Electromagnetic Wave Emission Profiles: A Study of Everyday Electronic Devices

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ABSTRACT

The use of various electronic devices has become an integral part of daily life. However, there is growing concern about the potential impact of electromagnetic radiation (EMR) emitted by these devices on human health. EMR can penetrate body tissues, including the brain, and may pose negative effects if exposed for prolonged periods. This study aims to investigate and comparatively analyze the electromagnetic wave (EMW) emission from different electronic devices. This research also helps to understand the contribution of different devices towards overall electromagnetic field exposure in everyday environments. The devices used in this research include laptop, iPad, smartphone, and basic phone. Measurements were taken using an EMW detector at various distances (0 cm, 5 cm, 10 cm, and 15 cm) from the devices. This research finding shows that the longer the distance of devices from the EMW detector, the lower the intensity readings collected. Among the four devices, laptops exhibited the highest EMW readings (806.2 mW/m^2), followed by iPads (95.5 mW/m^2), smartphones (41.25 mW/m^2) and basic phones (98.939 mW/m^2) at 0 cm. These results suggest that both the type of device and its distance from the EMW detector significantly influence the level of electromagnetic radiation detected, with laptops being the most substantial source of EMW.

Keywords: electromagnetic waves, electronic devices, distance, radiation

INTRODUCTION

In this era of technology, electronic devices have become part of our daily lives such as smartphones and laptops and even many other home appliances such as televisions and microwaves. These devices are always around us and are everywhere. Apart from being able to help facilitate our daily work, it also has a negative impact on health by being able to emit electromagnetic waves as a side effect of its operation. Understanding this electromagnetic wave radiation is important so that we know the effects of harmful electromagnetic wave radiation.

The World Health Organization (WHO) has also emphasized the importance for us to understand the adverse effects on health caused by electromagnetic fields (EMF). Findings from the World Health Organization (2016), mobile phone users are exposed to much higher radio frequency fields because mobile phones are handled very close to the head, especially nowadays the field is exposed anywhere. Although many studies show that everyday electronic devices do not pose significant health risks when used, WHO continues to support continued research and careful assessment of EMF exposure levels.

In this article, we study and comparatively analyse the emission of electromagnetic waves (EMW) from different electronic devices of different distances. This article also helps to

understand the relationship of different devices towards electromagnetic field exposure. The electronic devices used are laptops, iPads, smartphones and basic phones.

METHODOLOGY

This research focuses on examining the level of harmful electromagnetic wave radiation from the use of various types of electronic devices from different distances. The data collection process involved three steps: 1) device selection, 2) determination of measurement distance and 3) data measurement and analysis.

Devices Selection

The study was conducted at Kolej PERMATA Insan. Several devices have been identified as frequently used by students. This is based on survey data taken on 75 students out of 407 Kolej PERMATA Insan students showing that 81.3% of respondents use laptops, 17.3% use iPads, 3.9% use smartphones and the rest use basic phones. Therefore, based on the survey conducted, the researcher has chosen laptops, iPads, smartphones and basic phones as research materials.

Determination of Measurement Distance

In this study, four measurement distances were used. According to Pranas B. and Raimondas B. (2015) stated that the distance measurement is determined with the aim of evaluating the electric magnetic field tested in relation to its level of exposure. Therefore, in this study, the distances that have been used are 0 cm, 5 cm, 10 cm, and 15 cm from the devices to identify the level of exposure of harmful electromagnetic waves.

Data Measurement and Analysis

Data measurements are performed in the physics laboratory using an EMW detector (GQ EMF Meter-390) to detect harmful electromagnetic waves. Electromagnetic wave measurements were taken at four predetermined distances. The highest reading was recorded within 30 seconds for each distance. The data obtained will be collected, recorded and analysed in Microsoft Excel. This is supported by the findings of Iain, R.B. *et al.* (2005) stated that Microsoft Excel provides a variety of features and benefits that enable the collection, review, and entry of data quickly and potentially accurately.

RESULTS AND DISCUSSION

Harmful EMW in Laptop, iPad, Smartphone and Basic Phone

Table 1 shows harmful electromagnetic wave radiation measured on a laptop, iPad, smartphone, and basic phone using an EMW detector at four different distances. The laptop recorded the highest reading at 806.2 mW/m^2 at 0cm, 102.4 mW/m^2 at 5 cm, 63.01 mW/m^2 at 10 cm, and 45.24 mW/m^2 at 15 cm. The laptop is followed by iPad with reading 95.5 mW/m^2 at 0 cm, 37.32 mW/m^2 at 5 cm, 13.92 mW/m^2 at 10 cm, and 6.094 mW/m^2 at 15 cm. Third row shows harmful EMW recorded from smartphones that have no data or wifi

and no call. The reading was 0.057 mW/m^2 at 0 cm, 0.042 mW/m^2 at 5 cm, 0.027 mW/m^2 at 10 cm, and 0.019 mW/m^2 at 15 cm. Row 4 of the table shows reading for smartphones that on data or wifi and when called. The reading was 41.25 mW/m^2 at 0 cm, 1.593 mW/m^2 at 5 cm, 0.272 mW/m^2 at 10 cm, and 0.022 mW/m^2 at 15 cm. The last row shows harmful EMW recorded for basic phones. The reading was 98.939 mW/m^2 for 0 cm. This shows a consistent reduction in exposure as distance increases, indicating that even small increases in distance can significantly lower radiation levels. Harmful electromagnetic wave radiation becomes strongest when the devices is in direct contact with the laptop and iPad. The reduction in radiation intensity follows an inverse square law relationship, where the intensity of radiation decreases proportionally to the square of the distance from the source. This behaviour is evident from the sharp drop in values between 0 cm and 15 cm.

Table 1. EMW reading recorded on laptop, iPad, smartphone, and basic phone

	0 cm (mW/m^2)	5 cm (mW/m^2)	10 cm (mW/m^2)	15 cm (mW/m^2)
Laptop	806.200	102.400	63.010	45.240
Ipad	95.500	37.320	13.920	6.094
Smartphone (off data/wifi and no call)	0.057	0.042	0.027	0.019
Smartphone (on data/wifi and when call)	41.250	1.593	0.272	0.022
Basic phone	98.939	-	-	-

CONCLUSION

The results suggest that distance from the devices is a critical factor in reducing exposure to electromagnetic radiation. As expected, the highest levels of radiation are recorded at 0 cm, where the measuring device is in direct contact with the devices. However, even small increases in distance, such as from 0 cm to 5 cm, result in a notable decrease in radiation intensity. Thus, it highlights the importance of maintaining a certain distance from electronic devices to minimize potential exposure to electromagnetic radiation. Although the values measured at 15 cm are significantly lower, they still suggest that many other electronic devices emit radiation even at a relatively far distance. Further analysis could involve comparing these findings with established health standards for electromagnetic radiation exposure, determining whether these levels pose any health risks over long-term use, and exploring potential shielding methods or safe usage guidelines.

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