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Climate change awareness in a developing nations' second level education system - Tanzania

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Even if stringent global emission reductions and mitigation efforts over the next few decades prove to be successful, global climate change appears to be inevitable. 'Adaptation' has therefore emerged as a key policy response to manage the impending impacts of climate change. Adaptation is particularly relevant in the context of developing nations, as climate change impacts pose a substantial threat to their continued sustainable development. Adaptive capacity is affected by many socio-economic, political, and gender-based factors, and may be enhanced by climate change awareness. Ascertaining levels of climate change knowledge in different sectors of society is therefore an important aspect of dealing with future climate change, in order to understand how best to improve climate change awareness and adaptive capacity.

Elevating such awareness in society as a whole can be facilitated by focusing on the education system, and particularly by enhancing school students' knowledge and understanding of climate change. It is essential to determine students' conceptions (and misconceptions) of climate change, while also focusing on curricula content and on secondary school teachers' knowledge of climate change, in order to plan and design effective instruction that builds on these concepts.

The Climate Change Awareness and Education Programme (CCAEP) aims to ascertain secondary school student teachers, teachers and students' prior knowledge of the causes and consequences of climate change, and to determine the existing status of climate-change related material on the secondary school curriculum in Tanzania with an initial focus on climate change awareness among secondary school teachers. The research outputs currently envisaged will make it possible to develop or update a climate change knowledge instrument for proposed inclusion in the school curriculum. The programme is aimed to progress between 2014 and 2017. CCAEP Stage 1 data gathering commenced in May 2014 and focused on the knowledge and awareness of trainee secondary teachers at Dar es Salaam University College of Education (DUCE). Students at DUCE were surveyed using a questionnaire to determine climate change knowledge, awareness and emotional response to climate change. The questionnaire was adapted for Tanzania from a range of established and validated climate change awareness instruments.

Keywords: Climate Change Awareness, Education, Tanzania.

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1.   Introduction

Climate change is a major issue facing today's society. Successive reports from the Intergovernmental Panel on Climate Change (IPCC) present ever stronger evidence of the anthropogenic influence on climate: observations of increased atmospheric and ocean temperature, widespread melting of snow and ice, and rising average global sea levels indicate that warming of the climate system is unequivocal (IPCC, 2007; IPCC, 2013). As greenhouse gas concentrations continue to rise due to human activity, global temperatures are expected to rise further, with many potential associated effects on global climate. Even if efforts to reduce global emissions and initiate mitigation efforts for the coming decades are successful, global climate change will still occur (IPCC, 2007). 'Adaptation' has therefore emerged as a key policy response to manage the unavoidable impacts of climate change (Biesbroek et al., 2010). Climate change adaptation is particularly relevant in a developing country context, as climate change impacts pose a substantial threat to their continuous development (Ayers and Huq, 2009), particularly in relation to public health and societal development. Climate change is also highly inequitable: the poorest populations in developing nations have the greatest risk exposure, and yet are likely to have contributed least to greenhouse gas (GHG) emissions. As developing nations rapidly expand their socio-economic development with concurrent urbanisation, their populations will be both vulnerable to health hazards linked to climate change and, simultaneously, an increasing contributor to the problem (Campbell-Lendrum and Corvalan, 2007).

Adaptive capacity is affected by many socio-economic, political, and gender-based factors (Gandure et al., 2013), and may be enhanced through the elevation of climate change awareness in the general populace (Marshall et al., 2013). Ascertaining levels of climate change knowledge and awareness, as well as determining attitudes towards climate change internationally and locally in different sectors of society is therefore an important aspect of dealing with future climate change (Punter et al., 2011), in order to understand how best to improve climate change awareness and adaptive capacity. Increasing climate change awareness in society as a whole can be facilitated by focusing on the education system, and particularly by enhancing school students' knowledge and understanding of climate change (Grant and Featherstone, 2009). It is essential to determine students' conceptions (and misconceptions) of climate change, while also focusing on curricula content and on secondary school teachers' knowledge of climate change, in order to plan and design effective instruction that builds on these concepts (Grant and Featherstone, 2009; Shepardson et al., 2011; Nwankwo and Unachukwa, 2012). Once the education system incorporates effective teaching of the subject, the knowledge and awareness level of the students should increase, which will eventually lead to societal change and enhanced climate change adaptation. Adaptation comprises a range of actions across all sectors of society, by individuals, groups and governments and can be motivated by many factors, including the protection of economic well-being or improvement of society (Adger et al., 2005).

Studies focusing on assessing knowledge of climate change among students have shown a diversity of students' conceptions about the greenhouse effect, global warming and climate change. These include confusion between the greenhouse effect and global warming

(Andersson and Wallin, 2000, Punter et al., 2011), and confusion regarding the causes of climate change (e.g. Gowda et al., 1997; Boyes and Stanisstreet, 1998; Rebich and Gautier, 2005; Shepardson et al., 2011). Levels of concern about the impacts of climate change have also been found to vary widely, and include views that climate change will not cause any immediate or future impacts (Pruneau et al., 2001). Demographic factors are likely to be important in assessing spatial patterns among schools: for example, Owolabi et al. (2012) found that awareness of climate change varied between rural and urban schools. Other factors such as gender and household income may also contribute to variations in risk perceptions and levels of awareness (e.g. Crona et al., 2013; Vignola et al., 2013).

This research project aims to ascertain the levels of climate change knowledge and awareness among secondary school students, teachers and third-level students training as secondary school teachers in Tanzania. In addition, the existing status of climate change teaching and related educational material on the secondary school curriculum in Tanzania will be assessed, with a view to developing a supplementary educational package to support climate change teaching. By focusing on teacher training and what the students themselves will learn, education itself will be the adaptation strategy – as society will be influenced and advanced by the upcoming younger generations (Chang, 2014). Greater levels of awareness in the younger generations will lead to overall societal awareness and consequently action.

2.   Methodology
2.1   Research Programme

In collaboration with Dar es Salaam University College of Education (DUCE) in Tanzania, a multi-staged research programme was developed to ascertain the level of climate change awareness amongst university students that are aiming to become secondary school teachers. It is envisaged that these stages would run between 2014 and 2017:

- Stage 1 – An assessment of climate change awareness and educational needs of student (trainee) secondary school teachers (i.e. undergraduate degree students). A survey was developed and undertaken of these university students of their climate change awareness and their understanding of the level of information needed to educate secondary school students on the topic. Supplemental directed interviews with the university students regarding their understanding of climate change were also undertaken. The focus of this paper is the preliminary findings of this stage survey undertaken in this stage;
- Stages 2 and 3 – The identification of potential gaps in knowledge for secondary school teachers and the development of an awareness survey for secondary school students. The survey utilised in stage 1 will be adapted to survey secondary school teachers that teach at a secondary school affiliated to DUCE with potential for other secondary schools if time permits. Secondary school students at both "O" and "A" level will also be surveyed with a similar questionnaire appropriate for their level of

understanding. This will provide a broad assessment on the effectiveness of the current curricula climate change material;

- Stages 4 and 5 – Develop a supplementary educational package for secondary school students based on the initial assessment and on established methods from published literature. The educational package can be at two levels – lower and higher levels at secondary school. Develop and provide an accompanying interpretive package to secondary school student teachers in order to facilitate their delivery of the educational package;

- Stages 6 and 7 – After the educational package has been delivered a follow up awareness assessment to determine if the educational package increased awareness levels and local perception levels among both the university students as well as secondary school teachers and students. The educational packages can then be refined as required.

2.2   Stage 1 Development

The initial phase, Stage 1, was predominantly a qualitative data gathering exercise. A climate change knowledge and awareness "tick box" questionnaire was developed based on a range of previously utilised and validated awareness questionnaires (Adetayo, 2013; Brown et al., 2012; CIMC, 2012; Nwankwo and Unachukwu, 2012; Poldas and Jain, 2012; CEED, 2011; European Commission, 2011; Curry et al., 2007; Whitmarsh, 2003) ensuring questionnaire reliability (Fink, 2009). The anonymous questionnaire consisted of five sections and a free commentary:

- Participant Profile (Q1-8 Demographics);
- Climate Change Knowledge (Q9-16);
- Sources of Climate Change Information (Q17-19);
- Personal Views on Climate Change (Q20-25);
- Attitudes and Perceptions (Q26-38 Likert Scale); and
- Free comment.

The questionnaire was piloted initially in Ireland amongst MDP students and a native Swahili speaker to determine language and content appropriateness (Fink, 2009). The questionnaire was subsequently piloted with a test group of student teachers (n=25) at DUCE. The pilot resulted in modifications to question structure and language. The questionnaire was conducted in English, it was accompanied by a participant information briefing prior to participation (Edwards et al., 2002) and took approximately twenty minutes to complete.

DUCE has a total cohort of 3,360 students (male=2106, female=1254). This population is spread across three stages (years) and five programmes of education:

- Bachelor of Arts (Education) (n=2,329, 69% of student cohort);
- Bachelor of Education (Arts) (n=190, 6% of student cohort);
- Bachelor of Education (Science) (n=245, 7% of student cohort);
- Bachelor of Science (Education) (n=527, 16% of student cohort); and

- Postgraduate Diploma in Education (n=69, 2% of student cohort).

All university students are trainee teachers with varying levels of emphasis on subject and education per programme. In order to gather a representative assessment of climate change awareness among this large cohort that has varying levels of scientific knowledge across their programmes, a targeted sample of all years across all programmes was utilised, followed by a random selection from the completed database of questionnaire results. This comprised a convenience sample with a simple random sample subsequent stage to remove bias (Yates et al., 2008). A sample size calculator (www.raosoft.com) indicated a sample size of 555 would provide a 99% confidence interval from the student cohort, which was designated as the minimum target number for completed questionnaires (Cohen et al., 2007).

The questionnaire was administered by two TCD-UCD MDP students in May 2014 to student groups with the assistance of DUCE student representatives, in conjunction with Faculty of Education members providing access to their classes. The MDP students provided the participant information briefing to each group. The MDP students accessed a total of 8 student groups (each in the region of 150 students across a range of programmes) over a period of 12 days in order to gather the target of 555 questionnaires. The student body showed a keen enthusiasm for participation and a total of 932 questionnaires were returned. Data screening of the questionnaire resulted in 4 questionnaires designated as incomplete with 928 questionnaires coded and input into an excel database (Burgess, 2001). Data analysis was conducted utilising Statistical Package for Social Sciences (SPSS) Version 20. Preliminary analysis of the 555 randomly selected questionnaires commenced in July 2014 after data cleaning and recoding as necessary.

3. Preliminary Results

A preliminary analysis of the dataset has produced an overview of the information gathered and provided an indication of specific associations to assess in further detail.

3.1 Sample Demographics

The majority of university students at DUCE range between 19 and 30 years of age (90% Table 3.1) with a gender ration of 7:3 male:female (Table 3.2) which is representative of the 7:4 male:female distribution in DUCE as a whole. The random sample provided a relatively equal spread of science and arts university students across programmes and years (Tables 3.3 and 3.4), however no postgraduate students (which comprises 2% of the DUCE student cohort) were randomly selected into the sample. The natal origin results indicate that there is a relatively even spread between rural (52%) and urban (48%) environments for the students' background environment where their primary and secondary education was conducted (Table 3.5).

Table 3.1 University student age range (n=550).

Age Range	n	(%)
<18	1	(>1)
19 – 24	309	(56)
25 – 30	187	(34)
31 – 40	46	(8)
41>	7	(1)

Table 3.2 University student gender breakdown (n=552).

Age Range	n	(%)
Male	392	(71)
Female	160	(29)

Table 3.3 University student programme breakdown (n=555).

Programme	n	(%)
Bachelor of Education in Arts	87	(16)
Bachelor of Science in Education	177	(32)
Bachelor of Education in Science	71	(13)
Bachelor of Arts with Education	220	(39)

Table 3.4 University student year of programme (n=554).

Year	n	(%)
1st	159	(29)
2nd	209	(38)
3rd	186	(33)

Table 3.5 University student natal origin (n=545).

Natal Origin (~population)	n	(%)
Rural Small Village (less than 100)	52	(10)
Rural Large Village (100 – 1,000)	227	(42)
Small Town (1,000 – 80,000)	161	(29)
Large Town (80,000 – 1 million)	51	(9)
City (more than 1 million)	54	(10)

*3.2   Climate Change Knowledge*

The majority of students (44%) recognised one of the two principal greenhouse gas (GHG) contributors to global climate change (carbon dioxide and methane). A further 24% identified Chlorofluorocarbons (CFCs) as a GHG. 12% correctly identified the GHG nitrous oxide, while only 2% identified water vapour – an extremely important GHG. A minority of

students (12%) incorrectly identified four gases (hydrogen, oxygen, argon and nitrogen) as GHGs (Figure 4.1). 6 students (1%) correctly identified all 6 GHGs listed in the survey, while a further 31 students (5.5%) identified 5 of the 6 GHGs.

Figure 3.1 Percentage of university students' identification of Greenhouse Gases (GHGs). GHGs are marked with an asterisk (*).
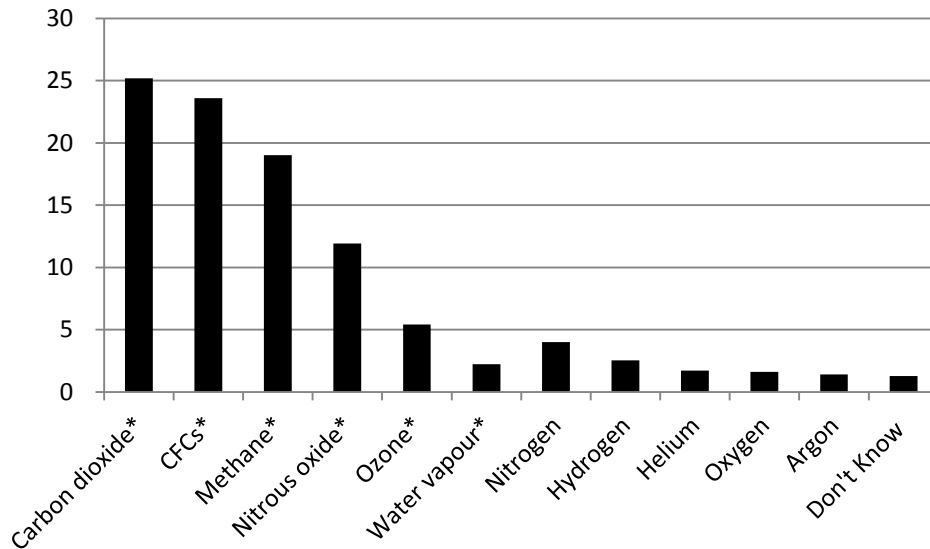
An awareness of the various anthropogenic contributing factors to global climate change was evident amongst the university students. The majority (54%) identified either industry or deforestation as the principal contributors (Figure 3.2). The natural phenomenon of volcanic eruptions was ascribed by only 6% of the sample, while just 1% of the sample indicated that natural solar variability was a contributing factor. Interestingly, 3% indicated that acid rain was a contributor to climate change. The principal effects of climate change (Figure 3.3) identified by the university students veered towards temperature effects, which are likely to be more readily apparent in Tanzania based on current climate change modelling. Higher temperatures, drought and health issues accounted for 59% of the effects identified by the university students. Melting ice caps and glaciers was selected by 9% of respondents. Other potential effects relating to water were at the lower scale of identification with water scarcity, more flooding and sea level rise accounting for just 8%.

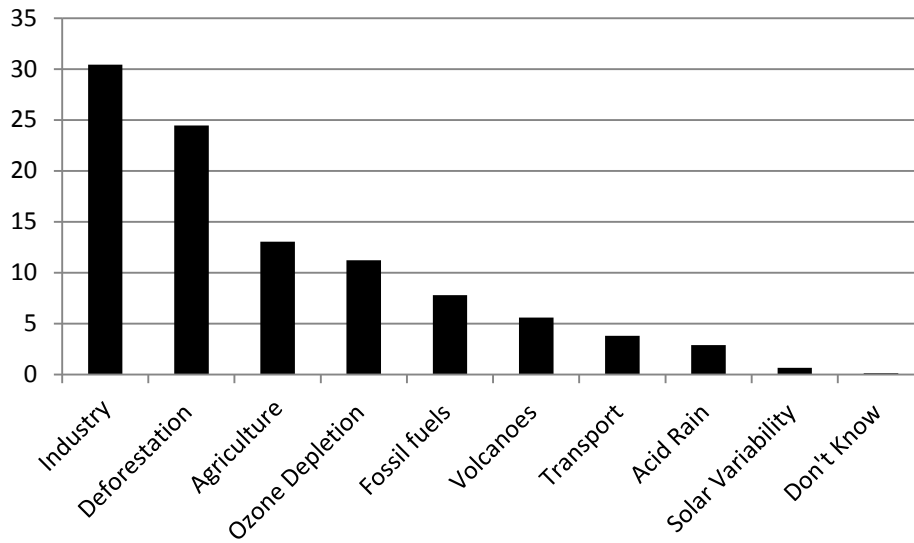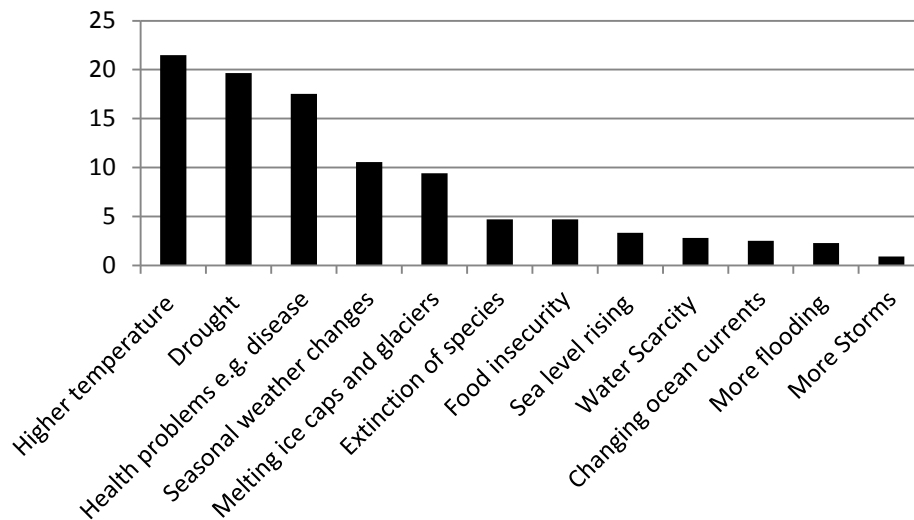*Figure 3.2 Percentage of university students' identification of contributors to global climate change.*

Figure 3.3 Percentage of university students' prediction of potential impacts of global climate change.

3.3   Climate Change Emotional Response

The university students were asked to identify which emotions they felt in relation to climate change. The emotions ranged from positive (e.g. Optimistic) to negative (e.g. Sad). Table 3.6 provides the results of the emotion identification in comparison between male and female university students to determine if there was a difference between the emotions felt by each gender. Interestingly there was no difference between genders in their emotional response, and in most instances were rated identically. The only significant difference was in the emotion of powerlessness. Male university students were significantly more likely to feel powerless than female university students (15% v 7%). The majority of university students feel negatively regarding climate change, with 69% afraid of it and 94% not hopeful. A

relatively even split in relation to confusion over climate change could be an indicator that more needs to be done to educate university students on the topic.

Table 3.6 University student emotions relating to climate change (total n=550; male n=390, female n=160).

Emotion	Gender	Yes		No		P*
		n	(%)	n	(%)	
Fearful	Male	267	(68)	123	(32)	
	Female	110	(69)	50	(31)	NS
	Total	377	(69)	173	(31)	
Excited	Male	55	(14)	335	(86)	
	Female	18	(11)	142	(89)	NS
	Total	73	(13)	477	(87)	
Optimistic	Male	21	(5)	369	(95)	
	Female	11	(7)	149	(93)	NS
	Total	32	(6)	518	(94)	
Sad	Male	239	(61)	151	(39)	
	Female	88	(55)	72	(45)	NS
	Total	327	(60)	223	(40)	
Happy	Male	10	(3)	380	(97)	
	Female	8	(5)	152	(95)	NS
	Total	18	(3)	532	(97)	
Confused	Male	207	(53)	183	(47)	
	Female	83	(52)	77	(48)	NS
	Total	290	(53)	260	(47)	
Powerless	Male	57	(15)	333	(85)	
	Female	11	(7)	149	(93)	.012
	Total	68	(12)	482	(88)	
Enthusiastic	Male	13	(3)	377	(97)	
	Female	5	(3)	155	(97)	NS
	Total	18	(3)	532	(97)	
Disbelief	Male	21	(5)	369	(95)	
	Female	4	(3)	156	(97)	NS
	Total	25	(4)	525	(96)	
Angry	Male	104	(27)	286	(73)	
	Female	42	(26)	118	(74)	NS
	Total	146	(27)	404	(73)	
Hopeful	Male	27	(7)	363	(93)	
	Female	9	(6)	151	(94)	NS
	Total	36	(6)	514	(94)	
Nothing	Male	4	(1)	386	(99)	
	Female	2	(1)	158	(99)	NS
	Total	6	(1)	544	(99)	

*Pearson Chi-Square – Non-significant <0.05

3.4   Climate Change Awareness

Table 3.7 contains the results for the following Likert scale questions that were asked of the university students in the final section of the survey:

    i.   Climate change is primarily a natural phenomenon;
    ii.   Human activities have a significant impact on climate change;
    iii.   We do not know enough about climate change so more research should be done;
    iv.   It is already too late do anything about climate change;
    v.   All countries should do something to stop climate change, because it is a global problem;
    vi.   Europe and America are causing most climate change, so they should take the blame for it;
    vii.   Developed countries should fund climate change adaptation and mitigation in developing countries;
    viii.   The Tanzanian government should do more to tackle climate change;
    ix.   Tanzania does not have any responsibility for climate change;
    x.   Climate change should be a high priority in Tanzania's education system;
    xi.   There is already enough teaching of climate change in schools;
    xii.   Tanzanian children are interested to learn about climate change;
    xiii.   Climate change makes me fear for my children's future.

The results were analysed to determine if there was a difference between the genders in relation to the statements. Overall there was very little difference in how each gender responded to the statements, two of the statements produced identical responses between the genders and there were some significant differences. Both genders consider that climate change should be a high priority in Tanzania's education system (82%) and that climate change induces fear for their children's future (86%). However, significantly more female university students consider that there is not enough knowledge regarding climate and more research needs to be done (female 75% vs. male 65%). Interestingly the remaining significant results lie in the topic of who is responsible for climate change. Significantly more male university students blame Europe and America for causing climate change (male 74% vs. female 58%) and in association with this, consider Tanzania not responsible for causing climate change (male 13% vs. female 7%).

Table 3.7 University student responses to climate change awareness statements.

Statement	Gender	Strongly Agree / Agree		Neither Agree or Disagree		Disagree / Strongly Disagree		Total n	P*
		n	(%)	n	(%)	n	(%)		
i	Male	180	(47)	73	(19)	126	(44)		
	Female	77	(50)	27	(18)	49	(32)	532	NS
	Total	257	(48)	100	(19)	175	(33)		
ii	Male	363	(94)	14	(4)	9	(2)		
	Female	142	(92)	7	(5)	6	(4)	541	NS
	Total	505	(93)	21	(4)	15	(3)		
iii	Male	246	(65)	49	(13)	82	(22)		
	Female	115	(75)	16	(11)	22	(14)	530	.015
	Total	361	(69)	65	(12)	104	(20)		
iv	Male	40	(11)	34	(9)	302	(80)		
	Female	17	(11)	8	(5)	125	(83)	526	NS
	Total	57	(11)	42	(8)	427	(81)		
v	Male	364	(95)	8	(2)	11	(3)		
	Female	145	(94)	3	(2)	7	(4)	538	NS
	Total	509	(95)	11	(2)	18	(3)		
vi	Male	279	(74)	56	(15)	44	(11)		
	Female	89	(58)	31	(20)	33	(22)	532	.011
	Total	368	(69)	87	(16)	77	(15)		
vii	Male	271	(72)	65	(17)	42	(11)		
	Female	98	(64)	38	(25)	18	(12)	532	NS
	Total	369	(69)	103	(19)	60	(11)		
viii	Male	346	(92)	17	(4)	15	(4)		
	Female	146	(95)	4	(3)	3	(2)	531	NS
	Total	492	(93)	21	(4)	18	(3)		
ix	Male	49	(13)	33	(9)	297	(78)		
	Female	7	(5)	14	(9)	130	(86)	530	.077
	Total	56	(11)	47	(9)	427	(81)		
x	Male	315	(82)	45	(12)	23	(6)		
	Female	123	(82)	18	(12)	10	(6)	534	NS
	Total	438	(82)	63	(12)	33	(6)		
xi	Male	104	(28)	80	(21)	193	(51)		
	Female	32	(21)	39	(26)	80	(53)	528	NS
	Total	136	(26)	119	(23)	273	(51)		
xii	Male	239	(62)	100	(26)	45	(12)		
	Female	93	(61)	41	(29)	19	(12)	537	NS
	Total	332	(62)	141	(26)	64	(12)		
xiii	Male	331	(86)	27	(7)	29	(7)		
	Female	134	(86)	10	(7)	10	(7)	541	NS
	Total	465	(86)	37	(7)	39	(7)		

*Pearson Chi-Square – Non-significant <0.05

4. Discussion

It is in the classrooms of secondary schools and universities that the true evolution of society transpires and how it engenders anxiety, inspiration, argument, and conversely inaction among a populace (Punter et al., 2011). For society to control, mitigate and reverse environmental problems, society as a whole must act together to intervene independently without the attribution of blame. It is therefore in the classroom that the vanguard of action to inspire behavioural change must take place.

From the preliminary results it is clear that the university students have a reasonable perception on what the principal causes of climate change are (GHGs) and what anthropogenic activity is contributing to climate change (industry and deforestation). However, students showed a poor understanding of the natural factors that influence climate change, such as volcanic eruptions and solar variability, and focused primarily on anthropogenic factors. Many students do not know the difference between GHGs and other atmospheric gases, as only one-quarter of students were able to identify carbon dioxide as a GHG, and just 1% could correctly identify all GHGs in the questionnaire. The results suggest that climate change is often confounded with global environmental issues more generally, and also that there is much confusion in understanding the difference between cause and impacts. For example, >10% of students identified ozone depletion as one of the main contributors to climate change. CFCs and their detrimental effects on the ozone layer have received extensive international attention in recent decades, but this issue is not directly linked to the main issues of global climate change, caused by increased GHGs in the atmosphere leading to an enhanced greenhouse effect. While there is certainly a link between CFCs, ozone and climate change – not least due to the fact that CFCs and ozone both act as GHGs – one would not expect such a high tendency to associate CFCs and ozone with anthropogenic climate change. Similarly, while acid rain is an environmental issue associated with GHGs it is not considered to be a contributor to climate change, and is largely separate from climate change as a global environmental issue.

Further analysis on the full range of questions relating to climate change knowledge needs to be undertaken to fully ascertain the differences and/or similarities between the university students. It has been noted in several studies globally that there is a decline in the level of knowledge in the general populace regarding climate change (Nordhaus and Shellenberger, 2009; Ratter et al., 2012). Combatting this decline could be undertaken at various levels of education in order to ensure that the next generation of adults is fully aware of the causes and consequences of climate change.

There is currently a lack of research into student awareness of a range of natural phenomena including climate change. The current focus is directed more at assessing factual knowledge regarding environmental issues rather than their attitudes and consequent behaviours (Rickinson 2001; Manduca et al., 2002). In order to utilise education as an intervention mechanism to bring about social awareness and associated behavioural change research, second and third level education needs to have the right information to prepare a relevant curricula but also teachers need to be conversant in these major environmental themes (in

particular the causes and impacts of global climate change) in order to help the students understand what the facts actually mean for society and the future (Payne, 1998).

5.   Conclusions and Moving Forward

The very preliminary analysis of this dataset indicates that there could be some very significant differences between genders and other potential groupings that warrant further investigation. Potentially a range of analyses can be conducted on the data assessing differences between university students focusing on arts versus the sciences, of rural versus and urban origin, and the topics they studied in secondary school. Through this analysis gaps in climate change knowledge and awareness may become apparent which can then be rectified in the future. Results thus far indicate that third-level students training as secondary school teachers have several misconceptions about climate change, particularly regarding separating the causes and impacts of climate change from other global environmental issues.

The next phase of the project will be to ascertain the climate change knowledge and awareness levels amongst secondary school students and working secondary school teachers that are implementing the current curricula. Upon completion of that analysis an overarching assessment of the three groups interacting in climate change education in Tanzania (secondary school students, university student/trainee teachers and secondary school teachers) can be completed and recommendations can be proposed for potential new educational material or methods which can be utilised to either supplement or improve current levels. A supplementary educational package to educate secondary school students on the causes and consequences of climate change has been proposed to take place as part of the following phase of research. The ultimate aspiration is for DUCE to take the lead in providing climate change knowledge and awareness education for secondary school teachers in Tanzania and in doing so educate the next generations on this very important global topic that has the potential to severely impact the sustainable future of Tanzania.

Bibliography

Adger, W.N., Arnell, N.W. and Tompkins, E.L., (2005). Successful adaptation to climate change across scales. Global Environmental Change, 15, 2, 77-86.

Adetayo, A.O. (2013). Assessment of Poor Resource Farmers' Level of Awareness on Climate Change and Adaptation/Mitigation Strategies in some Selected Rural Areas in Oyo State, Southwest, Nigeria. ARPN Journal of Earth Sciences, 1(2), 57-61.

Andersson, B. and Wallin, A. (2000). Students' understanding of the greenhouse effect, the societal consequences of reducing CO_2 emissions and the problem of ozone layer depletion. Journal of Research in Science Teaching, 37, 1096-1111.

Ayers, J.M. and Huq, S. (2009). Supporting adaptation to climate change: what role for official development assistance? Development Policy Review, 27, 675-692.

Biesbroek, G.R., Swart, R.J., Carter, T.R., Cowan, C., Henrichs, T., Mela, H., Morecroft, M.D. and Rey, D. (2010). Europe adapts to climate change: Comparing National Adaptation Strategies. Global Environmental Change, 20, 440-450.

Boyes, E. and Stanisstreet, M. (1998). High school students' perceptions of how major global environmental effects might cause skin cancer. Journal of Environmental Education, 29, 31-36.

Brown, C., Christensen, D., Leene, E., Putman, D. and Whited, B. (2012). Comparing Survey Results to Assess Climate Change/Global Warming Awareness, Perceptions and Beliefs of College Students in the United States and China. Department of Economics, University of Wisconsin-Eau Claire. Watershed Institute for Collaborative Environmental Studies, United States of America.

Burgess, T., (2001). A general introduction to the design of questionnaires for survey research. University of Leeds, Leeds.

Campbell-Lendrum, D. and Corvala, C. (2007). Climate Change and Developing-Country Cities: Implications For Environmental Health and Equity. Journal of Urban Health: Bulletin of the New York Academy of Medicine, 84, 1, 109-117.

Caribbean Institute of Media and Communication (CIMC) (2012). Report on Climate Change Knowledge, Attitude and Behavioural Practice Survey. Planning Institute of Jamaica. Available at: https://www.climateinvestmentfunds.org/cifnet/sites/default/files/CCKAPSurvey2012_Report.pdf

CEED (2011) Knowledge, Attitudes and Practices Survey on Children and Climate Change. UNDP and UNICEF. Available at: http://www.unicef.org/montenegro/KAP_Survey_on_children_and_climate_change.pdf

Chang, C.H., (2014). Climate Change Education – knowing, doing and being. Routledge, New York.

Crona, Wutich, Brewis, and Gartin (2013). Perceptions of climate change: Linking local and global perceptions through a cultural knowledge approach. Climate Change available at http://link.springer.com/article/10.1007/s10584-013-0708-5/fulltext.html

Cohen, L., Manion, L., and Morrison, K., (2007). Research Methods in Education. Routledge, New York.

Curry, T. E., Ansolabehere, S. and Herzog, H. (2007) A Survey of Public Attitudes towards Climate Change and Climate Change Mitigation Technologies in the United States: Analyses of 2006 Results. Laboratory for energy and the environment, MIT, United States of America.

Edwards, P., Roberts, I., Clarke, M., Di Guiseppi, C., Pratap, S., and Wentz, R., (2002). Increasing response rates to postal questionnaires: systematic review. British Medical Journal, 324, 1183-1192.

Fink, A., (2009). How to conduct surveys: a step-by-step guide. Sage, London.

Gandure, S., Walker, S. and Botha, J.J. (2013). Farmers' perceptions of adaptation to climate change and water stress in a South African rural community. Environmental Development, 5, 39-53.

Gowda, M.V.R., Fox, J.C. and Magelky, R.D. (1997). Students' understanding of climate change: Insights for scientists and educators. Bulletin of the American Meteorological Society, 78, 2232-2240.

Grant, L. and Featherstone, H. (2009). Climate Change Schools Project: Final evaluation report. Available at http://www.sciencelearningcentres.org.uk/centres/north-east

IPCC (2007). Climate Change 2007: Synthesis Report. Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, Pachauri, R.K. and Reisinger, A. (eds.)]. IPCC, Geneva, Switzerland.

IPCC (2013). Working Group I Contribution to the IPCC Fifth Assessment Report − Summary for Policymakers. Climate Change 2013: The Physical Science Basis. IPCC, Geneva, Switzerland.

Manduca, C., Mogk, D., Stillings, N. (2002). Bringing research on learning to the geosciences. Report from a Workshop Sponsored by the National Science Foundation and the Johnson Foundation.

Marshall, N.A., Park, S., Howden, S.M., Dowd, A.B. and Jakku, E.S. (2013). Climate change awareness is associated with enhanced adaptive capacity. Agricultural Systems, 117, 30-34.

Nordhaus, T., Shellenberger, M., (2009). Apocalypse fatigue: losing the public on climate change. Environment 360. Available at http://e360.yale.edu/content/feature.msp?id=2210.

Nwankwo, C.A. and Unachukwu, G.O. (2012). Teachers Awareness of the Causes and Effects of Climate Change and their Classroom Management Strategies in Climate Change Era. Research Journal in Organizational Psychology & Educational Studies, 1(3), 161-167.

Owolabi, H.O., Gyimah, E.K. and Amponsah, M.O. (2012). Assessment of junior high school students' awareness of climate change and sustainable development in central region, Ghana. Educational Research Journal, 2, 309-317.

Payne, P. (1998). Children's conceptions of nature. Aust J Environ Educ 14(1):19–26.

Poldas, B. and Jain, A. (2012). Students' Awareness of Climate Change and Awareness Raising Strategies for Junior Colleges in the Emerging Megacity of Hyderabad. Emerging Megacities Discussion Papers, Volume 1/2011.

Pruneau, D., Moncton, U., Liboiron, L. and Vrain, E. (2001). People's idea about climate change: a source of inspiration for the creation of educational programs. Canadian Journal of Environmental Education, 6, 58-76.

Punter, P., Ochando-Pardo, M. and Garcia, J. (2011). Spanish secondary school students' notions on the causes and consequences of climate change. International Journal of Science Education, 33, 447-464.

Ratter, B.M.W., Phillip, K.H.I., von Storch, H. (2012). Between hype and decline: recent trends in public perception of climate change. Environmental Science and Policy, 18, 3–8.

Rebich, S. and Gautier, C. (2005). Concept mapping to reveal prior knowledge and conceptual change in a mock summit course on global climate change. Journal of Geoscience Education, 53, 355-365.

Rickinson, M. (2001). Learners and learning in environmental education: a critical review of the evidence. Environ Educ Res 7(3):207–320.

Shepardson, D.P., Niyogi, D., Choi, S. and Charusombat, U. (2011). Students' conceptions about the greenhouse effect, global warming, and climate change. Climatic Change, 104, 481-507.

Vignola, Klinsky, Tam and McDaniels, (2013). Public perception, knowledge and policy support for mitigation and adaption to Climate Change in Costa Rica: Comparisons with North American and European studies. Mitigation and Adaptation Strategies for Global Change 18: 3 pp 303-323.

Whitmarsh, L. (2003). Survey Questionnaire ('Climate change' version). Survey of Environmental Concerns. University of Bath, United Kingdom.

Yates, D.S., Moore, D.S. and Starnes, D.S., (2008). The Practice of Statistics, 3rd Edition. Freeman Publications (MacMillan), New York.