



Student Awareness of Cell Phone Radiation and Its Possible Health Effects: A Case of the National University of Lesotho

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ABSTRACT

Today's world is characterised by technologies that range from hardware to software. Every day there is a technological innovation which is being integrated into people's lives to make life easier. Education, like other aspects of the society, has been affected by such technological innovations and had begun integrating cell phones and laptops into the system. Therefore, many students are forced to buy a smart phone in order to complete a course. The researcher observed that the National University of Lesotho students were not an exception to this, and that they spend most of their time close to their phones. While further studies are being carried out to assess the health effects of these phones, few already established a connection between cell phones and health effects such as brain cancer and sleep disturbances.

Thus, the study is mainly a survey research which aimed at assessing the level of awareness of cell phone radiation and its possible health effects. While this study was mainly a survey, it also served as an awareness campaign to undergraduate students who had never heard of cell phone radiation before. Further, the study was purely quantitative research which utilised simple random sampling. Questionnaires were distributed to students around NUL campus on the 23rd June. The results were presented and analysed through descriptive statistics.

It was found that majority of students were aware of cell phone radiation and its possible health effects. Again, it was also found that despite knowing the risks, majority of the learners would still choose a cell phone with a faster internet connection even if it impacted their lives. As such, the researcher recommends that attitudes of learners towards cell phone radiation should be positively changed.

Keywords: Student awareness, cell phone radiation, health effects, National University of Lesotho

1. Introduction

This chapter presents the background of the study, statement of the problem, purpose of the study, research objectives, research questions, significance of the study, assumptions of the study.

1.1. Background to the study

Today's world is characterised by technologies that range from hardware to software. Every day there is a technological innovation which is being integrated into people's lives to make life easier. Examples of such innovations include the development of electric cars, fast trains, satellites, televisions, cameras, kitchen ware, microchips, and even computers that operate with the aid of a software. The latter has impacted people's lives either directly or indirectly, as most of today's activities are executed through a computer based diagnosis.

Education, like other aspects of the society, has been affected by such technological innovations around the world. Many schools, even before the COVID-19 pandemic, had begun using technological tools to run their school based activities. Recently, it is quite possible that most people, including the

researcher, have consciously or unconsciously used a technological innovation or tool in their educational practice. Most educationists are increasingly using technological tools for different reasons and these are discussed in the following paragraphs.

Some researchers (e.g Abukhattala, 2016; Ahmadi, 2018; Elmahdi et al., 2018; Halim & Hashim, 2019; Li et al., 2015; MacDonald, 2016) emphasise that integrating technology in education (e.g smart phones and laptops) helps increase students' motivation. As argued by Li et al. (2015), technology integration in classrooms has been increasing since 1990s and schools are currently increasing their demands for technology use in their classrooms due to a number of benefits that come along with it.

Further, technology helps the learners to learn even beyond the four walls of the classroom (Halim & Hashim, 2019). In addition, Halim and Hashim (2019) states that learners have the ability to use internet to watch academic videos, search for materials, and consult with their peers within online platforms. In my opinion, it is the two latter that influences most university students to use mobile phones and laptops in order to make their academic lives easier and cheaper, yet more productive. This is supported by Rekha (2017) who asserts that the increase of laptop and cell phone usage had made possible the new approach of teaching and learning, popularly known as 'distance learning' (Rekha, 2017).

1.1.1 Cell phone use in institutions of higher learning

The use of cell phones in institutions of higher learning has increased parallel to the increase in technological advancements. Recent studies suggest that many universities have taken advantage of these technological innovations and integrated them in their educational activities to improve student engagement in the courses (Abukhattala, 2016). Citing relevant examples, Foen Ng et al. (2017) examined how students in one Malaysian university used their cell phones to support their learning activities. The results showed that majority of students spent longer hours using their cell phones to execute their learning activities.

Similarly, Ataş and Çelik (2019) conducted a cross sectional survey study that primarily aimed at describing smart phone usage patterns among university students in developing countries. The results established that majority of the students use their smart phone to connect to the internet, followed by texting and chatting with others. Another similar study by Ahmad (2019) was conducted to assess how students from The University of the West Indies in Jamaica perceived a cell phone as a learning tool. The study established that 97% of students own a cell phone, which they claimed it helps them to collaborate with peers and seek assistance from their teachers (Ahmad, 2020).

Another good example is the study carried out by Nagari (2020) which showed that at least 27% of New Delhi do not have a smart phone. For Nagari (2020), the closure of schools due to COVID-19 pandemic encouraged practitioners to hold online classes, thus encouraged students to buy smart phones and laptops to continue learning online. The list of examples concerning mobile usage in institutions of higher learning is endless.

Therefore, it is not novel that majority of university students own a laptop or a smart phone or both. The cited examples in the above paragraphs illuminate that cell phones are fast becoming key instruments in the teaching and learning in many universities across the world. In my opinion, the rising global pandemics such as COVID-19 will foresee or double the amount of institutions which run their programmes online and diffuse materials that can be downloaded by smart phones and laptops. The National University of Lesotho had already joined this race and advocated for blended learning in which certain credit hours are advocated for online lectures and the rest for face-to-face learning.

1.2. Problem statement

Based on the above background, it is evident that distance learning has become a new trend in the education systems of many colleges and universities across the world. This has resulted in the increase in the number of students and lecturers (NUL students and lecturers included) who own cell phones and laptops. Arguably, many students had not felt any desire to buy cell phones and laptops before the pandemic. However, the abrupt change from on-campus learning to virtual learning in many universities pushed such students to rethink about buying a cell phone to be able to engage in an online course.

The rising trend of online learning in universities imply that more students are now buying wireless communication tools so as to operate within an online programme. Despite their significant academic and social success, cell phones impose a number of problems when in use. As far as the researcher is concerned, such wireless technologies emit electromagnetic waves called cell phone radiation. As many students engage in online courses, they are forced to spend most of their academic hours close to their cell phones. Against this background, there is a growing concern about the possible health risks brought by radiation emitted by these cell phones.

1.3. Purpose of the study

The study sought to assess student awareness of cell phone radiation and its possible health effects.

1.4. Objective of the study

The main objective of the study was to evaluate the extent to which National University of Lesotho students are aware of cell phone radiation and the possible health risks imposed by such radiation emissions from cell phones. The objective was further broken down into the following research questions:

1.5. Research questions

What do students mainly use the cell phone for?

What percentage of students are aware of cell phone radiation?
 Which health risks imposed by mobile phones are most known by the students?
 How many students believe that their cell phones can impose certain health hazards?
 What attitude do students have regarding the health risks imposed by cell phones?

1.6. Scope of the study

The study focused on the knowledge about cell phone radiation as perceived by students. The study is mainly quantitative research that was done with the National University of Lesotho undergraduate students as the target population.

1.7. Significance of the study

The findings of the study may be used as baseline information for researchers interested in examining the health risks imposed by cell phones to humans. The findings can further be used to evaluate the extent to which National University of Lesotho (NUL) students are knowledgeable about cell phone radiation and its possible health risks. This may inform and guide curriculum implementation in NUL and other universities which may want to continue with virtual learning. It is my hope that the information from this research may be helpful to other interested researchers who would wish to document and evaluate the student's awareness of cell phone radiation. Finally, the findings can be used to contribute to the existing research on this topic.

1.8. Assumptions of the study

While administering this survey, it was assumed that all participants would provide enough information about their awareness of cell phone radiation. The researcher assumed that such information was true and unbiased.

1.9. Definition of terms

In this study, there are certain terms that are frequently used and are explained below to help the reader understand how they are used in this research.

Student -A person who is studying at a university or other place of higher education. In simpler terms, a student is someone who goes to school to learn.

Awareness-Consciousness about a situation or fact.

Cell phone-A portable, cordless tool with access to a cellular network that can be used to connect people over a wide area without a physical connection.

Radiation -The electromagnetic waves that are emitted by a particle and can cause ionization due to high energy.

Health risk-Something that potentially exposes an individual to disease.

1.10. Acronyms

NUL	-National University of Lesotho
RF	-Radio Frequency
EMF	-Electromagnetic Frequency
KHz	-Kilohertz
MHz	-Megahertz
SAR	-Specific Absorption Rate

1.11. Research outline

This research is organised into five chapters. Chapter one is the introduction, Chapter two is the review of related literature, Chapter three is the methodology, Chapter four is the presentation and discussion of findings, and Chapter five is the summary, conclusion and recommendations.

2. Literature review

In this section, theoretical framework underpinning this study and literature relevant to this study are discussed. In the discussion, convergent and divergent ideas from different authors are critically reviewed.

2.1. Theoretical background

The theory underpinning this research is Risk Perception Theory. This study is focused on how the National University of Lesotho students perceive possible health risks imposed by cell phones. The researcher had observed that many students own a cell phone, which they are so much married to. As such, the researcher felt the need to assess risk awareness concerning the intensive use of cell phones amongst undergraduate students.

2.2. Conceptual background

2.2.1. Awareness

Some authors, such Muscato and Myers (2021), define awareness in a manner that is closely linked with consciousness. They argue that even though some authors may want to separate these words, it cannot make sense to say that someone is aware of something without being conscious about that particular thing. Therefore, Muscato and Myers (2021) combines consciousness and awareness and refer to the concept as conscious awareness which they define as the state of being aware that we are conscious about something. Defined in this way, it appears that awareness is being conscious that we actually know something.

Further, Trevethan (2017) also defines awareness as a general knowledge that people have concerning the existence of a particular subject. For example, if one is asked whether he or she knows about the events that are taking place in Ukraine, the expected answer is yes or no. It is either the person has heard or seen something about Russian-Ukrainian war or they had not heard or seen anything concerning such events. Therefore, if they answer yes then they are aware but if they answer 'no' then they are not aware. As argued by Trevethan (2017), the respondent does not need to read about the topic in order to answer the question; they should only provide what they are conscious of.

There are three main types of awareness; the peripheral awareness, sensory awareness, and self-awareness (Muscato & Myers, 2021). Furthermore, peripheral awareness is when the brain stores information about the events that happen around us while sensory awareness is the awareness that people have motivated by direct experiences (Muscato & Myers, 2021). The last known type of awareness is self-awareness that Muscato and Myers (2021) define as simply the awareness about oneself; which includes how one understands him/herself. In this study, the researcher subscribes to the peripheral type of awareness and marries the definition that is provided by Muscato and Myers (2021).

What's more, there are mechanisms through which different people become consciously aware about certain things. Even though the work of Nova (2002) is considered old in this conceptual review, it appears to be the only latest framework that explains how people become aware of certain things. For Nova (2002), awareness is gained through direct communication with other people, through seeing something happen (consequential communication), and through environmental feedback. In this paper, it is preserved that the respondents had gained awareness of cell phone radiation through all the aforementioned mechanisms.

2.2.2. Mobile phone radiation

When in use, mobile phones emit low levels of non-ionizing radiation called the Radiofrequency (RF) radiation (Bhargavi et al., 2013). For Bhargavi et al. (2013), some of the RF radiation emitted by these gadgets is absorbed into our bodies; motivated by many factors like proximity of the device, duration of cell phone use per day, and the strength of the signal. According to İKiNciKeleş and Uzun Şahin (2021), the energy absorption is usually measured in terms of Specific Absorption Rate (SAR) and it is primarily the measurement of the speed at which energy is absorbed by our bodies when exposed to electromagnetic fields (EMF).

Radiofrequency waves are electromagnetic fields (EMF) having a frequency range between 300KHz-300MHz (Saikhedkar et al., 2014). The above paragraph purports that RF radiation exposure is significantly dependant on the usage patterns of mobile phones and the risk can vary with each user. Therefore, the researcher wishes to extend the discussion by conceptualising common effects connected to intensive use of cell phones. The next paragraph establishes this connection.

2.2.3. Health hazards imposed by cell phones to people

To date there has been little agreement on the health risks imposed by mobile phones to humans. However, the only common understanding that is found in debates around this topic is that mobile phones emit radiation. Whether such radiation has ability to directly or indirectly impact people's health remains disputed by a significant number of studies (Sultangaliyeva et al., 2020). Arguing against authors who claim cell phones do not impose health risks, Mani (2019), Hardell (2017) and Nichole (2019) state that the International Agency for Research on Cancer had classified cell phone radiation as possible cause of cancer.

This is to assert that there is a relationship between brain cancer and mobile phones. The topic is also challenged by the experimental studies that involve laboratory animals from United States National Toxicology Program (Bartosova et al., 2021) and Italian Ramazzini Institute (Nicole, 2019). These two research bodies demonstrated evidence of tumours in some tested animals (Mani, 2019; Nicole, 2019). As such, arguing that cell phones do not impose health risks to people can be linked to individual agendas because scientific evidence is emerging as more studies are being carried out to investigate how cell phones impact people's health.

Short term effects

Literature suggests that intensive use of smart phones can lead to certain symptoms such as nausea, dizziness, vomit, depression, and sleep disturbances (Nath, 2018; Nicole, 2019; Parasuraman et al., 2017; Wu, 2018). In addition, Nicole (2019) adds to the list of short term health effects by mentioning that changes in the heart beat rate is also associated with mobile phone radiation. In support of Nichole (2019), the researcher subscribes to Nath's (2018) explanation that subjects who were exposed 3G network experienced increased heart beat rates that was similar to heart rates of people with stress.

Further, Parasuraman et al. (2017) contribute to this topic by demonstrating that some health risks are not brought by the radiation as such, but the use of the phone itself. Parasuraman et al. (2019) further demonstrate that some health risks can directly be connected to cell phone radiation. Combining all of the short term risks of cell phones, they mention weakness of thumb and wrist, neck pains as non-radiation risks and list dry eyes, hallucinations, delusions, and insomnia as radiation risks. Similarly, Fowler and Noyes (2017) also listed eyestrain and blurred vision as the possible risks due to cell phone radiation. They go a step further and mention that electromagnetic frequencies absorbed by the ear during calls can result in hearing problems (Fowler & Noyes, 2017).

Again, Nath (2018) connects sleep problems and changes in energy levels to mobile phone radiation and Wi-Fi networks. Nath (2018) cites a relevant example by asserting that in an experiment (simple memory test) that involved men and women, women who were exposed to 2.4 GHz Wi-Fi had changes in their brain and energy levels. It appears that sleep disturbances can also be caused by mobile phone stations or towers rather than just cell phones. If people with excessive use of cell phones do not experience the aforementioned short term effects, then they are luckily to experience the long term effects which are discussed in the following paragraphs.

Long term effects

Extreme cell phone usage can result in a number of long term risks. Although there are in progress researches on the potential health risks imposed by cell phones, the few that have been published established a link between cell phone radiation and brain cancer (Fowler & Noyes, 2017; Mani, 2019; Nath, 2018; Nicole, 2019; Sultangaliyeva et al., 2020; Toxicology & Ntp, 2020). As Sultangaliyeva et al. (2020) state, studies that tested the effect of Radio Frequency waves on lab rats established that the RF EMFs had contribution on brain tumours.

For Sultangaliyeva et al. (2020), people who reside near cell phone towers are more luckily to develop brain tumours than those who reside farer away. However, Mani (2019) has a contradicting view as (s)he argues that RF fields from cell phones are riskier than those of cell phone towers themselves. Comparing these two authors, it is evident that both cell phones and towers impose health risks to people near them. Their views only differ on which is more dangerous than the other. The researcher wishes not to dwell in such debates but to acknowledge that radiation from both tools can cause brain cancer.

On the same note, children are most vulnerable to cell phone radiation compared to other age groups (Fowler & Noyes, 2017). Fowler and Noyes (2017) argue that fluid content of children's brains is high, and that their skulls are much more thin before they reach eighteen (18) years. Therefore, cell phone radiation penetrates easily through the skulls and impact their more fluid brains, thus develop brain tumours. Argued by Nath (2018), the risk of brain tumours happens in the long run of continued use of a mobile phone; after ten (10) years or more. If a person uses a cell phone for more than an hour on a call a day, (s)he is at higher risk of developing brain cancer after at least 10 years (Nath, 2018).

Other researches on this topic suggest that cell phone radiation contributes to reduced fertility rates; in both men and women. For example, Fowler and Noyes (2017) states that men who carry their cell phones in their pockets are at a risk of damaging their sperm count, or in activate sperm mobility. However, Nicole (2019) argues that males are the at higher risks of reduced fertility compared to women. Similarly, Shivaji et al.(2020) also assert that exposure to cell phone radiation affects men's sperm than women. Women, especially pregnant women, can damage their unborn babies due to long time exposure to cell phone radiation (Nath, 2018).

The students from the National University of Lesotho are at a risk of cell phone radiation as they spend more hours close to their phones. As a result, the researcher wished to distribute a questionnaire that assessed student awareness of the mentioned health risks. The researcher personally developed a conceptual frame work shown in figure 1, to demonstrate how the variables are linked.

2.3. Conceptual Framework

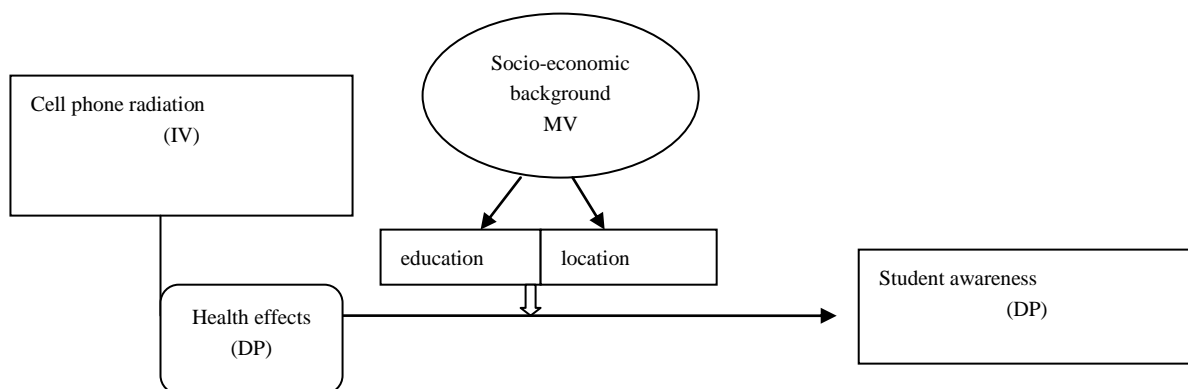


Fig 1- Conceptual framework showing the relationship between awareness of cell phone radiation and its possible health effects

Figure 1 illustrates how student awareness and health risks imposed by cell phones are associated. The independent variable (IV) is cell phone radiation. Health risks and student awareness are the dependent variables (DP) as they depend on cell phone radiation. The socio-economic background of students such as education and location can either strengthen or weaken awareness about cell phone radiation and its possible health risks. As such, education and location assume the role of mediating variables (MV) in this study.

2.4. Empirical research

There is a considerable number of studies that have been published concerning usage patterns of mobile phones in college education. Some of these studies further assessed knowledge about health risks of cell phones due to intensive use. However, some of these studies are considered old, thus will be ignored for the purposes of this research. The most recent and relevant are discussed in this section.

One of the recent studies that assessed awareness of cell phone radiation was published by Amare et al.(2020). In their study, the authors had used a cross sectional study which established that age, sex and year of study had a significant contribution to the awareness of cell phone radiation. Further, the results revealed that female students were much aware of cell phone radiation as compared to males. Lastly, Amare et al.(2020) also found out that students in the age range 18-20 had more knowledge of EMF than those in the age range 21-28.

Similarly, Hassan and Refaei (2020) carried out a cross sectional study to assess radiation awareness among Minia University students. The findings show that 99.2% of male students were aware of cell phone while female awareness was 99.5%. In addition, the most known health effects were sleep disturbance, and headache.

Lastly, a study by Paul et al.(2022), which was meant to assess student and the working class's awareness of cell phone radiation, revealed that above 50% of both two groups (students and working professionals) were not aware of the impact of cell radiation to people. Further, 64% of the students and 65.2% of the working professionals denied that their phones can impose health risks to them. It left 32.4% of the students in agreement that cell phones can harm them. The table below summarises the empirical review on this topic.

Table 1- Studies that are related to the present study

Paul et al.(2022)	To assess knowledge of possible health effects due to radiation	VIT University, India	351	17.3% of the participants aware of cell phone radiation
Amare et al.(2020)	To assess knowledge levels of radiation exposure from diagnostic imaging procedures among medical students	University of Gondar, Ethiopia	473	45.5% of medical students knew about radiation exposure and hazards
Hassan and Refaei (2020)	to find out the perceptions of students concerning health hazards imposed by phones	Minia University	765	99.3% of participants were aware of health risk imposed by cell phone

2.5. Appraisal and gaps to be filled

While the studies shown in table 1 are not many, yet recent studies on this topic, all of them were not conducted in the Southern part of Africa. Putting aside Ethiopia, they were carried out in much more developed countries. There are no studies of this kind in the down South countries like Lesotho. As a result, there is justification to fill in the gaps, and to contribute to knowledge concerning this topic.

The purpose of this paper was to find out the extent to which students from the National University of Lesotho are aware of cell phone radiation. Thus, the next chapter discusses the methodological approach followed by the researcher to gather information on the student awareness of cell phone radiation and its possible health risks.

3. Methodology

This chapter discusses the methodology followed by the researcher to assess NUL students' awareness of cell phone radiation and possible health risks. As such, the methodology of this study was to a large extent influenced by the research objective and research questions highlighted in chapter 1. Meanwhile, the chapter presents research approach, research design, sampling techniques and sampling size, instrument for data collection, procedures for collecting data, and data analysis methods.

3.1. Research approach

In this study, the researcher applied quantitative research approach. Quantitative research is an approach that utilises and analyses data in a statistical manner using statistical methods (Apuke, 2017). In addition, this approach is employed to address questions such as how many, what extent, how much, and who (Apuke, 2017). Therefore, qualitative research seeks to quantify data which helps the researcher understand vast amounts of data within a short time frame. Thus, the researcher found quantitative research as the more appropriate approach to address the research questions established in chapter one.

3.2. Research design

A research design can be defined as the plan for collecting, analysing, interpreting, and reporting data in research (Boru, 2018). A research design outlines how the research study will be carried out (Akhtar, 2017). The research design used for this study is descriptive research design. Descriptive survey design is defined by Nassaji (2016) as the research design that allows the researcher to account for questions such as what, where rather than why. Furthermore, Nassaji (2016) asserts that this design utilises observation and survey tools from which data can be analysed through frequencies and percentages and/or averages. The study therefore, employed descriptive survey design to assess the attitude towards and the extent to which National University of Lesotho students are aware of cell phone radiation.

3.3. Research paradigm

For Rehman and Alharthi (2018), a research paradigm is one's understanding of the world and how the problems should be addressed or solved. In addition, there are three main types of research paradigms and these are positivism, interpretivism, and critical theory (Rehman & Alharthi, 2018). This study is primarily driven by positivism, which is a paradigm that involves a scientific/objectified explanation of a phenomena. To add more, Kivunja and Kuyin (2017) argue that positivism attempts to interpret meanings in terms of measurable units. In this study, the researcher was only interested in quantifying the percentages of students who are aware of cell phone radiation, thus carried out this study using the positivist lens.

3.4. Classification of variables

The independent variable is cell phone radiation while the dependent variables are health risks and student awareness.

3.5. Research ethics

Research ethics refer to the processes or activities for ensuring that no participant is put at harm and that anonymity is maintained (Dooly et al., 2017). In this study, the researcher developed a likert scale questionnaire that was distributed to participants across campus. Before issuing questionnaires to the participants, the researcher introduced himself and explained the motives behind the research. The participants were asked to read the letter of introduction that was attached to the questionnaire before deciding to participate in the survey.

Additionally, there was no consent form attached to the questionnaires but the respondents and the researcher verbally agreed on the rules of engagement in this study. Confidentiality was maintained as the questionnaire did not require the names of the participants. Additionally, all participants were given freedom to ask where they did not understand and the researcher offered explanations. Lastly, the participants were allowed to withdraw from the survey if they wished to.

3.6. Setting of the study

Data was gathered from the undergraduate students at the National University of Lesotho campus on the 23th June 2022.

3.7. Study population

The population consisted of only undergraduate students from any programme in the university. Undergraduate students are mostly taught through online lessons, inter-changeably with physical classes. Thus, they are at a higher risk of cell phone radiation impacts than their counter parts.

3.8. Sampling technique

Probability sampling was used by the researcher when carrying out this study. The researcher followed simple random sampling technique to select students. Simple random sampling was employed because all the students from different faculties had equal chances to participate in the survey. As such, any student found by the researcher was selected to participate in the survey.

The researcher planned for a maximum of 76 randomly selected undergraduate students from any programme. On the one hand, inclusion criteria comprised of any undergraduate student studying at the National University of Lesotho. On the other hand, exclusion criteria consisted of all post graduate students and undergraduate students who were not around campus during the distribution of questionnaires.

3.9. Data collection tools

In this study, the researcher used questionnaires for data generation. The objective of this study was to find out the extent to which National University of Lesotho students are aware of cell phone radiation. The instrument that was considered fit for this purpose is a questionnaire which helped the researcher quantify the percentage of students who are aware of cell phone radiation and its possible health risks.

Thus, the questionnaire was developed by the researcher and comprised of three sections. The first section covered the demographic details of the participants. The second section comprised of 16 statements from which the participants had to strongly agree, agree, disagree, or strongly disagree. This

was a forced response questionnaire, thus 'neutral' was purposively removed. The last part consisted of two items that assessed the attitudes of students towards cell phone radiation.

In order to confirm that the questionnaire was designed appropriately and accurately measured what it was supposed to measure, it was given to three expert lecturers and two Masters students in the faculty of education for content validity. The panel advised the researcher to make few adjustments. After that, the questionnaire was piloted to ten participants to see how they would react to it. There were no problems so the researcher moved to the data collection phase.

3.10. Data collection procedure

The questionnaire was distributed to the students around NUL campus on a simple random sampling basis. The researcher explained the scope of the study to the participants and explained the items in the questionnaire. After all, the responses had to be consistent and accurate to provide for better analysis. The questionnaires were administered on the 23th June 2022 and were collected on the same day to achieve higher return rates. All the respondents were given enough time to read and respond to the questions.

The researcher had printed out 76 questionnaires. Only 14 did not get distributed as some students were busy preparing for their exams, thus could not have time to respond to the questionnaires. Out of the 62 that were distributed, only 4 questionnaires were not returned. This resulted in the mortality rate of 6%. The returned questionnaires were completely answered and contained no errors. Generally, the response rate was 94% and this was good to generalise findings

3.11. Data analysis

Data was collected, then analysed through Microsoft Excel. Primarily, the data generated by the questionnaires was carefully evaluated to look for errors, then analysed through descriptive statistics. Descriptive statistics is defined by Ali(2021) as process of analysing data in a way that it allows for quantification of findings. In addition, it allows the researcher to present data in numerical (Ali, 2021). By using tables and graphs and bar charts, the researcher was able to present frequencies, and percentages from results.

4. Data presentation and interpretation

The purpose of this study was to assess the student awareness of cell phone radiation and its possible health effects, as well as assess students' attitude towards cell phone hazards. The findings are presented in this section.

4.1. Findings

Table 2- Profile of sample based on demographic characteristics (n=58)

Gender	Age group								Total
	(15-20) Years		(21-26) Years		(27-32)Years		33 and above years		
	Frequency	%	Frequency	%	Frequency	%	Frequency	%	
Female	11	19%	33	56.9%	0	0%	0	0%	44(75.9%)
Male	4	6.9%	8	13.8%	0	0%	0	0%	12(20.7%)
Other	0	0%	2	3.4%	0	0%	0	0%	2(3.4%)
Total	15	25.9%	43	74.1%	0	0%	0	0%	58(100%)

Table 2 illustrates that female participants in the age range(15-20) were 11(19%) while in the age range(21-26) were 33(56.9%). On the other hand, male participants in the age range(15-20) were 4(6.9%) while those in the age range(21-26) were 8(13.8%). There students who did feel like they were either male or female, thus were assigned to 'other' as dimension of gender. There were not students in the age range (15-20). There were only 2(3.4%) of these kind of participants in the age range(21-26).

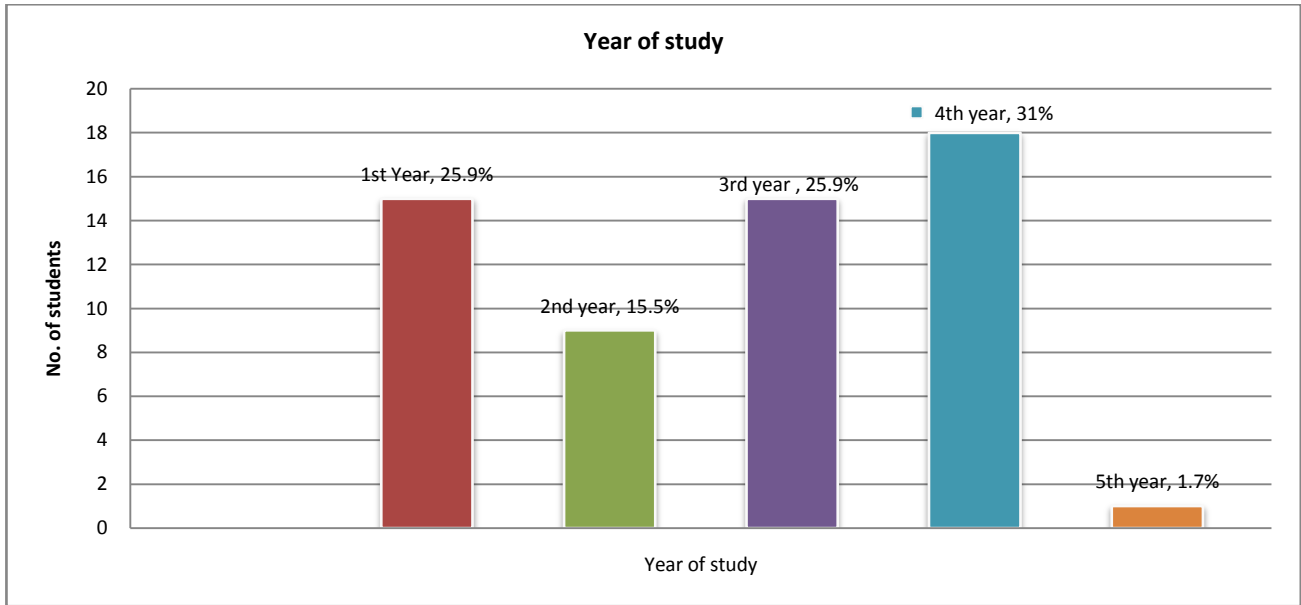


Fig 1- Distribution of students per year of study

Results in figure 1 reveal how students who participated in this study are distributed across the year of study. Hence, there are 15(25.9%) first year students, 9(15.5%) second year students, 15(25.9%) third year students, 18(31%) fourth year students, and only 1(1.7%) fifth year student.

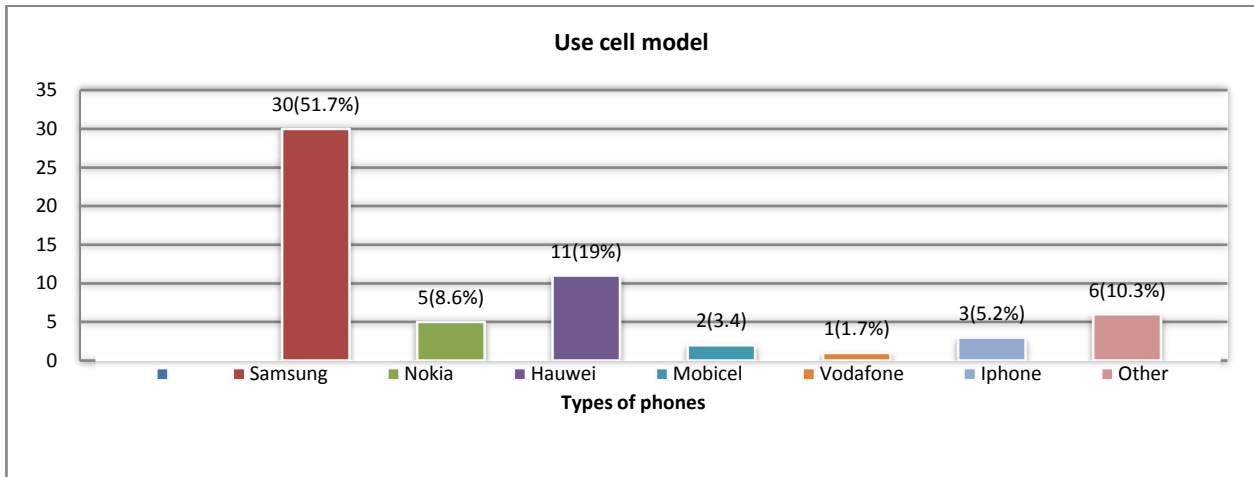


Fig 2- Distribution of cell phone models used by students

Figure 2 shows the used cell phone models by students. Samsung is used by 30 students, Nokia by 5 students, Hauwei by 11 students, Mobicel by 2 students, Vodafone by 1 student, Iphone by 3 students, while 6 students used none of the mentioned brands.

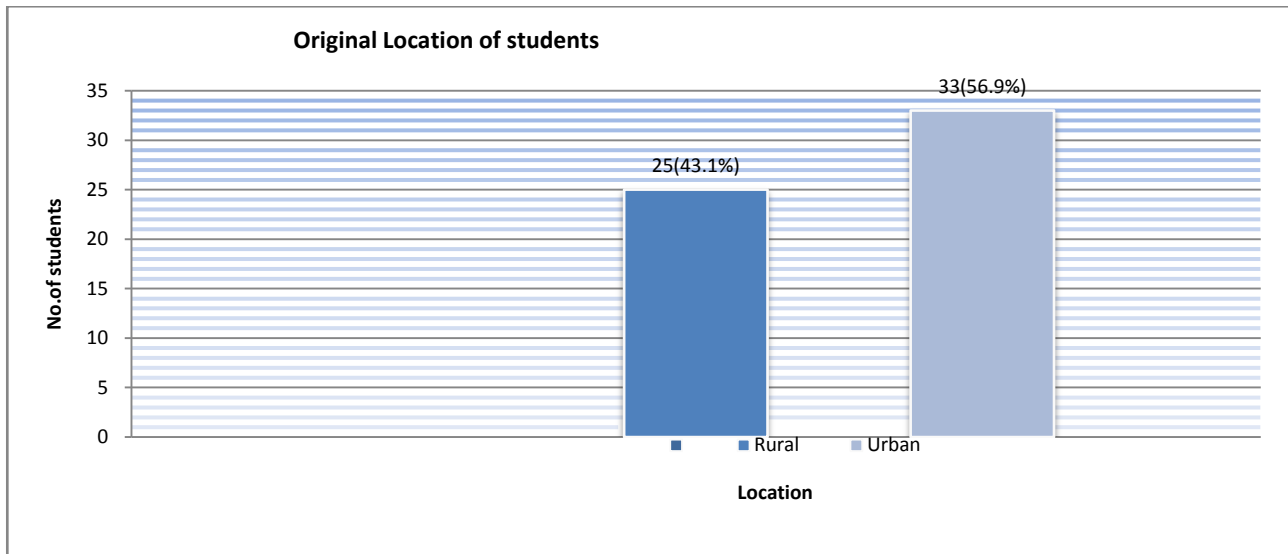


Fig. 3- Distribution of students with regard to original locations they come from

In figure 3, participants are distributed with respect their original location. Therefore, 25(43.1%) come from rural areas while 33(56.9%) come from urban areas.

Table 3- Profile of students as distributed across their programmes

Bsc Pharmacy = 3(5.2%)	Bsc Nutrition = 1(1.7%)	BA Humanities = 1(1.7%)
Bsc Crop Science = 4(6.9%)	Social Work = 9(15.5%)	BA Economics = 5(8.6%)
Bsc Nursing = 4(6.9%)	Biotechnology = 4(6.9%)	BA Sociology = 10(17.2%)
Bsc Biology & Chemistry=3(5.2%)	LLB 5years = 2(3.4%)	Bachelor of Pharmacy = 2(3.4%)
Bsc General = 2(3.4%)	Bachelor of Commerce= 2(3.4%)	

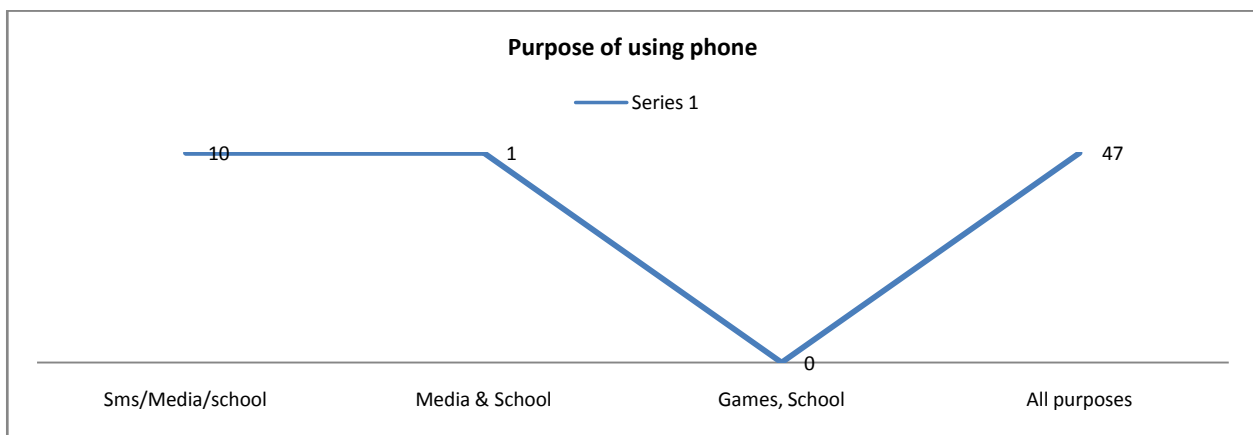


Fig. 4- Graphical presentation of what students use their cell phones for

The line graph in fig. 4 illustrates that 10 students use their cell phones for SMS & calls, social media, and school only while 1 student uses his/her cell phone for social media and school work only. Lastly, majority of the students (n=47) use their cell phones for SMS & calls, social media, games, and for school work.

Further, the students were given a statement from which they were supposed to strongly agree, agree, disagree, or strongly disagree. The statement read as 'I am aware that cell phones emit radiation'. The results of this item are provided in the column chart below.

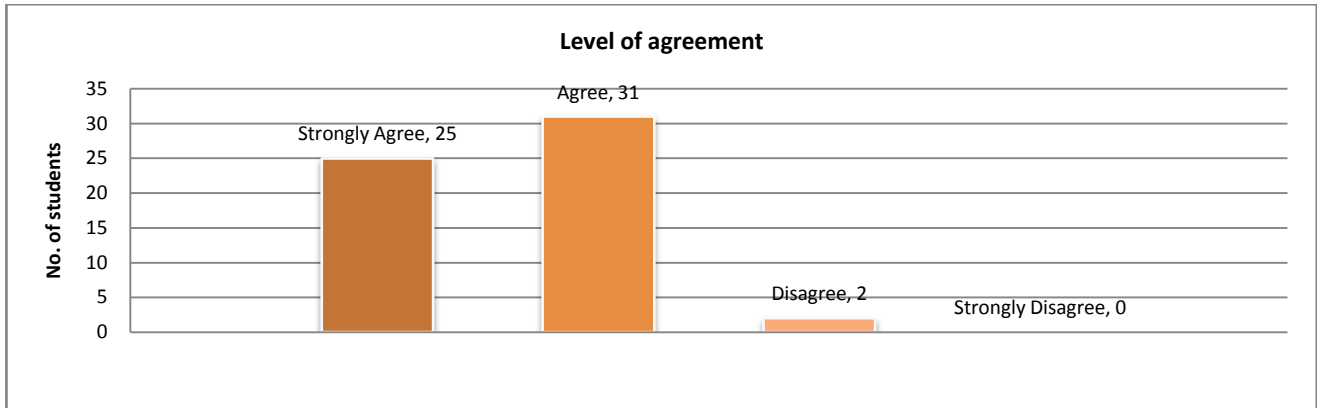


Fig. 5- Distribution of students with regard to awareness of cell phone radiation

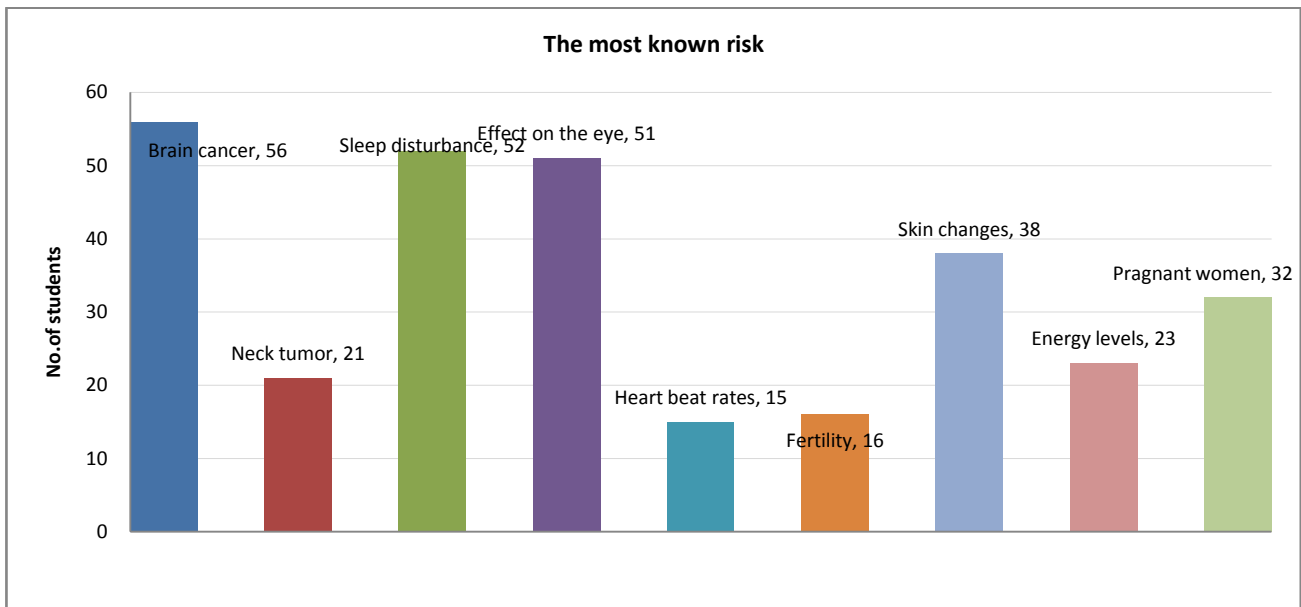


Fig.6- Distribution of known health risks by students

The students had been assessed on the health risks imposed by cell phones. Figure 6 distributes the health risks according to how they were consciously known by students. As a result, brain cancer is the most known health risk (n=56), followed by sleep disturbance (n=52) and effect on the eye (n=51). The least known effect is changes in heart beat rate (n=15).

Again, the researcher was interested in finding out how many students believed their cell phones can impose certain health risks. Thus, the researcher included the related item on the questionnaire whereby the students had to choose (YES) or (NO). The results to this item are presented in the table 3 below.

Table 4- Perceptions regarding health risk imposed by participant’s phone

Answer options	Frequency	Percentage
Yes	52	89.7%
No	6	10.3%
Total	58	100%

Table 4 shows that 52(89.7%) of the students believe that their cell phones can cause serious harm to them. However, 6(10.3%) did not believe that their cell phone can impose health risks to them.

To gather data concerning the attitude of students regarding health risks of their cell phones, they were asked if they would still prefer a phone with a fastest internet connection even if it imposed health risks. The results are detailed in table 5 below.

Table 5- Attitude of students regarding health risks imposed by phones

Answer options	Frequency	Percentage
Yes	44	75.9%
No	14	24.1%
Total	58	100%

In table 5, 44(75.9%) students agreed that they would still prefer a cell phone with a faster internet connection even if it imposed certain health risks to them. However, 14(24.1%) students disagreed that they would prefer a cell phone with a fast internet connection over their health.

5. Discussion of findings

Results in table 1 reveal that the most represented gender in the sample is females (n=44), followed by males (n=12) then 'other' (n=2). Again, the results in table one reveal that the age range (21-26) is the most represented in both genders(n=43). It can be further observed in table 1 that there were no participants in the age range(27-32) and 33 and above. This implies that most of the undergraduate students are below age 27.

While Paul et al.(2022)found Samsung as the second most brand, this study reveals that Samsung is in the lead with 51.7% of the sample using it. Therefore, it can be perceived that Samsung is one of the most popular brands amongst university students.

As shown in table 3, the majority of students who participated in this study come from BA Sociology (n =10), followed by students from Social Work (n =9). The least represented programmes in this study were Bsc Nutrition (n=1) and BA Humanities (n=1). The reason behind this could be that the questionnaire was distributed when BA Sociology students were mostly around the campus to prepare for their exam. As a result, they might have had a higher chance of taking part in this survey than students who were at their hostels and homes.

With regard to the first research question, which assessed the main purpose of using their cell phones, majority of students (n = 47) used their cell phones mainly for SMS and calls, social media, games, and school work. No students were found to be using their cell phone to only play games and do school work. The results further established that some students (n=10) use their cell phones only for SMS and calls, social media, and school work; not playing games.

The second research question was developed to find the percentage of students who were aware of cell phone radiation. Thus, the participants who strongly agreed were 25, those who just agreed were 31. Therefore, the total agreement was n=56 (96.6%). This implies that majority of students are aware that cell phones emit radiation. These findings are in agreement with Hassan and Refaci (2020) who found that majority of the respondents in their study were aware of cell phone radiation.

However, the results are in disagreement with Paul et al.(2022) and Amare et al.(2020) who all found that the level of radiation awareness was generally weak among their participants. Therefore, it is evident that the level of radiation awareness cannot be anticipated or predicted for any university across the world.

Brain cancer appeared to be the most known risk (n=56) due to extensive use of cell phones. Furthermore, sleep disturbance and effect to the eye followed with (n=52) and (n=51) respectively. These findings are more similar to the findings of Hassan and Refaci (2020) which established that sleep disturbance was amongst the most known health effect.

In addition, data presented in table 4 reveal that majority (89.7%) of students do not believe that their cell phones can impose serious risks to them. Despite being aware that their cell phones emit radiation, these students had nothing to believe about radiation effects to humans. Possibly, if the researches that are still in progress would establish that cell phones can cause severe damage to people, the 89.7% of NUL students would be at a double risk.

Moreover, the results in table five reveal that the attitude of students towards health effects of cell phones is negative. Majority (75.9%) of the students said they would still prefer a cell phone with a fast internet connection over their lives. It is evident that these students are ignorant and careless concerning their safety measures. However, the minority (24.1%) of the students still consider their lives meaningful and could not sacrifice their lives over a cell phone. In critical events such as the current COVID-19 pandemic, these types of students should be encouraged to use cell phone radiation shields as they engage in online courses. In a nutshell, majority of the NUL students are at a higher risk of severe impacts of their cell phones due to ignorance.

6. Summary, conclusions, and recommendations

This chapter presents the summary, conclusions, and recommendations of the study. This is done through the data presented in chapter four. Doing this therefore, summary of findings from this study is presented first. What follows is the conclusion, and later possible suggestions for further research.

6.1. Summary of findings

In this chapter, data has been presented and discussed in line with the research questions of the study. It was found out that the majority of students who participated in this research were from the age group (21-26) years. It was further found that gender wise, females dominated the sample used in this study. Furthermore, the results established that majority (96.6%) of students were aware that cell phones emit radiation. Regarding the most known health effect, sleep brain cancer, sleep disturbance, and effect to the eye. Nonetheless, majority of the students still did not believe that their cell phones can

cause them any harm. Lastly, majority of the students showed a negative attitude towards health hazards of cell phones because majority (75.9%) of the students said they can choose to have a cell phone with a faster internet connection even if it imposed certain health risks.

6.2. Conclusions

It is an undeniable fact that many students across the world have developed positive attitudes towards cell phone technology. Their dependency on a cell phone does not end with school work but goes to as far as social media networks. To add more, during painful events such the COVID-19 pandemic, students get closer to cell phones than they did before. For example, COVID-19 forced many universities to shut down any face to face interactions and continue with online programmes. This means more students felt the need to buy a smart and stay close to it for the entire school hours.

Arguing alongside the findings presented in this research, the researcher concludes that the level of Radiofrequency (RF) awareness is high amongst undergraduate students, particularly NUL. However, the attitudes towards safety of cell phone are negative. This imply that the health risks that come along with cell phones remain a serious health issue that needs to be properly addressed. Thus, there is a need to evaluate the potential harm these tools can have on children and to kick start campaigns that are meant to teach students to practice safety measures when using a cell phone.

6.3. Study limitations

The limitation of this study is that the sample used is relatively small to generalise findings to a larger population. Again, it can be seen in the findings that there are no participants from other faculties such as Education, Urban and Regional Planning, and many others. As such, I believe an attempt could have been made to recruit more participants through Google and WhatsApp forums. This could have helped to avoid possible biases. However, I still believe the results can be used to hypothesise the level of awareness of the entire University regarding cell phone radiation.

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Competing interests

The researcher claims that there were no sponsors behind this research. Therefore, the researcher declares that there is no conflict of interest.

References

- Abukhattala, I. (2016). The Use of Technology in Language Classrooms in Libya. *International Journal of Social Science and Humanity*, 6(4), 262–267. <https://doi.org/10.7763/ijssh.2016.v6.655>
- Ahmad, T. (2020). *Student perceptions on using cell phones as learning tools Implications for mobile technology usage in*. 4(1), 25–43. <https://doi.org/10.1108/PRR-03-2018-0007>
- Ahmadi, D. M. R. (2018). The Use of Technology in English Language Learning: A Literature Review. *International Journal of Research in English Education*, 3(2), 115–125. <https://doi.org/10.29252/ijree.3.2.115>
- Akhtar, I. (2017). Research design Research design. *Research in Social Science: Interdisciplinary Perspectives*, September, 68–84. [file:///E:/Documents/dosen/buku Metodologi/\[John_W._Creswell\]_Research_Design_Qualitative,_Q\(Bookos.org\).pdf](file:///E:/Documents/dosen/buku%20Metodologi/[John_W._Creswell]_Research_Design_Qualitative,_Q(Bookos.org).pdf)
- Ali, A. (2021). *Title : Quantitative Data Analysis Author : Ameer Ali. May*. <https://doi.org/10.13140/RG.2.2.23322.36807>
- Amare, D. E., Dagne, H., Matters, I. P., & Count, M. (2020). *Knowledge and Associated Factors of Medical Students Regarding Radiation Exposure from Common Diagnostic Imaging Procedures at the University of Gondar , Ethiopia. July*.
- Apuke, O. D. (2017). Quantitative Research Methods : A Synopsis Approach. *Kuwait Chapter of Arabian Journal of Business and Management Review*, 6(11), 40–47. <https://doi.org/10.12816/0040336>
- Ataş, A. H., & Çelik, B. (2019). *Smartphone Use of University Students : Patterns , Purposes , and Situations*. 7(2), 59–70.
- Bartosova, K., Neruda, M., & Vojtech, L. (2021). *Methodology of Studying Effects of Mobile Phone Radiation on Organisms : Technical Aspects*.
- Bhargavi, K., Balachandrudu, K. E., & Nageswar, P. (2013). Mobile Phone Radiation Effects on Human Health. *International Journal of Computational Engineering Research*, 03(4), 196–203. www.ijceronline.com
- Dooly, M., Moore, E., & Vallejo, C. (2017). *ethics*. 351–362.
- Elmahdi, I., Al-Hattami, A., & Fawzi, H. (2018). Using Technology for Formative Assessment to Improve Students' Learning, *Turkish Online Journal of Educational Technology - TOJET*, 2018-Apr. *TOJET: The Turkish Online Journal of Educational Technology*, 17(2), 182–188. <https://eric.ed.gov/?id=EJ1176157>
- Fowler, J., & Noyes, J. (2017). *A study of the health implications of mobile phone use in 8-14s Un estudio de las implicaciones para la salud del uso del*

teléfono móvil en niños de 8-14. 84(200), 228–233.

- Halim, M. S. A. A., & Hashim, H. (2019). Integrating web 2.0 technology in ESL classroom: A review on the benefits and barriers. *Journal of Counseling and Educational Technology*, 2(2), 57. <https://doi.org/10.32698/0421>
- Hardell, L. (2017). *World Health Organization , radiofrequency radiation and health - a hard nut to crack (Review)*. 405–413. <https://doi.org/10.3892/ijo.2017.4046>
- Hassan, E. E., & Refaei, S. A. (2020). Awareness of Cell Phone Hazards among University Students . *Sapporo Medical Journal* , 54(9).
- İKİNciKeleş, A., & Uzun Şahin, C. (2021). Exposure to electromagnetic field, cell phone use behaviors, SAR values, and changes in health following exposure in adolescent university students. *Arquivos de Neuro-Psiquiatria*, 79(2), 139–148. <https://doi.org/10.1590/0004-282X-ANP-2020-0283>
- Kaysi, F., Yavuz, M., & Aydemir, E. (2021). Investigation of University Students' Smartphone Usage Levels and Effects. *International Journal of Technology in Education and Science*, 5(3), 411-426.
- Kivunja, C., & Kuyin, A. B. (2017). Understanding and Applying Research Paradigms in Educational Contexts. *International Journal of Higher Education*, 6(5), 26-41.
- Li, L., Worch, E., & Aguiton, R. (2015). An EXPLAN. SEQ. MM study: How and Why Digital Generation Teachers Use Technology in the Classroom. *International Journal for the Scholarship of Teaching and Learning*, 9(2).
- MacDonald, G. (2016). Technology in the Montessori classroom: Benefits, Hazards and Preparation for life. *NAMTA Journal*, 99–107. <http://files.eric.ed.gov/fulltext/EJ1112230.pdf>
- Mani, R. (2019). *Do Mobile Phones Cause More Harm than*. 198–205. <https://doi.org/10.4236/jss.2019.78014>
- Muscato, C., & Myers, R. (2021, February 11). *What is Conscious Awareness?* Retrieved July 24, 2022, from Study.com: <https://www.study.com>
- Nagari, A. (2020, August 20). *At least 27% students do not have access to smartphones, laptops for online classes: NCERT survey*. Retrieved July 24, 2022, from Hindustan Times: <http://www.hindustantimes.com>
- Nassaji, H. (2016). *Qualitative and descriptive research : Data type versus data analysis Qualitative and descriptive research : Data type versus data analysis*. April. <https://doi.org/10.1177/1362168815572747>
- Nath, A. (2018). *Comprehensive Study on Negative Effects of Mobile Phone / Smart Phone on Human Health*. February. <https://doi.org/10.15680/IJRCCE.2018>
- Nicole, S. (2019). *Mobile phones and health : Where do we stand ?March*.
- Parasuraman, S., Sam, A. T., Wong, S., Yee, K., Lau, B., Chuon, C., & Ren, L. Y. (2017). *Smartphone usage and increased risk of mobile phone addiction : A concurrent study*. 125–131. <https://doi.org/10.4103/jphi.JPHI>
- Paul, J., Shivaram, A., Panchami, P., Patel, B., & Jaikrishnan, D. (2022). *Awareness of Mobile Phone Radiation and Its Potential Health Hazards Among Students and Working-class Population During the COVID-19 Pandemic : A Cross-sectional Survey*. March, 0–10. <https://doi.org/10.21467/ajgr.12.1.1-10>
- Rehman, A. A., & Alharthi, K. (2018). *An introduction to research paradigms An Introduction to Research Paradigms*. October 2016.
- Rekha C. J. (2017). *USE OF MOBILE PHONES AND THE AWARENESS OF ITS HEALTH HAZARDS AMONG HIGHER SECONDARY*. 6(1), 61–70.
- Saikhedkar, N., Bhatnagar, M., Jain, A., Sukhwai, P., Sharma, C., & Jaiswal, N. (2014). Effects of mobile phone radiation (900 MHz radiofrequency) on structure and functions of rat brain. *Neurological Research*, 36(12), 1072–1079. <https://doi.org/10.1179/1743132814Y.0000000392>
- Shivaji, D. R., Malpani, S. G., & Dharashive, V. (2020). *A Review : Effects of mobile phone on human health*. 5(10), 167–170.
- Sushita, R., & Anwar, R. (2014). Education for Sustainable Development: Connecting Dots for Sustainability. *Journal of Learning for Development*, 72–89.
- Sultangaliyeva, I., Beisenova, R., Tazitdinova, R., Abzhalelov, A., & Khanturin, M. (2020). *The influence of electromagnetic radiation of cell phones on the behavior of animals*. 13, 549–555.
- Toxicology, N., & Ntp, P. (2020). *Cellphone Radio Frequency Radiation Studies*. August.
- Trevethan, R. (2017). *Deconstructing and Assessing Knowledge and Awareness in Public Health research*. 5(August), 16–19. <https://doi.org/10.3389/fpubh.2017.00194>
- Wu, Y. (2018). *Master Thesis The Relationship between Smartphone Addiction and Interaction Anxiousness among College Students in Sweden Health and Lifestyle* , 15 credits.

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