



AWARENESS ENHANCEMENT ON ATOMIC ENERGY AND NUCLEAR TECHNOLOGY APPLICATIONS USING ICT

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ABSTRACT

Purpose: There have been a lot of applications of atomic energy and nuclear technology in different development activities in Tanzania but it seems that people are not aware of this. On the other hand, ICT has been reported to enhance the awareness of various issues. It is not known how much ICT takes a role in enhancing the awareness of atomic energy and nuclear applications in Tanzania. This study therefore aimed at uncovering the role of ICT in enhancing awareness of atomic energy and nuclear technology applications in Tanzania.

Design/Methodology/Approach: The study used a quantitative method whereby a five scale Likert-scale questionnaire was used to collect data from higher education students and the public. The descriptive statistics and a t-test were used as part of the analysis of the findings.

Findings: The results show that generally, most students and people from the public are not aware of the applications of nuclear technology in Tanzania (Mean: 3.18) and most of them (Mean: 3.42) have not been using ICT to get information on nuclear technology application in Tanzania. It was also found that there is a significant difference ($p < 0.05$) between students and the public in both awareness and perception of the use of ICT to increase awareness with a small effect ($0.2 < d < 0.5$).

Implications/Research Limitations: The study involved university/college students in all fields and also the people from the public from any field and any study level; which may call for more studies on more specific groups. The study focused on Tanzania which may be limited to the environment present.

Practical Implication: This study is useful in the process of taking necessary measures on increasing awareness among Tanzanians and especially students who can be the future experts in the field of nuclear technology.

Keywords: *Atomic energy; awareness; nuclear; technology; Tanzania*

1.0 INTRODUCTION

The peaceful use of atomic energy and nuclear technology in Tanzania has been positively supported by the government. Management of safe use of atomic energy and nuclear technology has been experienced in performing different development activities. Different institutions like Tanzania Atomic Energy Commission (TAEC) exist worldwide to ensure strong global safety and security on atomic energy uses in the society (Abdel-Wahab,

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Lahoupe, Polo, Zubizarreta, Adnan, Johnston, ... & Meghzifene, 2017). The agencies like the International Atomic Energy Agency (IAEA) have always been working on promoting better and safe use of atomic energy for sustainable development (Dondi, Pascual, & Paez, 2018).

Atomic energy and nuclear technology have been used in different fields like Health, Agriculture, Mining, water, food preservation and others in different ways (van der Merwe, Van Dyk, Healy, Zubizarreta, Izewska, Mijnheer, & Meghzifene, 2017). In all aspects, the use of Atomic energy and nuclear technology in these fields is for the betterment of the country's development (Cannavan & Maestroni, 2020). Different projects to ensure more usage of atomic energy for development in Tanzania are being conducted to allow people to benefit from its application in different ways. Most of these projects need public awareness, though it is not well known whether Tanzanians are aware of the good applications of atomic energy and nuclear technology in Tanzania.

This study therefore aimed at finding out how Tanzanians understand the applications of atomic energy and nuclear technology in the country. Furthermore, it aimed at determining how they perceive the use of ICT in enhancing awareness of this technology in society. Specifically, this study worked on the following research objectives:

- i. To determine the awareness of Tanzanians on the applications of nuclear technology in Tanzania*
- ii. To determine the perception of Tanzanians on using ICT to increase awareness of the applications of nuclear technology in Tanzania*
- iii. To determine the difference in awareness among the higher learning students on the applications of nuclear technology in Tanzania and the other people in the Tanzanian society and also the difference in their perceptions of the use of ICT to increase awareness*

On fulfilling the mentioned research objectives, this study presents the level of awareness of the general public and students from higher learning institutions in Tanzania are aware of the applications of atomic energy in Tanzania together with their perception of the use of ICT in increasing awareness in the society. The difference between students and the general public on their awareness and their perception of the use of ICT to increase awareness in society is also checked. The study also recommends different ways in which ICT can be used to increase awareness among Tanzanians on the applications of atomic energy in Tanzania.

2.0 LITERATURE REVIEW

2.1 Awareness

Literature shows that awareness of something is important to increase the sense of responsibility and consciousness of information processing (Levy, 2013). According to Ahmed, Hosan, Begum, Rahman, Razzaque, & Hasani (2020), it is important to consider public awareness and how the public perceives the use of nuclear technology for its successful



implementation in the countries. Projects like uranium mining in Tanzania as explained by Dixit (2016), need enough public awareness as one of its tools to succeed. Public awareness of the good benefits of atomic energy applications is important on avoiding negativity in people's minds on the application of nuclear technology (Lyons, Akin, & Stroud, 2019).

A post by Caplan (2016) on The Energy Collective Group website explains the importance of making people aware of the goodness of the use of atomic energy rather than just telling them about the safety and disasters of its use it. Although the literature gives due weight to the need for awareness, the degree of awareness of atomic energy and nuclear technologies in Tanzania is not well known. Furthermore, there are rare (if no) studies that relate to the determination of awareness of the Tanzanians on the aforesaid applications. This study tries to bridge this gap. According to the findings by Levy (2013), this study is very important in ensuring the successful operations of the Tanzania Atomic Energy Commission.

2.2 Importance of ICT

Due to the growth of information and communication technology (ICT) (Albiman & Sulong, 2016), the dissemination of information in society can be easier and faster. The use of ICT is known to simplify the distribution of information (Zhang, Wang, & Duan, 2016) in different ways and hence it can be very useful in ensuring awareness of the peaceful applications of atomic energy and nuclear technology in Tanzania. A study by Latha, Pravitha, Dasgupta, & Chaturvedi, (2020) proved the effectiveness of social media in increasing awareness of mental health and so it can also be used on other issues as well. Tambo, Aliamo, Davis, Mugambi, Romney, Onyango, Kansime, Alokkit, & Byantwale (2019) showed that the use of ICT helps in spreading information faster with a reduced cost which was corroborated by Khan & Bokhari, (2018). Walsham (2017) proved the importance of ICT in ensuring development in the society and hence it is expected that it is can be used on enhancing awareness in the society on nuclear technology matters.

Although ICT is advocated to create this great role, it is not well known how it helps Tanzania with atomic energy and nuclear technology applications. This study contributes greatly by uncovering the truth.

3. 0 METHODOLOGY

3.1 Data collection

A quantitative method approach was employed which involved a five-point Likert scale questionnaire to collect data. The target population of this study was 750 students from different colleges/universities in Tanzania and 1200 people from the public.

The study involved a sample of Tanzanians from six regions from which college students from twelve colleges/universities were involved. The selection of the regions and colleges/universities was done based on data collection convenience (Creswell, 2013). A



random selection of the participants was done from the public and the colleges/universities (Creswell, 2013).

A face to face administration strategy was used for the public participants which were randomly picked by the researcher from different visited offices. A total of two hundred (200) copies of a questionnaire were printed in each region for public data collection whereby six (6) regions were involved. For the students' data, the questionnaires were distributed to one college/university at a time by the researcher. Students were randomly picked by the researcher outside the lecture venues. A total of fifty (50) copies of questionnaires were distributed to each college/university whereby fifteen(15) colleges were involved. The information on the distributed questionnaires is shown in table 1. All the participants voluntarily participated in the study.

Table 1. Questionnaire response rate

Region	Public			College/university			
	Distribution	Response	Percentage	Number of Colleges	Distribution	Response	Percentage
Dar es Salaam	200	168	84%	3	150	124	83%
Kilimanjaro	200	147	73%	3	150	127	85%
Arusha	200	200	100%	3	150	115	77%
Morogoro	200	182	91%	1	50	50	100%
Dodoma	200	114	72%	3	150	116	77%
Pwani	200	93	93%	2	100	66	66%

3.2 Data analysis

Data analysis was done using SSPP open-source statistical software. A t-test was used to find out the difference between the public and the students in higher education institutions on awareness of the applications of atomic energy in Tanzania and the perception of using ICT to enhance awareness of atomic energy application in Tanzania. The effect size was also computed to find out how large is the difference between the two groups (Cohen, 1988). The descriptive statistics were also computed to present more findings on the study.

4.0 FINDINGS AND DISCUSSION

4.1 Findings

Generally, the results show that there is little awareness among Tanzanians on the good applications of nuclear technology in Tanzania. It also shows that most Tanzanians have not



been using ICT on getting information about the good applications of nuclear technology in Tanzania but most of them believe that ICT can help on increasing awareness. The general results are presented in Table 2.

Table 2. General descriptive statistics

Item	Mean	Standard Deviation
Awareness	3.18	0.78
Used ICT	3.42	0.59
Perception of using ICT	3.82	0.71

In determining how aware are the Tanzanians of the applications of atomic energy and nuclear technology in their country; generally, the results show that there is a little awareness among both students and the public (Mean: 3.18) as shown in table 2.

Table 3. The descriptive statistics on awareness to students and the public on the applications of atomic energy and nuclear technology in Tanzania

STUDENTS							
Item	Strong Disagree	Disagree	Neutral	Agree	Strongly Agree	Mean	Standard Deviation
I understand that nuclear technology can be used in a peaceful way	16.67	16.14	28.95	25.61	12.63	3.01	1.26
I understand that Tanzania have nuclear technology experts in different sectors to support development activities	19.82	17.89	24.74	24.56	12.98	2.93	1.32
I know that nuclear technology is useful in different development activities in Tanzania	18.60	15.09	22.63	33.68	9.65	3.01	1.28
I know that nuclear technology is used only for war weapons and not in Tanzania	11.93	16.32	24.56	23.86	23.33	3.30	1.31
I know that there are nuclear technology management agencies in Tanzania	20.18	13.51	25.09	24.74	16.49	3.04	1.36
I have some information on Tanzania Atomic Energy Commission (TAEC)	22.63	16.14	22.11	27.19	11.93	2.90	1.34



PUBLIC							
Item	Strong Disagree	Disagree	Neutral	Agree	Strongly Agree	Mean	Standard Deviation
I understand that nuclear technology can be used in a peaceful way	11.22	13.09	11.77	48.51	15.40	3.44	1.22
I understand that Tanzania have nuclear technology experts in different sectors to support development activities	5.50	19.03	16.61	45.54	13.31	3.42	1.11
I know that nuclear technology is useful in different development activities in Tanzania	5.94	13.64	13.75	56.99	9.68	3.51	1.04
I know that nuclear technology is used only for war weapons and not in Tanzania	17.38	35.75	3.08	30.91	12.87	2.86	1.36
I know that there are nuclear technology management agencies in Tanzania	5.61	18.15	15.18	52.04	9.02	3.41	1.06
I have some information on Tanzania Atomic Energy Commission (TAEC)	22.11	17.82	8.14	43.67	8.25	2.98	1.35

Table 3 presents the detailed results on awareness to both students and the public. It is found that many students (47.19%) agreed that nuclear technology is used only for war weapons and not in Tanzania compared to the public which at least (53.13%) have shown to disagree with this statement. It is also shown that only a few students agreed to understand that nuclear technology can be used peacefully compared to the public (Students: 38.24%; Public: 63.91%). The results also show that many students and the public agreed to be aware of the existence of nuclear technology management agency in Tanzania (Students: 41.23%; Public: 61.08%) though many disagreed (Students: 38.77%; Public: 39.93%) to know much about the Tanzania Atomic Energy Commission(TAEC). Moreover, it is found that few students agreed (37.54%) that Tanzania has nuclear technology experts in different sectors to support development activities compared to the public (58.85%). Furthermore, many students and the public agreed (Students: 43.33%; Public: 66.67%) to know that nuclear technology is useful in different development activities in Tanzania.



Table 4. The descriptive statistics on students and public perception of the use of ICT to increase awareness of the applications of atomic energy and nuclear technology in Tanzania

STUDENTS							
Item	Strong Disagree	Disagree	Neutral	Agree	Strongly Agree	Mean	Standard Deviation
I think ICT can help on increasing awareness of nuclear technology application in Tanzania	5.26	8.95	28.42	28.95	28.42	3.66	1.14
Social media can be used to increase awareness of nuclear technology applications in Tanzania	5.09	4.74	22.28	38.77	29.12	3.82	1.06
I think if there will be online videos about the application of nuclear technology in Tanzania people would like to watch	1.75	7.54	28.60	37.72	23.68	3.75	0.96
I think the use of ICT decreases the cost of information spreading on nuclear technology applications in Tanzania	4.91	14.56	29.47	31.23	19.82	3.46	1.11
ICT is useful in spreading information easily to many people on nuclear technology applications in Tanzania	17.54	12.63	27.19	29.30	13.33	3.08	1.28
I have been using the internet to get information on nuclear technology applications in Tanzania	18.77	17.19	24.21	29.65	9.65	2.94	1.27
I visit the TAEC website to get information on the application of nuclear technology in Tanzania	34.91	11.93	23.68	17.19	12.28	2.60	1.42



PUBLIC

Item	Strong Disagree	Disagree	Neutral	Agree	Strongly Agree	Mean	Standard Deviation
I think ICT can help on increasing awareness of nuclear technology application in Tanzania	0.55	1.32	7.92	55.56	34.65	4.22	0.69
Social media can be used to increase awareness of nuclear technology applications in Tanzania	3.52	3.96	3.63	50.50	38.39	4.16	0.93
I think if there will be online videos about the application of nuclear technology in Tanzania people would like to watch	3.41	5.61	18.48	41.25	31.24	3.91	1.01
I think the use of ICT decreases the cost of information spreading on nuclear technology applications in Tanzania	7.59	10.78	25.41	40.92	15.29	3.46	1.11
ICT is useful in spreading information easily to many people on nuclear technology applications in Tanzania	0.66	7.81	5.39	47.96	38.17	4.15	0.89
I have been using the internet to get information on nuclear technology applications in Tanzania	29.59	35.97	7.70	23.32	3.41	2.35	1.22
I visit the TAEC website to get information on the application of nuclear technology in Tanzania	43.56	33.66	5.83	13.86	3.08	1.99	1.15

In determining the perception of Tanzanians on using ICT to increase awareness of the applications of atomic energy and nuclear technology in Tanzania; the results generally show that both students and the public have some confidence that ICT can be used to help on increasing awareness of the society on the good applications of nuclear technology in Tanzania (Mean: 3.82) as shown on table 2. The detailed descriptive statistics are presented in table 4. The findings showed that many students and the public agreed (Students: 42.63%; Public: 66.21%) that ICT can be useful in spreading information easily to many people on nuclear technology applications in Tanzania. It is also found that most students and the public agreed (Students: 67.89%; Public: 88.89%) that social media can be used to increase awareness of nuclear technology applications in Tanzania and many agreed (Students: 61.40%; Public: 72.49%) that if there will be online videos about the applications of nuclear technology in Tanzania people would like to watch. However, the results show that most



students and the public disagreed (Students: 35.96%; Public: 65.56%) to have been using the internet to get information on nuclear technology applications in Tanzania and they also disagreed (Students: 35.96%; Public: 65.56%) on visiting TAEC website to get information on applications of nuclear technology in Tanzania.

Finally, on finding how students' awareness and perception of the use of ICT are different from the other people in the Tanzania society; a comparison of the two groups was done using a t-test. The results show that there is a significant difference between the students' awareness and perception and the public ($p < 0.05$) as shown in table 5. To get how different are the two groups, Cohen's d effect size was computed (Cohen, 1988). It was found that there is a small difference ($0.20 < d < 0.50$) between the two groups in both awareness and perception of the use of ICT as shown in table 6.

Table 5. T-Test Results

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Awareness	Equal variances assumed	40.15	0.000	-5.88	1474.00	0.000	-0.24	0.04	-0.32	-0.16
	Equal variances not assumed			-5.48	942.70	0.000	-0.24	0.04	-0.33	-0.16
Use ICT	Equal variances assumed	0.50	0.478	-3.93	1469.00	0.000	-0.12	0.03	-0.19	-0.06
	Equal variances not assumed			-4.02	1268.04	0.000	-0.12	0.03	-0.19	-0.06
ICT Perception	Equal variances assumed	0.18	0.668	-11.48	1472.00	0.000	-0.42	0.04	-0.49	-0.35
	Equal variances not assumed			-11.70	1266.64	0.000	-0.42	0.04	-0.49	-0.35



Table 6. Cohen's *d* effect size

	State	N	Mean	Std. Deviation	Cohen's <i>d</i>
Awareness	Student	567	3.03	0.91	0.40
	Public	909	3.27	0.67	
Use ICT	Student	562	3.34	0.56	0.34
	Public	909	3.46	0.61	
ICT Perception	Student	565	3.56	0.65	0.46
	Public	909	3.98	0.70	

4.2 Discussion

4.2.1 Awareness

Generally, the results showed that few (Mean: 3.18) Tanzanians understand the peaceful applications of atomic energy and nuclear technology in Tanzania and hence more effort is required to increase awareness in the society. As said by Levy (2013), being aware of something increases a sense of responsibility and consciousness of information processing, and therefore it may increase positive perceptions of the use of nuclear technology in Tanzania and hence more successful implementation in the country.

Interestingly, most of the university students do not understand that Tanzania has nuclear technology experts in different sectors to support development activities, which may imply that more effort is required to educate the students in the early stages to have more of them show interest in becoming nuclear technology experts.

Moreover, it is shown that most students and the people from the public are not aware of the existence of the Tanzania Atomic Energy Commission. This brings more proof that most Tanzanians are not aware of the applications of atomic energy and nuclear technology in Tanzania, and they even do not know where to get information on this technology in Tanzania. Knowing that there is low awareness, the agency should work harder to educate people on the good applications of atomic energy and nuclear technology for their development.

In the process of increasing awareness of the peaceful use of atomic energy in Tanzania, the use of ICT can help simplify the process as shown by Zhang, Wang, & Duan, (2016) that ICT simplifies the distribution of information.

4.2.2 Perception of the use of ICT to increase awareness in the society

Results show that both students and the public believe that using ICT may help to increase awareness of society. However, it was found that the public is more aware compared to the students which may have different implications. For example, we may think that:



- i. Tanzanian students concentrate only on the things taught in the class and have no time for other different news compared to the public who have more time to listen/view the news
- ii. Students generally would like to view/listen to the social news more than other news

Based on these two examples it is important to think about how ICT can appropriately be used to increase awareness of the two groups as it may need to use different measures. The results show that both students and the public think that the use of social media may increase awareness in society. According to Latha, Pravitha, Dasgupta, & Chaturvedi, (2020) social media have effectively succeeded in increasing awareness of mental health and hence it is believed that it may also help nuclear technology.

The use of ICT can help on spreading information to many people in a short time (Tambo et al., 2019) and it can also decrease the costs of information dissemination (Khan & Bokhari, 2018). It is also believed by most of the respondents in this study that it may help on increasing awareness of the good applications of atomic energy and nuclear technology.

This study also found that both students and the public have not been using the internet to get information on the applications of atomic energy and nuclear technology. This may imply that even if the information will be online, very few people may like to view it due to some reasons and hence the use of ICT should be at least innovative to attract more viewers.

5.0 LIMITATIONS OF THE STUDY AND FUTURE WORK

This study is very important to the concerned agencies on atomic energy and nuclear technology in Tanzania to see what they can do to improve awareness of the good use of these technologies in Tanzania. The obtained results may not be generalized in other countries than Tanzania and hence further research is invited. The study also involved university/college students in all fields and also the people from the public from any field and any study level; which may call for more studies on more specific groups based on the field of study and so on.

6.0 CONCLUSION AND RECOMMENDATIONS

This study is useful in the process of taking necessary measures on increasing awareness among Tanzanians and especially students who can be the future experts in the field of nuclear technology. Based on the findings, shows most people have very little knowledge of the peaceful use of atomic energy in Tanzania. Most of them don't know if atomic energy is used in different development activities in the country as they think atomic energy is used only for creating war bombs. The respective agencies need to work harder on enhancing awareness among the people and especially the young generation to allow them to learn and become future experts. This study recommends that; on increasing awareness among the people, ICT can be used in different ways like:

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i. Conducting different online seminars

The online seminars can be conducted live and be recorded to be accessed later by other people who would like to listen to the discussions. These seminars may include different atomic energy experts who can be discussing different topics and may even answer people's questions live. The findings show that people would like to know much about how atomic energy is used in Tanzania but they don't know where to get the information.

The seminar dates and times can be advertised through different media like radios to make more people join the online seminar sessions. It is known that people listen to radios frequently and hence the information may reach a large group of people. The recorded seminars can also be broadcasted via radio or other media so that more people can get knowledge on atomic energy usage in Tanzania.

ii. The use of social media

Social media have become a good place for new broadcasting and advertising different issues. The knowledge of atomic energy and nuclear technology can also be provided through social media. The findings showed that people like to use social media to get different updates whenever they get time.

iii. Creating documentary sessions, especially for universities and schools

These can be created and distributed to different schools and universities in soft copies so that they can be made available in libraries and also their digital libraries for easy access.

However, the recommended ways can further be researched to find out which one can effectively be used based on the Tanzanian context and how they can be implemented for productive outcomes.

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