements, the suitability of the time needed to fill in the answers, the language and the contextualization of the questions. The final questionnaire was organised in four sections namely (i) intrinsic ability (questions 1 and 3); (ii) relevance (questions 2 and 7); (iii) nature (question 6) and (iv) interest (questions 4, 5, 8 and 9). The reliability factors of the instrument were tested using Cronbach's Alpha, producing a value of 0.70. A peer correlation value among pupils' responses varied between 0.67 and 0.90, meaning that both the questionnaire and pupils' responses are valid.

Concerning the teaching intervention, the two groups, experimental and control, were taught by the same teacher, had the same time allocation (45 minutes per lesson) and the same topic. The only difference between them was the use of the contextualized teaching materials by the experimental group anchored on inquiry approach based on analogy and Predict-Observe-Explain (POE) strategies. Often an analogy included the words "... is like ...", while POE required pupils to confront their previously made predictions (P) with some measured results (O) and to explain (E) possible discrepancies**.** The teaching materials incorporating IK and pupils' environment were developed by the researchers (see a sample in the appendix). The school physics teacher who gave the lessons was trained by the first researcher and during the teaching intervention the first author also participated as observer.

RESULTS AND DISCUSSION

This section gives a description of the results, which are based on an analysis of attitudes questionnaire comprised by 9 questions dived into four (4) sections, namely intrinsic ability, relevance, nature, and interest.

Impact of teaching intervention

Table 1 shows the frequencies of pupils in each group who strongly agreed or agreed with each statement. The results for both the pre-test and post-test are shown, together with the gain in the number of positive responses.

TABLE 1: Frequencies of pupils who strongly agreed or agreed with each statement in the pre and post-test for the experimental and control groups (n = 108)

Statements / Categories	Experimental Group			Control Group		
	Pre	Post	Gain	Pre	Post	Gain
Intrinsic ability						
Q1 - I think that anyone can be a good physics pupil if he or she works for it	90	93	03	95	88	-7
Q3 - Only bright Mathematics' pupils can do well in Physics	57	47	-10	53	61	08
Relevance						
Q2 - Physics is related with my own everyday life	53	94	41	47	88	41
Q7- Physics subject has little relation to my everyday life	50	33	-17	55	42	-13
Nature						
Q6 - It is possible to explain physics ideas without mathematical equations	45	68	23	59	48	11
Interest						
Q4 - I find Physics interesting	58	88	30	50	60	10
Q5 - I like to discuss Physics with other pupils	52	65	13	47	58	11
Q8 - Currently, I like Physics very much	32	57	15	33	34	01
Q9 - Next year I plan to take Physics subject	46	62	16	40	49	09

Mean scores and standard deviation

Table 2 shows the post-intervention mean scores and standard deviation (P-IMSD) of the statements for the experimental and control groups on the attitudes' questionnaire, where 1 is 'strongly agree' and 5 is 'strongly disagree'. Thus, values lower than 3 represent positive attitudes, while the opposite represent negative attitudes.

According to the results in Table 2, all positive attitudes tend to an average of 2.41 and 2.49 in the experimental and control group, respectively, while questions with negative statements in both groups tend to an average of 3.23 and 3.35, in the experimental and control group, respectively. As a result, the peer correlation value among pupils' responses varied between 0.67 and 0.90, meaning that both the questionnaire and pupils' responses are valid. In general, the results show that the teaching and learning based on contextualized materials promote pupils' positive attitudes towards physics.

TABLE 2: P-IMSD of the responses to the attitudes questionnaire of both groups.

Statement / Categories	Experimental Group			Control Group	
	M	***SD***		***M***	***SD***
Intrinsic ability					
Q1 - I think that anyone can be a good physics pupil if he or she works for it	1.92	1.13		2.12	1.61
Q3 - Only bright Mathematics' pupils can do well in Physics	3.00	1.68		2.75	1.74
Relevance					
Q2 - Physics is related with my own everyday life	1.89	1.25		2.20	1.76
Q7 - Physics subject has little relation to my everyday life	3.46	1.60		3.44	1.88
Nature					
Q6 - It is possible to explain physics ideas without mathematical Equations	2.70	1.74		3.12	1.86
Interest					
Q4 - I find Physics interesting	2.05	1.34		2.88	1.84
Q5 - I like to discuss Physics with other pupils	2.62	1.56		3.08	1.88
Q8 - Currently, I like Physics very much	2.82	1.65		3.79	1.94
Q9 - Next year I plan to take Physics subject	2.86	1.71		3.30	2.08

Table 1 shows the frequencies of agree and strongly agree responses of both groups, before and after the intervention. The responses showed that, in general, pupils who had lessons with contextualized teaching materials based on inquiry approach had after the intervention more gains in strongly agree and agree with each statement of attitudes towards physics than pupils from the control group.

Nonetheless, in order to refine the pupils' responses according to the goals of the study *the effect of the contextualized teaching materials to their attitudes* was calculated via a descriptive statistic mean and standard deviation in both groups as shown in table 2.

Further, beside a single analysis per question, it was useful to compare the qualitative responses of pupils in each of the four categories. Thus, pupils' responses were coded in the following way: Sx-P1-E and Sx-P2-C, where letter "S" means pupils and "x" means a number sequence in which each questionnaire was analysed. In addition "P1" means pre-test and "P2" post-test. Finally, "E" designates experimental group and "C" represents the control group. Below are the qualitative results per category; analysed together with quantitative data from Tables 1 and 2.

Intrinsic ability

This section deals with questions related to pupils' intrinsic ability, questions 1 and 3. For question 1, Table 1 shows that 7 pupils in the control group who had shown a positive attitude in the pre-test shifted their answer, within the *Likert* scale in the post-test. Consequently, the percentage of positive responses dropped 6,5%, while in the experimental group the gain was from 90 to 93. Per question, the researchers had requested the pupils to justify their options. Looking at some pupils' justifications for their answers related to the intrinsic ability we found the following reasoning:

> S30-P1-C: I agree. If you study well ... and follow the teachers' recommendation you can do well in Physics and exchange ideas with colleagues;
>
> S30-P2-C: Physics is difficult … you need to know the formulas and theory...is not easy if you remember one thing you forget the other, you need to be a good pupil ... teachers also give different assignment from what they taught during classes;
>
> S35-P1-C: Physics is a difficult subject but if you study properly... do homework, have a study group on weekends ... you can get good marks;
>
> S35-P2-C: ... I disagree completely ... only good pupils can do well in physics ... I do my homework ... we have a study group ... after a test you are sure that you did well ... but you don´t get positive marks ... physics is difficulty ... is easy for good pupils.

In general pupils agree that commitment is a key factor for success in physics. The pupils' justifications after the test suggest that their responses are strongly influenced by marks in the test. Also, pupils reasoning, for instance, S30-P2-C suggest that the low pupils' marks are due to the absence of any relation between the content taught and the content assessed.

As for question 3, "Only bright mathematics' pupils can do well in Physics" a sample of pupils' justifications shows an increase of pupils in the control group holding that only bright pupils can do well in physics. Here are some examples of justifications:

> S5–P1-E: To explain phase change you need to calculate heat, to change scale you need formula ... if you are not good in mathematics you can't be good in physics;
>
> S5-P2-E: Yes, I agree that anyone can be *a* good pupil in physics even if he is not good pupils in mathematics ... for instance to explain how clothes dry is not necessary any mathematics;
>
> S11-P1-E: Physics is difficult …you need to know the formulas and theory ... is not easy if you remember one thing you forget the other, you need to be a good pupil ... teachers also give different assignment from what they taught during classes;
>
> S11-P2-E: I disagree; there are many phenomena that we can explain without Mathematics ... for instance the drops of water around the surface of clay elements ... to define heat is not necessary any formula ... you can understand physics even if you are not good in mathematics.

The findings presented by experimental group are different from the ones given by the control group. According to the reasoning given to this section by participants the teaching intervention have promoted a new relationship between mathematics and physics. In the experimental group the numbers of respondents who link the success of physics to mathematics decreased 10 points (9.3%), while in the control group increased 8 points (7.4%). Looking deeply to the whole section associated with intrinsic ability we found similarity with studies which claim that attitude is influenced by individual *likes* or *dislikes* towards something, a way of individual acting and behaviour (GEORGE, 2000; KHAN and ALI, 2012; SALEH, 2014).

Relevance

This category helps us to understand why physics is or is not relevant to pupils' everyday life. In question 2, table1 shows that the gains in both groups, experimental and control, are high and the same, 41. The results suggest that the contextualized teaching materials did not have any influence on this question. Nonetheless, if we compare the means and SD in table 2, between responses of both groups we found that the value of the means is 1.89 against 2.20, and SD=1.25 against SD=1.76 in the experimental and control groups, respectively. These values show that, although the gain was the same, the spread of values in the experimental group is lower than in the control group, meaning that the contextualized teaching materials affected pupils' responses. Examples of pupils' justification are shown below.

> 17P1E: Physics is science ... only last year I started to study physics;
>
> S17-P2-E: Yes, physics is related to my life, according to our physics teacher cars are able to stop due friction force between the wheels and the road ... even in hospital they use thermometer ... in public transport drive are moving in high speed ... Here in Chókwé in the morning is very cold;
>
> S50-P1-C: I don't know;
>
> S50-P2-C: We discussed in the class the velocity, temperature, conductivity ... yes physics is related to my everyday life.

For question 7, stating that "Physics is related with my own everyday life" we found that the gain was positive, 17 (15.7%) in experimental group against 13 (12%) in control group.

The following extracts illustrate pupils' justifications:

> S34-P1-C: I don't know;
>
> S34 –P2-C: I disagree. Every day we see and complain with high speed of "chapa" (private transport);
>
> S45-P1-E: I Agree. ... without comments;
>
> S45 – P2-E: Is not true. When we cook ... we use stove and fire wood both situations are dealing with heat and related to temperature variation ... things that we study in physics.

The awareness of relationship between everyday life and physics increased after teaching intervention more in the experimental group than in the control group. These results suggest that the teaching process that shows different examples of phenomena and concepts associated with physics, but taken from pupils' everyday environment, influence their responses. According with literature these results are not unique for Mozambican reality because there are studies which claim that pupils interest increase with social and cultural environment of the learners (Whitelegg and Parry,1999).

Nature

This category comprises only question 6, stating that 'It is possible to explain physics ideas without mathematics equations'. Table 1 shows a significant change of opinion between control and experimental groups after the intervention. The examples given below illustrate pupils´ justifications:

> S40- P1-E: ...Is not possible to study physics without mathematics, I have never done any physics test without problem solving questions;
>
> S40-P2-E: Physics is interesting ... we can explain many phenomena without using mathematics ... for instance we can explain why murringwé has drops of water around its surface ... why we have fogs in the morning in the farms, etc;
>
> S70-P1-E: I disagree completely ... is not possible ... how can we talk about velocity without mathematics? ... even to show distance we need a formula or Mathematics knowledge;
>
> S70-P2-E: There are many phenomena that we can explain without using mathematics expressions, for instance how the clothes dry ... how fog is formed or why the fog disappear when the sun rises?
>
> S28- P1-C: ... It isn´t possible … I never do physics test without problem solving ... and problem solving has high marks ... if you fail the formula or forget it you get wrong results;
>
> S28-P2-C: I am not sure ... but it is possible ... the problem is that what we discuss in the classroom with the teacher many times is not coming in the assignment.

The pupils' justifications show that contextualized teaching materials promoted positive attitudes among pupils, as shown for instance by pupil S70-P2-E, who gave examples of thermal phenomena related with phase change, something that pupils see in their everyday life in Chókwé. Again, some pupils' comments suggest that there are disconnections between the content taught and the content assessed lack of assessment of conceptual understanding, as it can be seen from the justification of pupil S28-P2-C.

Interest

Questions 4, 5, 8 and 9 comprised the section related to *interest.*

In question 4 'I find Physics interesting' the gain in the experimental group was 30 points against 10 of the control group. Some pupils' justifications are:

> S30-P1-E: Physics is nice ... but you need to memorize many things, formulas, thermal scales from Celsius to Fahrenheit;
>
> S45-P2-E: Physics is interesting because we talk about things that exist and happen in our daily life … unfortunately most of these things that we learn in the class we cannot find in our books ... and not all teachers teach physics in the same way ... In the Grade 8 we had many problem solving without showing us examples from everyday life;
>
> S12-P2-E: I don't like physics ... we need to memorize a lot of formulas;
>
> S12-P1-E: Physics is interesting ... now I know that heat, condensation, cooking even iron is related to physics but there are problems with the lack of teaching materials ... we do not have books ... only we study through teachers.

Pupils claim that physics is a difficult subject because it demands that the learners know the mathematics algorithm known as formulas (SALEH, 2014).

For question 5, 'I like to discuss Physics with others pupils'. Pupils' justifications indicate that pupils' have discussed physics in groups.

> S15-P1-E: Many times we have group work tasks given by our teacher;
>
> S15-P1-E: ... I do my homework ... we have a study group on weekends...;
>
> S17-P1-E: Group work is nice because help us to understanding physics better;
>
> S17– P2-E: Physics is not easy because is full of formulas and graphics ...but if you have been studying in a group you can understand it.

As for the question 8, stating that 'Currently, I like Physics very much', table 1 shows that the gain, after the post-test in experimental group was 15 against 1 in control group. Some comments are:

> S78-P1-E: I disagree, I don't like to write and the physics teacher likes to read many assignments and we write them from the beginning until the end;
>
> S78-P2-E: I like physics because we discuss things that we are dealing with our daily life ... for instance we studied velocity, frictional force, heat temperature;
>
> S22-P1-E: I don't know this is my second year studying physics...;
>
> S22–P2-E: I like to study physics because it helps me to understand many things ... how the clothes dry ... the difference between heat and temperature ... conditions for phase change, etc.

As for question 9 "Next year I plan to take Physics subject", the increase in the experimental group after post-test was 16, while in the control group was only 9.

> S33-P1-E: I don't know;
>
> S33-P1-C: I want to study physics because I would like to understand more about my environment and my everyday life... and in future I want to be a physics' teacher;
>
> S23-P1-E: I don't like physics ... and in future I will not follow science subject;
>
> S23-P2-E: Physics is nice you can

discuss with your colleagues many natural phenomena related to physics...conductivity, difference between heat and temperature ... to explain thermal equilibrium and other things.

CONCLUSION

This study wanted to explore the effect of incorporating pupils' environment, with focus on indigenous knowledge, into formal teaching and learning of physics materials on pupils' attitude towards Physics. The interest in probing the Effect of Indigenous Knowledge in a Physics teaching materials on pupils' attitudes towards physics was driven by the recognition that pupils' environment and preconceptions are influential effective pupils' learning in formal education. The research developed and used three basic instruments namely content knowledge questionnaire, attitude questionnaire and contextualized teaching and learning curriculum materials. Except the latter, these instruments were administered to two groups, one experimental and other control group.

In general, pupils' reasoning have also suggest that pupils' interest consequently motivation towards Physics is still very much influenced by the pupils' predisposition to accept the subject to learn (SALEH, 2014).

More specifically, the results indicate that the contextualized teaching materials promote positive attitudes towards physics. For instance, after the intervention some pupils understood that anyone can be *a* good pupil in physics even if he/she is not a good pupil in mathematics. They could see that to explain how clothes dry is not necessary mathematics. Also, other examples like the drops of water around the surface of clay elements, defining concepts like heat is not necessary any formula.

Further, pupils' comments suggest that besides contextualizing teaching materials it is important to relate the content taught with the content assessed in the classroom. Regarding this aspect, one pupil rightly complained saying "... the problem is what we discuss in the classroom with the teacher many time is not coming in the assignment". Thus, it is important to eliminate the disjuncture among teaching materials by contnextualizing them, aligning the content taught with the content assessed, because these aspects might provoke discontinuity in pupils' learning and consequently disrupt their motivation towards physics.

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APPENDIX

Lesson 1

Thematic: Heat flow

Topic: Thermal conductivity

Objective: At the end of the topic the student should be able to explain the concept of heat flow and how this phenomenon occurs

Previous knowledge

Be able to: (i) Distinguish the concepts of heat and temperature; (ii) use of thermometer.

Material: Set of two wood and two metal spoons**,** hot water (approximately 80^0C); one small clay pot, one small metal pot, 4 thermometers.

Note: From previous lessons pupils were asked to bring three small objects such as wood, metal and plastic spoons and clay pot. However teacher should provide these materials and 2 l of hot water.

1) Predict thermal conductivity of each material in the following situation:

   N.B.: Each pupil may predict and write on his/her worksheet the answer

   a) If we take a wooden spoon and a metal spoon and place it into a clay pot with hot water (approximately 80^0C), which one whose extreme end will feel hot?

      a.1 Mark by placing a cross your answer in the following table

Line	Sentences	Your answer
A	The wooden spoon will be as hot the metal one	
B	The wooden spoon will be hotter than the metal one.	
D	The metal spoon will be hotter than the wooden one	
E	Other response, write down	

   b) Justify your response:________________

2) Observe the experiment.

   Invite four pupils to come to the centre of the classroom, form groups of two pupils and help them to:

   a) Prepare two desks. After that select two sets of spoons, composed of a wooden and metal spoon each.

      a.1) Carefully, place on each desk a small clay pot and a small metal pot.

   b) Invite four pupils to come to the desk, two at each desk.

Desk A:		**Desk B**
Provide		Provide
One metallic and one wooden spoon,		One metallic and one wooden spoon,
a metallic and a clay pot		a metallic and a clay pot

   c) Fill the pots up to 2/3 with hot water (approximately 80^0C)

      c.1) Each group may place into the pots with hot water their wooden and metallic spoons.

      c.2) leave the spoons in the water for 5 minutes

   d) After 5 minutes each member of the group is asked to touch the extreme ends of the spoons

      d.1 Mark by a cross your answer in the following table

Line	Sentences	Your answer
A	The wood spoon will be as hot as the metal one	
B	The wood spoon will be hotter than the metal one	
C	The metal spoon will be hotter than the wooden one	
D	Other response, write down	

   e) Justify your response:

3) Explain

   a) Comment on your responses, and the class is invited to participate in the debate

   b) Conclusion:

Consolidation/ homework:

Now, touch the surface of the metal pot and the surface of the clay pot. Which one is hotter? Comment on your response (comments should include knowledge from previous lessons)