Spatial Investigation on Noise Level at Sultan Idris Education University Campus, Malaysia

by Ellyn Normelani

IOP Conference Series: Earth and Environmental Science

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Abstract. This article aims to identify the level of spatial noise within the Universiti Pendidikan Sultan Idris Campus. This research is based on an exploratory study using quantitative methods and assisted by a geographic information system (GIS) software. The data used are primary data collected in the field based on sampling at 11 selected locations based on the main road intersection in the Sultan Abdul Jalil Shah Campus (KSAJS). Data collected with the help of the sound meter application in smartphones. Sampling time is from 8 am to 5 pm on weekdays. The analysis used is descriptive analysis and GIS regression technique, which is spatial interpolation to identify areas with the potential to experience high noise levels. The results show that some campus areas experience high noise levels in the morning and afternoon during the rush time going/back to/from work. Noise values ranging from 44.8 dBA to 66.4 dBA were obtained. The value indicates the maximum value exceeds the standard by the Department of Environment (DOE)(55 dBA). In conclusion, the noise level at KSAJS is acceptable due to the marginal use of vehicles on campus. This situation is due to a forbidden act to stop some students from using vehicles and maximizing the shuttle bus. This study's implications are important to be used as a guide to university administrators to maintain noise levels at the lowest level in creating a high-security environment, conducive learning environment, and a more peaceful working environment.

1. Introduction

The world's rapid development indirectly drives economic growth in a country, and Malaysia is no exception. It is a positive thing, but there is no denying that the world's rapid development and technology also harm the population, such as environmental pollution. Environmental pollution includes noise pollution, which is unwanted noise or excessive noise unneeded. Noise pollution generally in the area of downtown, industrial, and commercial [1]. Noise pollution is no stranger, as it occurs in almost every community area [2, 3]. What is even more surprising is when the World Health Organization (WHO) states that noise pollution is the third most dangerous environmental pollution in the world after

air and water. Thus, noise pollution is not a trivial matter because, in some cases, it can create various adverse implications for humans. Sound is always present, and human beings cannot miss it all the time. Sound can be defined as a form of compression wave that disperses intermediate substance particles, originating from sound sources and resulting from vibration [1,2,4,5,6]. The resulting sound will travel through the air in waves and cause the air molecules to vibrate and produce waves. In everyday human life, sound plays an important role in various fields, especially in the arts, culture, services, and socioeconomics. However, there is no denying that this unwanted noise can threaten the community's social order and, at the same time, can create a stressful atmosphere in a community [4,6,7]. The main purpose is to study noise levels in selected places in Sultan Abdul Jalil Shah Campus (KSAJS), Sultan Idris Education University (UPSI). Furthermore, with this study, it is hoped that the factors that contribute to the noise in KSAJS can be identified. With this study, the levels and factors contributing to the noise at the designated stations can be identified. Therefore, through this study, the selected station's noise factor can be controlled in the future.

2. Background

The level of noise studies or noise pollution is not new because many previous studies address this issue. In Malaysia, the main point contributing to the highest noise level is traffic or transportation network systems [1,2,4,5]. Why does this situation exist? As many as 88 percent of Malaysians own and hinge on private vehicles than the other 12 percent using public cars. Thus, it is undeniable, leading to an increase in noise level due to the high intensity of road users or traffic [1]. Furthermore, the noise level is driven by transportation factors, but other elements contribute to noise in an area. In the study area, KSAJS, noise value sampling was carried out at selected stations. These selected stations are the intersection road that is believed to contribute to the noise at KSAJS. So with the help of a sound meter application, this study was implemented on weekdays starting from 8 am to 5 pm. This study focuses on specific times and identifying specific stations that contribute to noise in the study area. Such studies are necessarily relevant because they are sustainable for a long time. If this noise pollution is not addressed, then there will be various negative implications for the surrounding community. These negative implications include adverse effects on the local community's health and invite multiple stress symptoms that can threaten the community's mental health, especially university students. This noise will indirectly create disturbances to individuals, such as causing anger due to exposure to noise, which is believed to impact human health and hearing [3]. The general public is well aware of pollution problems visible to the naked eye, such as water or air pollution, and sometimes not realize the noise pollution is also a critical issue. In Malaysia, especially in urban areas and other rapid development areas, the noise pollution issues have been considerably taken seriously because, in some cases, it has caused various confusion such as social stress or 'societal stress' in the public community.

Some parts in Malaysia have recorded severe noise pollution levels, such as Kuala Lumpur, Georgetown, and Johor Bahru, due to the increasing number of vehicles every year [1]. However, there is no denying that the study area also received the same problem of increasing vehicle users consisting of students and staff and UPSI staff. According to the Environmental Quality Act, 1974 (CLR 2006, 26 section 23) [5] states that no person shall, unless licensed, emit or emit any greater noise in quantity, intensity, or quality contrary to the prescribed conditions. Offenders can be fined more than RM1000 or jailed for five years or both [5]. Based on previous studies that have been conducted, the issue of noise pollution has given rise to various negative implications. Noises that contain maximum vibration levels can harm human health [8]. Noise is an element of mental disorder that is now experienced by humans in the world today. In some situations, this noise can give an individual emotional disturbance, such as causing stress or anger due to exposure to noise believed to impact and harm their health and hearing [4]. There is no denying that extreme noise will threaten a society that loves peace and harmony in an area. There are many kinds of research related to the use of GIS and this noise. Much of this research involves spatial regression analysis using the inverse distance weighting (IDW) method to identify areas polluted with this noise.

3. Materials and Methodology

3.1. Study area

The study area selected was KSAJS, Sultan Idris Education University, or the main campus for UPSI. This campus is an educational center located in the Muallim district in Tanjong Malim. Physically, the KSAJS is located at coordinates ‘41'00”N and 101 ‘32'01' E. The campus houses various administrative centers that are the focus of students. This campus houses five faculties that are a reference for all UPSI staff. Among the faculties are the Faculty of Language and Communication (FBK), the Faculty of Humanities (FSK), the Faculty of Music and Performing Arts (FMSP), the Faculty of Vocational Techniques (FTV), and the Faculty of Computer Science and Creative Industry (FSKIK).

3.2. Data

The campus area is the main area for students and lecturers to carry out activities. For the students, the campus is their place to study, and for the lecturers and other employees, the university campus is their place of work. Therefore, these university residents' activities have led to noise in the campus area, among them through the sound of vehicles belonging to university residents who always pass by the campus area, repair work that is being carried out, students who gather en masse, and various other activities. A total of 11 study stations have been selected. This study station's selection is based on the focus activities area and is the main intersection of public roads. The sampling locations are shown in Table 1.

Table 1. Sampling Locations

Station	Location	Lat	Long
1	Main Gate Junction	3.685917	101.522618
2	Junction in front of the Museum	3.685450	101.524841
3	Junction in front of the Chancellory	3.687255	101.525353
4	Junction in front of the Gymnasium	3.687702	101.525513
5	Junction in front of Malim Sarjana Complex	3.685586	101.526973
6	Junction in front of the Maybank ATM	3.685385	101.527598
7	Junction in front of UPSI Clinic	3.682131	101.523893
8	Junction in front of the SUKSIS Office	3.683225	101.526206
9	Junction in front of the Bus Station	3.682463	101.525464
10	Junction in front of the Library	3.684267	101.524577
11	Junction in front of Bitarasiswa Building	3.686115	101.527669

This study's primary data was obtained through noise value results at eleven main stations located in KSAJS. The station selection is due to these stations' focus on university residents with various activities around the stations. These selected stations are the main road junctions that vehicles often pass, especially vehicles belonging to university residents. The only device used is a mobile phone with the Sound Meter application from google play. This Sound Meter application is used to measure the level of ambient noise in decibels. This application displays dBA values measured for various readings, i.e., for sound readings at maximum levels, minimum levels, and environmental noise readings on average. Also, this application shows the time the noise was recorded. Therefore, the information recorded is the minimum, maximum, and average noise reading, and the time the data is recorded. These data are all recorded every hour once from 8.00 am to 5.00 pm for each station. This noise observation was done on Monday, a working day after holidays on Saturday and Sunday, to assess the noise level better. The sampling time is due to more university residents on the day in the campus area.

3.3. Analysis

The data analysis stage was made based on the primary data collected during the field study. The primary data are minimum, maximum, and average noise readings. Maximum and minimum readings refer to

the highest and lowest observation values recorded at each study location at specific times. In contrast, the average value is the overall noise reading at certain times at each study location. The analysis used in this study is a descriptive analysis that shows specific values, such as average value, minimum, maximum, standard deviation, and range. On the other hand, the spatial analysis uses the interpolation spatial analysis method, which attempts to predict areas with no value based on the observation station's values [9]. This article applied the Inverse Distance Weighting (IDW) interpolation method, which provides satisfactory results when the number of elevation points in an area is large, and the points are uniformly distributed. Generally, interpolation predicts the cell values in a pattern format using a given number of sample data. The IDW Interpolation method is based by considering the data obtained from noise sources and distances between them by utilizing the given values surrounding the predicted location. It predicts that each given point has a local influence that shrinks with space by giving greater value to the nearest points of the prediction location, with the distance decay effect. This process leads to the procedure being referred to as the inverse distance weighted.

4. Results and Discussions

4.1. Noise levels at the selected location in KSAJS

Table 2 shows the noise observation values at all stations in KSAJS. Observation values are divided into three parts according to time, namely morning, noon, and evening. Table 2 shows the overall value and The highest value at 66 dBA at station six and the lowest at station 7 (45.90 dBA). The average for the overall observation value ranged from 46.98 dBA to 65.03 dBA. The standard deviation value is not too high, between 0.83 to 5.88, which indicates that stations recorded significant changes for the overall observation and tone that did not change much as in Station 11. The lowest noise level among all stations in the KSAJS, Station 4 located in the Gymnasium area, which is indeed an area that does not have many student activities except for students who want to pray at Surau An-Nur or use the field and gymnasium. The situation affects the noise level at this station due to lack of student activity and traffic congestion. Furthermore, the gymnasium area does not have the buildings used by UPSI students as their lecture rooms. Therefore, this area will only have an increased noise level in the early morning of 8 to 9 am with a sound level of 50.3 dBA. The number indicates that the noise that occurs at this station is due to car and motorcycle traffic at this time as it is office hours for students to lecture and staff to work. The other stations show the same noise level where there are a drop and rise of each station's noise level at each station in the KSAJS.

Table 2. Sampling Values by times

Station	AM8-9	AM9-10	AM10-11	AM11-12	PM12-1	PM1-2	PM2-3	PM3-4	PM4-5
1	65.60	65.70	60.70	54.70	55.30	56.40	55.20	54.00	54.00
2	48.10	48.30	44.80	52.00	45.80	49.50	53.70	52.00	47.20
3	52.90	51.30	46.30	48.20	48.50	49.00	51.90	58.00	59.60
4	50.30	45.90	48.60	48.80	45.20	46.20	45.30	45.80	46.70
5	54.20	55.70	55.60	55.10	55.00	57.20	55.40	53.40	55.00
6	62.80	64.70	65.60	65.00	65.90	66.40	64.80	64.10	66.00
7	48.00	50.00	66.00	54.00	49.40	51.60	49.80	45.90	48.80
8	54.90	53.50	53.90	53.80	53.10	55.00	54.60	56.50	53.80
9	57.50	61.10	59.30	56.50	55.30	56.50	57.70	59.70	53.60
10	52.90	55.80	56.10	55.60	58.80	56.90	56.10	58.10	58.50
11	52.00	53.00	53.00	53.00	52.30	52.50	50.70	51.70	51.20

Station 1 recorded the loudest noise at 9am to 10am with a reading of 65.7 dBA, followed by station six (64.7 dBA), station nine (61.1 dBA), station 10 (55.8 dBA) and station five (55.7 dBA). These five stations exceed the standard set by DOE, which is 55 dBA. In addition, station eight (53.5 dBA), station

11 (53.0 dBA), station three (51.3 dBA) and station seven (50 dBA). Station two (48.3 dBA) and station four recorded the lowest noise of 45.9 dBA. At 10 to 11 am, some stations have recorded a high value of station 7, which is the area that has recorded the loudest noise at this time of 65.7 dBA. Next are station six (65.6 dBA), station one (60.7 dBA), station nine (59.3 dBA), station 10 (56.1 dBA) and station five (55.6 dBA). Eight stations with a reading of 53.9 dBA and station 11 (53.0 dBA). Station Six is the area that records the highest noise level at 3 to 4 pm with a sound level of 64.1 dBA, followed by station nine (59.7 dBA), station 10 (58.1 dBA), station three (58.0 dBA), and station eight (56.5 dBA). In the last hour of the study, which is 4 to 5 pm, the station that recorded the highest noise at this time was at station six with a sound level of 66.0 dBA. Next are station three (59.6 dBA), station 10 (58.5 dBA) and station five (55.0 dBA). The maximum value obtained in the morning is 66 dBA (station 7), and the minimum value is 44.80 dBA (station 2). Some stations record the highest value for minimum and maximum, which is station 6 (mean: 62.80 dBA, mother: 65.50 dBA). The standard deviation value also indicates diversity with a high value, suggesting that the noise value difference is large, like at station 7. The high number is because station 7 is also among the entrances to KSAJS.

The maximum value obtained is at station 6 (66 dBA) for the noon observation, and the lowest value is at station 4 (45.20 dBA). The lowest values for all stations are between 45.20 dBA (station 4) to 65.90 dBA (Station 6). 6 stations show a minimum value of less than 55 dBA. The highest values recorded were Between 46.20 dBA (station 4) and 66.40 dBA (station 6). The average value obtained is between 45.70 dBA (station 4) and 66.51 dBA (station 6). The standard deviation showed no change in the observed value, with station 11 (014 dBA) showing a more or less the same value at each observation. Each station's range indicates no high-value difference between the observation time and the value between 3.70 dBA (station 2) and 0.20 dBA (station 11). The number suggests that stations exposed to vehicle noise at station six will continue to record high noise levels and at noon. The highest value recorded was between 46.70 dBA (station 4) and 66 dBA (station 6) for the afternoon observation. The minimum value obtained is between 45.30 dBA (station 4) and 64.10 dBA (station 6). Even station six also recorded a high average value for all afternoon observation times (64.97 dBA). This station six also recorded a low standard deviation making this station six not change the value obtained, making station six the station that recorded the highest value for all observation hours whether morning, noon, afternoon.

Table 3 shows the descriptive values for observations for all stations. Morning observations between 8-9 am indicate the values obtained are Between 48 dBA and 65.60 dBA. The average also does not exceed the DOE standard, which is only 54.47 dBA but has approached 55 dBA. Even the standard deviation is not too large, showing the value between stations in the morning is not too large. The range obtained is 17.60, which is quite large for this small area. The number indicates that there is a great deal of value this morning. A similar situation also occurred at 9-10 am. Observations of times 10-11 show that the times that are not with the vehicle are only recording a minimum value of 44.80 dBA. However, the maximum value still exceeds the DOE standard with a value of 66.00 dBA. Nevertheless, this cough also shows the highest average value, which suggests that some stations recorded a high value, and this average value exceeds the DOE standard of 55.45 dBA slightly. Even the standard deviation also shows the highest value in all observation times. The range value is also high (21.20 dBA0. The high value at the same time suggests that there is a lot of vehicle activity in some areas, such as station six, which increases the noise value. Next is more or less the same value obtained for the time between 11-12 noon. Noontime is calculated from 12 to 2 pm shows a value that is approximately equal to the time between 10 to 12 noons, but the increase in vehicles is affected at 1 to 2 pm by showing the maximum value of 66.40 dBA. The maximum value is also recorded at the highest in the afternoon, 66 dBA from 4 to 5 pm. Compared to the highest minimum value at the same time, which is 46.70 dBA.The evening's value range is Among the highest, which is Between 18.30 dBA to 19.50 dBA, which suggests that among the busy hours in KSAJS is also in the evening, especially when returning home from work.

Table 3. Noise Descriptive Values by Sampling Times

	AM8-9	AM9-10	AM10-11	AM11-12	PM12-1	PM1-2	PM2-3	PM3-4	PM4-5
Min	48.00	45.90	44.80	48.20	45.20	46.20	45.30	45.80	46.70
Max	65.60	65.70	66.00	65.00	65.90	66.40	64.80	64.10	66.00
Average	54.47	55.00	55.45	54.25	53.15	54.29	54.11	54.47	54.04
SD	5.60	6.48	7.14	4.43	6.01	5.46	4.97	5.60	5.76
Range	17.60	19.80	21.20	16.80	20.70	20.20	19.50	18.30	19.30

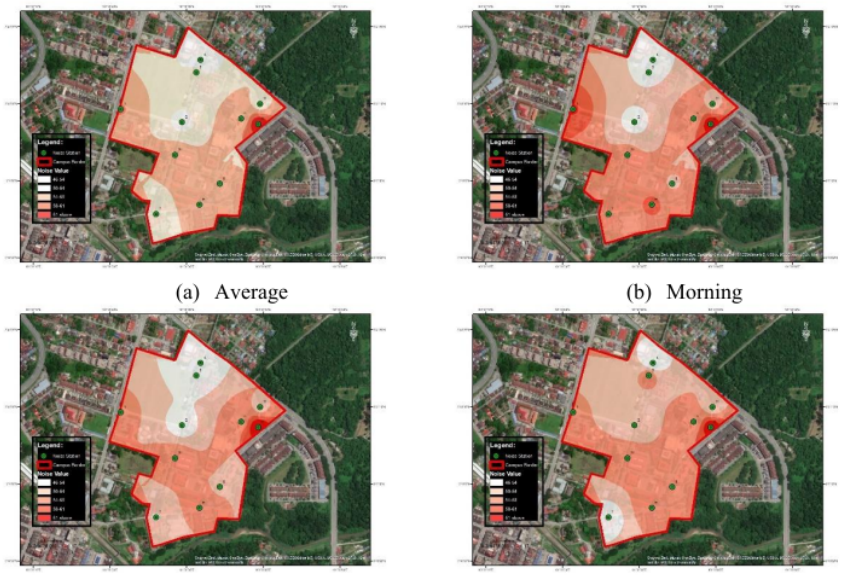
A spatial analysis was conducted by predicting the entire KSAJS area for noise level based on the noise level findings at previously selected locations. The analysis used is a spatial analysis using interpolation techniques using ArcGIS 10.7 software. The interpolation results are divided into four observation times, assuming that during peak hours, such as the time to enter, noon, and return from the office is when most vehicles are on campus. The noise level, according to the standards set by the Department of Environment (DOE) [4] for this institutional area, is not more than 55 Decibels (dBA). Mapping was done for each hour and grouped into three hours: morning, noon, and afternoon.

4.2. Spatial Overall Average of Noise Values

Figure 1(a) shows the area of the area experiencing various levels of noise. The highest level of more than 60 dBA is affected at station 6. This station 6 is close to the UPSI cycle bus station, which carries passengers from/to several locations such as the Sultan Azlan Shah Campus and others. It is not a strange thing when this station shows a high value. Compared to other areas, areas have administrative and learning blocks with a moderate noise level, such as Malim Sarjana Complex, Music Complex, and Faculty of Language and Communication. Noise is still reasonable because of the move to prevent students from bringing in-vehicle to campus, leading to fewer cars and a moderate noise value. Figure 1(a) shows that Station 6, located at the intersection in Maybank, has a very high noise level than other stations. Since the noise level observed at Station 6 has a high level from 8 am to 5 pm, there is a decrease in noise level at that station but cannot be compared with other stations' noise levels. Station 6 has a high noise level due to the area, which is very crowded with people passing by and the noise of vehicles passing through the area because the junction in front of Maybank is the main entrance and exit of vehicles into the KSAJS. Other factors contribute to the station's high noise level, such as bus noise and construction. Furthermore, any construction activity and repair work contribute to noise [6, 10, 11].

4.3. Spatial of Noise Values in the Morning

Figure 1(b) shows that the area with the highest value with station 6 is still high due to student transport activities near station six and station one, which is at the main gate and close to Methodist Secondary School. This high value is due to the use of main gates for employees entering UPSI and contributions from the number of vehicles that send children to school at the UPSI main entrance. However, areas with moderate to high noise levels are quite widespread, namely in the southern areas. Figure 1(b) shows the noise level pattern at the KSAJS, in the morning from 8 to 11 am. At 8 to 9 am, the area that has detected the noise level marked in red is at the KSAJS main gate junction (station 1), which recorded the loudest noise level at this time of 65.6 dBA, followed by the Maybank front junction (station) 6) such as 62.8 dBA and the intersection of bus stations (station 9) recorded a noise level of 57.5 dBA. For the part of the map that has been marked in yellow, it is at the intersection in front of the SUKSIS office (station 8), recorded noise at 54.9 dBA, the intersection in front of the Malim Sarjana Complex (station 5) is 54.2 dBA, the intersection in front of the Chancellery building (station 3) like 52.9 dBA, a junction in front of gymnasium (station 4) noise was recorded at 50.3 dBA, a junction in front of the library (station 10) like 52.9 dBA and Bitarasiswa junction (station 11) noise was recorded at 52.0 dBA. Meanwhile, among the areas that have been marked in green is at the front intersection of the museum (station 2); noise is recorded at 48.1 dBA, and the area with the lowest noise level at 8 to 9 am at the intersection of UPSI Health Clinic (station 7) which recorded reading at 48.0 dBA.



(a) Average (b) Morning

(c) Noon (d) Afternoon

Figure 1. Campus noise level

4.4. Spatial of Noise Values in the Noon

Figure 1(c) shows the noise level at noon. The area around station one still shows a high level of noise compared to other areas. The number shows that bus activity contributes to the noise level in KSAJS. Figure 1(c) shows the noise level in KSAJS in the room for noon, where three maps represent 11 to 2 noon have been produced. From 11 am to 12 noon, the station that recorded the highest noise was station six at the intersection in front of Maybank at a sound level of 65 dBA, followed by station nine (56.5 dBA), station 10 (55.6 dBA), and station five (55.1 dBA).). While station four with a sound level of 48.8 dBA and station 3, 48.2 dBA (recorded the lowest noise level at 11 to 12 noon). The stations with the highest noise level for 12 hours to 1 noon are station six with a reading of 65.9 dBA, followed by station 10 (58.8 dBA), station one (55.3 dBA), station nine (55.3 dBA), and station 5 (55.0 dBA). There are also medium-value stations, namely station 8 (53.1 dBA) and station 11 (52.3 dBA). Station seven (49.4 dBA), station three (48.5 dBA), station two (45.8), and station four recorded the lowest noise for the moment with a sound level of 45.2 dBA. At 1 to 2 noon. Next, station five (57.2 dBA), station 10 (56.9 dBA), station nine (56.5 dBA), station one (56.4 dBA) and station eight (55.0 dBA).

4.5. Spatial of Noise Values in the Afternoon

Figure (1d) shows the same situation for another time, which shows that station 6 has a high noise level. However, at the same time, the area near the main KSAJS field showed an increase in noise levels. Employee activities to return home are expected to impact this increase. Figure (1d) shows the room's noise level in the evening from 2 to 5 pm at KSAJS, UPSI. Station six recorded the highest noise level at 2 to 3 pm with a noise level of 64.8 dBA, followed by station nine (57.7 dBA), station 10 (56.1 dBA), station five (55.4 dBA), and station one (55.2 dBA). The low-level areas are station eight (54.6 dBA), station two (53.7 dBA), station three (51.9 dBA) and 11 (50.7 dBA). Station seven with a sound level of 49.8 dBA, and station four, which is the area that recorded the lowest noise at the moment with a reading of 45.3 dBA. Overall, on the day the study was conducted on 14 October 2019 at the KSAJS, the highest sound level successfully observed was at level 66.4 dBA at noon, 1 to 2 noon at station six. Station six is at the front intersection of Maybank. While the lowest noise level on the day of the study

was at station two, which is at the intersection in front of the museum, which took place in the morning, at 10 to 11 am with a sound level of 44.8 dBA.

5. Conclusion

Noise pollution is one of the environmental issues that need more attention now. This issue is not considered because this noise pollution is implicit and invisible to the naked eye. As such, this issue does not attract the attention of many parties. In contrast to other environmental pollution issues such as air pollution and water pollution. These issues are more of a concern for many parties because they can be seen with the naked eye. Also, the existence of relatively excessive noise pollution problems will pressure the local community's emotions and psychology and indirectly affect their productivity. Therefore, noise pollution is not an issue that can be taken lightly by any party. This issue is getting serious, especially in big cities or small towns. Noise problems that arise due to various factors also need to be taken seriously by certain parties to control and plan better so that any activities performed do not adversely affect the environment. Therefore, all parties should pay attention to noise pollution matters, especially noise pollution around the local area.

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Acknowledgment

The authors would like to thank the Universiti Pendidikan Sultan Idris (UPSI) and Deputy Vice-Chancellor (Academic and Internationalization) for funding this article publication.

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