Identifying Internet Content Risk for Children in Sabah using GIS

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Abstract

Safety risks to children because of internet and social media use are increasing, with exposure to sexual content seen as the greatest risk. United Nations International Children's Emergency Fund (UNICEF) studies show that risks vary by country and depend on a few factors, such as children's resilience, parental guidance, and support, as well as digital literacy (such as the ability to manage privacy settings). In Malaysia, statistical reports from government departments revealed that, sexual intercourse between unmarried young couples, being rude to parents, cyberbullying, skipping schools, smoking, drug abuse and others are becoming norms in the society. The fast development of information communication technology (ICT) was blamed for exposing negative influence on society. Therefore, this study developed an internet risk content model for children by integrating survey, statistics, and Geographic Information System (GIS). The study was based on four categories 4Cs model of online risk that can influence the children's resillience regarding online safety which consist of content risk, contact risk, conduct risk, and contract risk. Early findings show that the internet content risk among children can relate to geographical location as most of the risk are in the same area such as Sipitang and Kudat district. This can help the authorities to focus on that area to spread awareness regarding internet usage among children.

Keywords: Children, GIS, Internet Content, Risk, Sabah

1. Introduction

The usage of social media and the internet pose growing safety threats to youngsters, with exposure to sexual content being deemed to be the biggest concern. According to United Nations International Children's Emergency Fund (UNICEF) study, dangers differ from nation to nation and are influenced by a multitude of elements, including children's resilience, parental support and guidance, and digital literacy (including the capacity to adjust privacy settings). More than half of respondents to Plan International's State of the World 2020 report, which polled over 14,000 early teenage children and girls in 31 countries, reported experiencing online bullying, and one in four said they felt physically unsafe.

Parents and children aged 9 to 16 from 25 European nations participated in the European Union (EU) Kids Online survey. Of those kids, 55% agreed that there was stuff online that was bothersome. The most upsetting content was found to be pornographic material, which was followed by hate speech and violent content [1]. 14% of the participants reported having come across pictures on the internet that are "obviously sexual – for example, showing people having sex or people naked." But just 25% of respondents informed their parents, compared to 33% who told a friend [1]. Within the Malaysian context, content hazards arose from the availability of "prohibited content" (as defined by Sections 211 and 233 of the Communications and Multimedia Act 1998), which is deemed to be indecent, obscene, false, defamatory, offensive, and menacing. Under Malaysian law, these broad categories of "prohibited content" were deemed unlawful.

But given the breadth of the categories of "prohibited content," it is reasonable to wonder how Internet control ought to be implemented in the interest of safeguarding children.

Risks can also arise when children gain access to the internet before an infrastructure of awareness-raising, parental understanding, regulation, and safety protection is in place, as is the case in "high use, high risk" countries, or when children use the internet in a sophisticated, confident, or experimental manner. Therefore, even while there is no evidence to back up the widespread assumption that all children are at risk from the internet, there are still reasons to be concerned and take action. As more kids turned to internet contacts during the COVID-19 pandemic, the risk became more obvious.

2. Problem Statement

Malaysian children's exposure to content hazards is endangering our national values [2]. Previous research has shown that some of the effects of content hazards have actually had an impact on children and teenagers. For instance, Syed Shah Alam found that Malaysia's most compulsive Internet users were young adults. Their addiction to the Internet allowed them to access pornography, violent games, and online gambling [3]. They consequently engage with their family less frequently, waste money on internet gambling, shop excessively, and develop a sex addiction. The more time spent online, the more content risks children were exposed to [4]. In addition, societal issues were becoming increasingly prevalent among younger generations [5].

Based on the statistical reports from the government department, unmarried young couples having sex, rudeness towards parents, cyberbullying, skipping school, smoking, drug misuse, and other behaviors are becoming rampant in the society [6] and [7]. Since these acts violated the cultural, moral, and religious principles of Malaysian society, younger generations saw them as grave social evils. Negative influences on society were attributed to the rapid development of information communication technology (ICT) [8]. These results demonstrated that children are really at risk of harm from content dangers, both online and off. More importantly, there is little chance of the problems being resolved under Malaysia's self-regulation framework.

In Malaysia, the laws governing Internet content include the Content Code and the Communication Multimedia Act (CMA) 1998. They accept the framework for self-regulation because of CMA 1998 Section 124. Participating industry members can create their own self-regulatory codes, monitor compliance, create accreditation criteria, and voluntarily enforce them thanks to self-regulation. The industry maintains self-discipline by minimizing government intervention for the good of its own market. This isn't the case for Malaysia, though, as the government (via Malaysian Communications & Multimedia Commission (MCMC)) rigorously controls the country's Internet sector by enforcing the Content Code and CMA 1998. This is to make sure that service providers follow the rules that apply to the communication and multimedia sector so that, in keeping with Vision 2020, Malaysia may become a major center for ICT [9].

The self-regulation framework does not significantly lessen its exposure to youngsters, despite the mounting risks associated with the content. This is mostly due to the scheme's adoption of a non-censorship guarantee, which is based on Multimedia Super Corridor (MSC) Bill of Guarantee Part 7 and CMA 1998 Section 3(3). One may contend that the absence of censorship has strengthened self-regulation, which is essentially self-discipline. Nevertheless, non-censorship offers no proactive help in lowering the risks that children are exposed to when it comes to material. This demonstrates that even in the face of encouraging internet freedom, safeguarding kids from potentially harmful content is still essential.

As a result, the non-censorship guarantee's goal of encouraging self-discipline has not been accomplished. Instead, the Malaysian Internet business has chosen the "simple solution." There were no proactive efforts to create targeted policies to lower the hazards that children were exposed to in terms of content. Internet Service Providers (ISP) were therefore exempt from having to create any kind of categorization system that would have allowed them to group online material into age-appropriate categories. As of right now, Malaysian Censorship Board is the sole organization running a classification scheme specifically for movies [10]. Nevertheless, it does not include content that kids access online, including games, videos, and other media. Direct streaming of videos via the internet doesn't need classification or censorship. This creates further difficulties in preventing exposure to content hazards.

Thus, by combining GIS and survey, this study creates a model of internet danger material for kids. The four Cs of online risk—content, contact, conduct, and contract—that [11] identified as having the potential to affect children's awareness of online safety will serve as the foundation for the model. The survey results will then be processed and visualized using GIS and spatial analysis techniques like Local Indicators of Spatial Association (LISA).

3. Literature Study

According to the Organisation for Economic Co-operation and Development (OECD), access to dangerous, age-inappropriate, and unlawful online content gave rise to "content risks." Websites that provide violent, hateful, or sexual content undoubtedly fit this description. Additionally, self-harm, cyberbullying, sexting, meeting online contacts offline, and pornography are some other problems that children may face [12]. However, national interpretations and jurisdictional differences exist over what constitutes "illegal content" [13]. The internet risks were grouped into four categories. Content risk, contact risk, behavior risk, and contract risk [11]. The four categories (4Cs) of online risk to children that overlap with aggressive, sexual, values and commercial are summarized in Figure 1. An online risk has an aggressive, sexual, value-laden, and/or commercial nature, which leads to its intersectional. Examples are pornographic or violent videos (content risk), grooming (contact risk), cyberbullying behaviors (conduct risk), and commercial misuse of personal data (contract risk) [11]. Conversely, Figure 2 depicts the 4Cs concept of internet risk for children and youth. The content risks occurred from the digital content, which is through harmful online content such as pornography and violent content. While the contact and conduct are the risks from the communication platforms, such as mobile devices. Since the digital mobile devices can be connected with the internet in any location, the children can experience device addiction if not controlled. Lastly, the contract are risks produced directly from the digital providers. This means they can receive harmful effects physically from someone through any online platforms, including chat and messaging apps. One kind of risk is content risk, which arises when a youngster sees unwanted or unsuitable material. This can include websites that promote risky or unhealthy behaviors like self-harm, suicide, or anorexia; sexual, pornographic, and violent imagery; some types of advertising; and racist, discriminatory, or hate speech materials [15].

Risk	***Content*** Receiving mass-produced content	***Contact*** Participating in (adult- initiated) online activity	***Conduct*** Perpetrator or victim in peer- to-peer exchange	***Contract*** Exploited by potentially harmful contract
Aggressive	Violent/gory content	Harassment, stalking	Bullying, hostile peer activity	Identity theft, Fraud, scams, blackmail
Sexual	Pornographic content	'Grooming', sexual abuse or exploitation	Sexual harassment, 'sexting'	Sex trafficking, streaming child sexual abuse
Values	Racist/hateful content	Ideological persuasion	Potentially harmful user- generated content	Micro-targeting, dark patterns of persuasion or purchase
Commercial	Embedded marketing	Personal data misuse	Gambling, copyright infringement	-

Figure 1: The classifications of online risk to children [11]

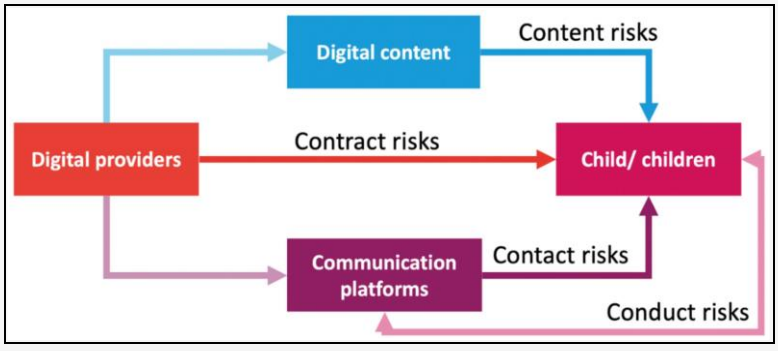


Figure 2: 4Cs model of online risk for children and youth [11] and [14]

While contact risks are a particular kind of risk that arises when a child engages in risky communication. Examples of this type of communication include when an adult approaches a child for sexual purposes or seeks inappropriate contact with them; or when a child is approached by someone who wants to radicalize them or convince them to engage in risky or unhealthy behaviors [15]. Next, a youngster who acts in a way that encourages potentially harmful information or contact is said to be posing a conduct risk. Children who write or create cruel messages about other children, encourage racism, or upload or distribute sexual images—including ones they have created themselves—may fall under this category [15]. Lastly, contract risks are those that arise from the exploitation of minors by potentially damaging commercial or contractual interests (gambling, age-inappropriate or exploitative marketing, etc.). Data processing that is automated (algorithmic) can mediate this. This includes the dangers associated with poorly thought out or unsecure digital services that expose the young person to fraud, identity theft, and other scams. Additionally, it covers agreements reached by other parties regarding the trafficking and streaming of child sexual assault [11].

For the purposes of importing, storing, analyzing, managing, exporting, and presenting spatially referenced data (data that is related to a location), Geographical Information System (GIS) functions as an information system [16]. A vast amount of geographic data has been produced to reflect the geographical nomenclature of the earth's surface due to technical advancements in automated data collecting in the GIS sector. Global positioning systems (GPS), high resolution remote sensors, location-aware services, surveys, and other heterogeneous disciplines provide GIS data. The aforementioned heterogeneous components connected to one another provided geo-reference spatially related datasets that were kept in a GIS database. These datasets provided spatial information about position, relationships with other components, and descriptions of nonspatial (attribute) properties. A dataset with a spatial location provides details on who, what, and where. GIS has become increasingly important in data mining and knowledge management analysis. For analysis and decision-making, it is a collection of position-related elements, including data, software, hardware, procedures, and methods [17].

Whether in tourism mapping [18], radio service distribution [19], disease detection [20], environmental effect [21], or climate change study [22], GIS has been used extensively for many studies. Therefore, in order to determine the distribution of internet risk among children in Sabah, this study used GIS with LISA as the spatial analysis method. However, before LISA can be applied, the spatial autocorrelation, or global Moran's I analysis need to be conducted. This it to investigate the presence of spatial autocorrelation and determine if clusters occur within the dataset. Spatial autocorrelation is also referred to as spatial dependence or spatial association, follows directly from [23] First Law of Geography, which stated "everything is related to everything else, but near things are more related than distant things". Consequently, these will inevitably be leading to spatial clusters among similar values in variable. Positive autocorrelation is said to occur when high or low values for a random variable tend to cluster in space. While a negative autocorrelation, occurs when locations tend to be surrounded by neighbours with very dissimilar values [24]. This test will describe the spatial pattern whether it is clustered, random or dispersed. The tool is calculated from (Equation 1).

$$I = \frac{n}{w} \frac{\sum_{i=1}^{n} \sum_{j=1}^{n} w_{ij}(x_i - \bar{x})(x_j - \bar{x})}{\sum_{i=1}^{n} (x_i - \bar{x})^2}$$

Equation 1

Where:

I = Moran's Index
n = the number of observations,
x_i = the value at location i
x_j = the value at location j
w = sum of the spatial weight matrix
w_{ij} = the spatial weights between observations
$\bar{x}$ = average of observed values

Local indicators of spatial association, or LISA an acronym created by [25] were used to conduct the geographical analysis for this study. LISA compares values at each given site to values in nearby locations in order to evaluate the null hypothesis of spatial randomness. Although there are a few LISA statistics that can be taken into consideration, a local version of Moran's I is very helpful since it enables the pattern of spatial connection to be divided into four groups [26]. Positive spatial association is implied by two of these categories, such as when a location's above-average value is surrounding by its neighbors' above-average values (high–high) or when a location's below-average value is surrounded by its neighbors' below-average values (low–low). In contrast, when a high (above average) value is surrounded by low neighbors, and vice versa, negative spatial connection is inferred for the other two categories. When both examples have significant matching LISA statistics, they are classified as spatial outliers. The following is the equation for local Moran's I (Equation 2).

$$I_i = z_i \sum_{j=1}^{n} w_{ij} z_j \qquad \text{for } i \neq j$$

Equation 2

Where: n is the number of regions; z_i and z_j are in standardized form of the attribute xi of interest, and w_{ij} is the element of ith row and jth column of the row standardized weight matrix, W.

The standardized, z_i, is given as in (Equation 3):

$$z_i = \frac{x_i - \bar{x}}{s_x}$$

Equation 3

Where: s_x is the standard deviation

4. Methodology

The area of this study is the state of Sabah in Malaysia as show in Figure 3. It is the second largest state in Malaysia and consists of 22 districts with the estimated population of 3.6 million [27]. Generally, there are few stages employed in the methodology to do this study. Figure 4 shows the flow chart of this methodology from the beginning until the end of this study. A Google Form was used for the survey, and some respondents were interviewed in person. The form can be found at https://forms.gle/e3fod4xZD STFPAtM8. The UMS-UNICEF research collaboration team provided the data, which was gathered between January and August of 2023. The 4Cs of online content risk—content, contact, behavior, and contract for aggressive, sexual, value, and commercial—are covered in 66 questions in the surveys. 841 respondents, representing every district in Sabah, were handed the questionnaires. The selected respondents used in this study consists of children within the age range of 7-18 years old. The number of respondents is varies depending on the size of the population in each of the 22 districts of Sabah. The minimum number of respondents is 25 for the district of Keningau, Sipitang, Kinabatangan, Tambunan and Tenom which is consider the rural district of Sabah. While the highest number of respondents is 112 for the district of Tawau, Tua ran and Kota Kinabalu that represent the urban district of Sabah. All the survey forms were distributed at the places in which the internet coverage is good. This is based on the information from Malaysian Communications and Multimedia Commission (MCMC) which provide us the location that have good internet access in each district. This can be found in their website at https://jendela.my/map/?network-coverage=show.

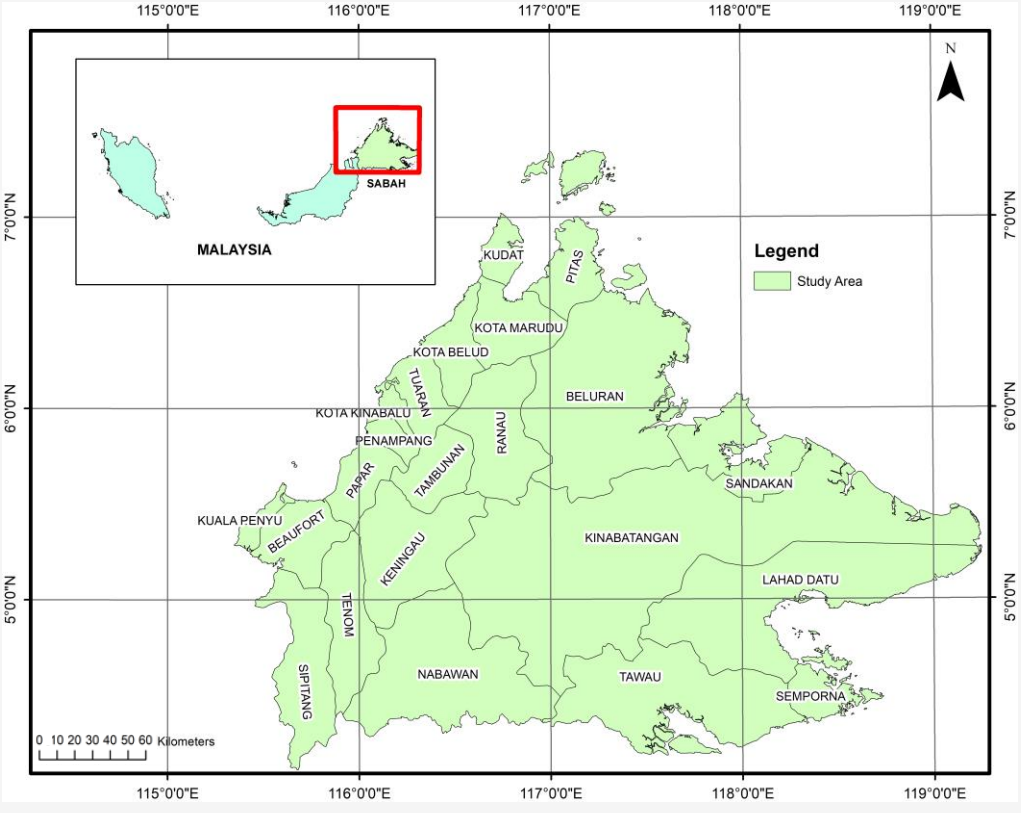


Figure 3: Study area of Sabah, Malaysia

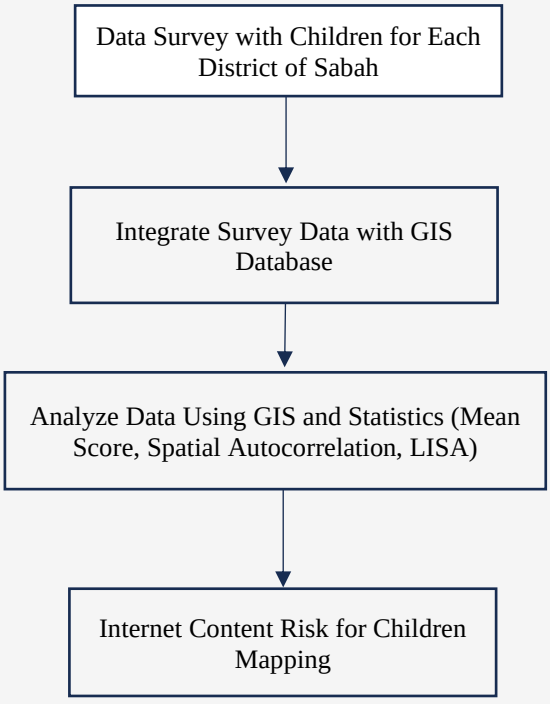


Figure 4: Study workflow

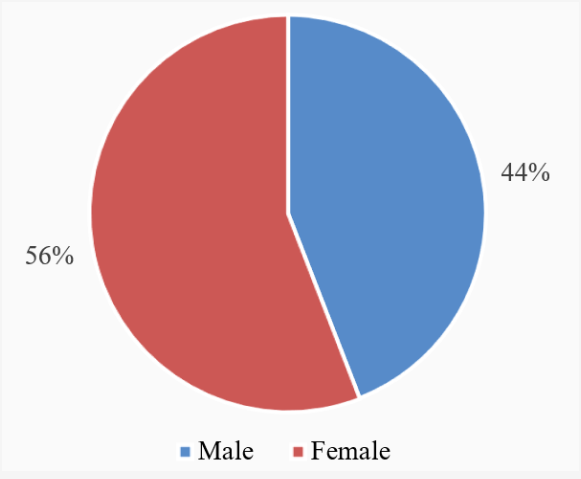


Figure 5: The percentage of respondent's gender

Figure 5 shows the percentage gender of the respondent in which 56% out 841 respondents are female while 44% are male. For the age group as shown in Figure 6, most of the respondents come from the age group of 16-18 years old with 38%, while the age group of 10-12 years old are the second highest with 34%. The age group of 7-9 years old are the least with 7%. In terms of education level, Figure 7 shows that the secondary school level is the highest with 60% while it is 40% for the primary school level. Since the sample size used for this research represents 30% of the relevant selected target's entire population, hence it is suitable [28]. The survey forms divided into 7 sections (A-G). These sections referring to respondent's background, exposure to the internet, digital literacy skill, aggressive internet content risk, sexual internet content risk, values internet content risk and commercial internet content risk. The details of the survey forms can be found at https://forms.gle/e3fod4xZDSTFPAtM8. Therefore, all the information obtained from the survey is valid and can be used for this study.

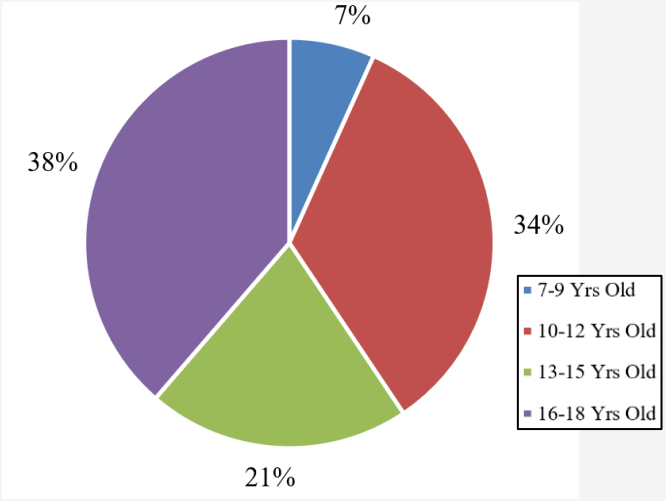


Figure 6: The percentage of respondent's age

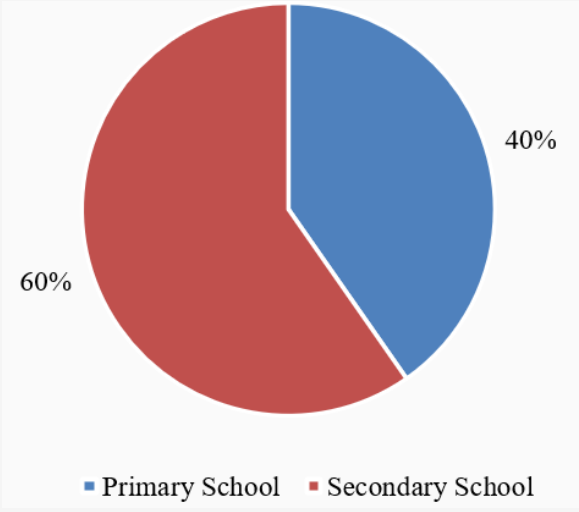
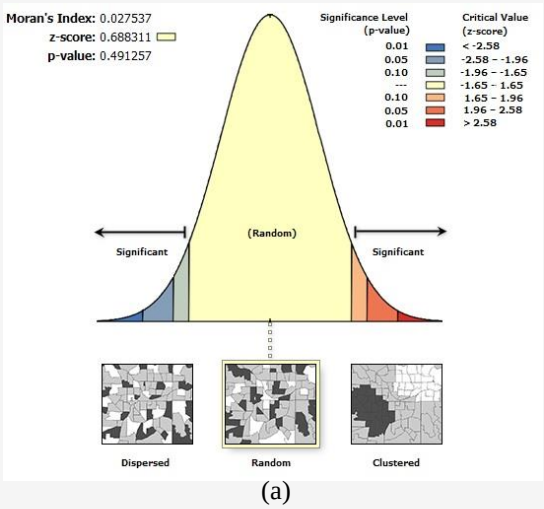


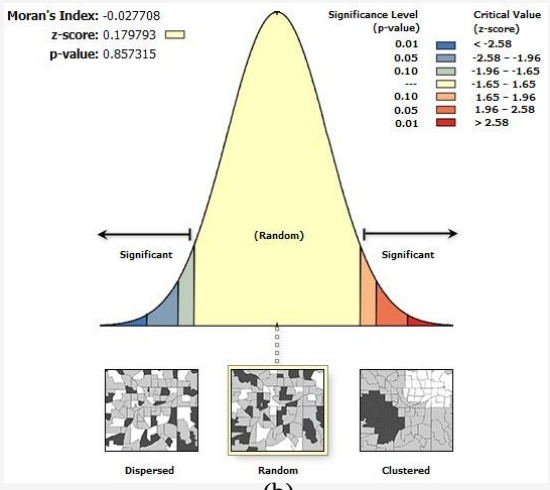
Figure 7: The percentage of respondent's educational level

Most of the survey's multiple-choice questions used an ordinal scale, where the response was represented by a number. For instance, "most agree" was denoted by the greatest number of 5, while "most disagree" was denoted by the number 1. For this study, the spatial analysis employed was local spatial autocorrelation, or LISA. Nonetheless, a few of the multiple-choice items have nominal scale answers (yes and no), which are assessed by frequency or descriptive analysis.

Preliminary, global Moran's I was conducted first before LISA can be used to determine the spatial pattern of the dataset. The Moran's I result of aggressive, sexual, values and commercial dataset are shown in Figure 8 below. Based on the output in Figure 8, the pattern in Moran's I analysis shows that the internet risk in terms of aggressive, sexual and commercial for children indicate a random pattern among the dataset with (z-score=0.688, p-value=0.49), (z-score=0.180, p-value=0.86) and (z-score=0.420, p-value=0.67) respectively. While the values risk shows a clustered pattern with z-score=1.835 and p-value=0.07. Following this, the average data or mean score for each area was computed. GIS analysis can be carried out after the data has been verified and cleansed.



(a)



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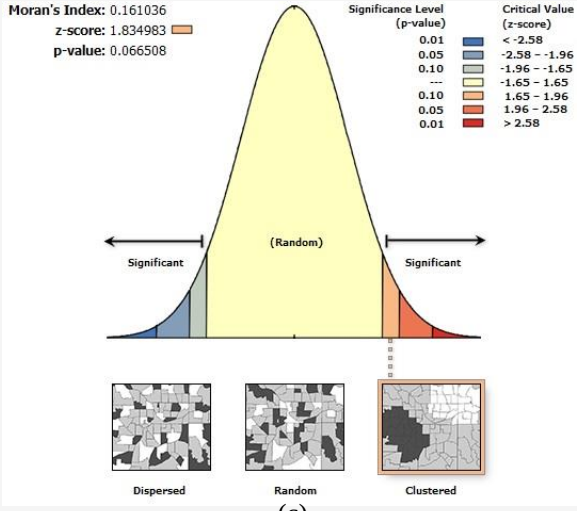
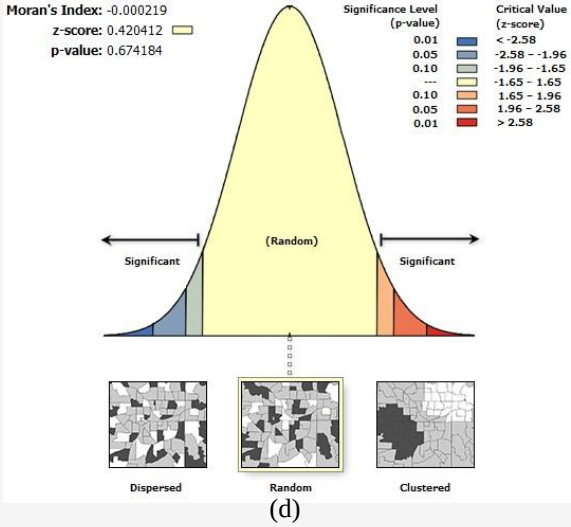


(c)



(d)

Figure 8: Moran's I result from top to bottom
(a) Aggressive, (b) Sexual, (c) Values and (d) Commercial

5. Analysis

This study uses the mean score to examine the data and determine the respondents' direction of response. Next, using GIS, the result of the mean score is converted into a spatial display. This study used spatial analysis, specifically GIS classification and LISA, to display the distribution of internet content danger for children in Sabah. The mean score output is shown in Figure 9. Figure 9(a) shows that the Sipitang district has a high mean score for aggressive content risk, while Pitas has a low level and Kudat, Papar, Keningau, and Tenom have an intermediate level of risk. Sipitang district was identified in Figure 9(b) as the primary high-risk area for sexual activity, followed by Kudat at the middle level and Kinabatangan at the lowest level.

Figure 9(c) shows that there are no high-level risks of value in any district in Sabah, but rather moderate level risks in districts like Papar, Keningau, Tenom, and Sipitang, and the lowest level risk in Pitas. The districts of Pitas, Kota Marudu, Penampang, Tambunan, and Kinabatangan have the lowest levels of commercial risk, while Sipitang and Kudat districts have the highest levels, with Keningau in the center (Figure 9(d)). Subsequently, the LISA analysis displays comparable results for sexual, aggressive, and commercial risk. Kudat generated the High-Low (HL) outlier (Figure 10), indicating that the region indicates a high-risk value but is largely surrounded by low values.

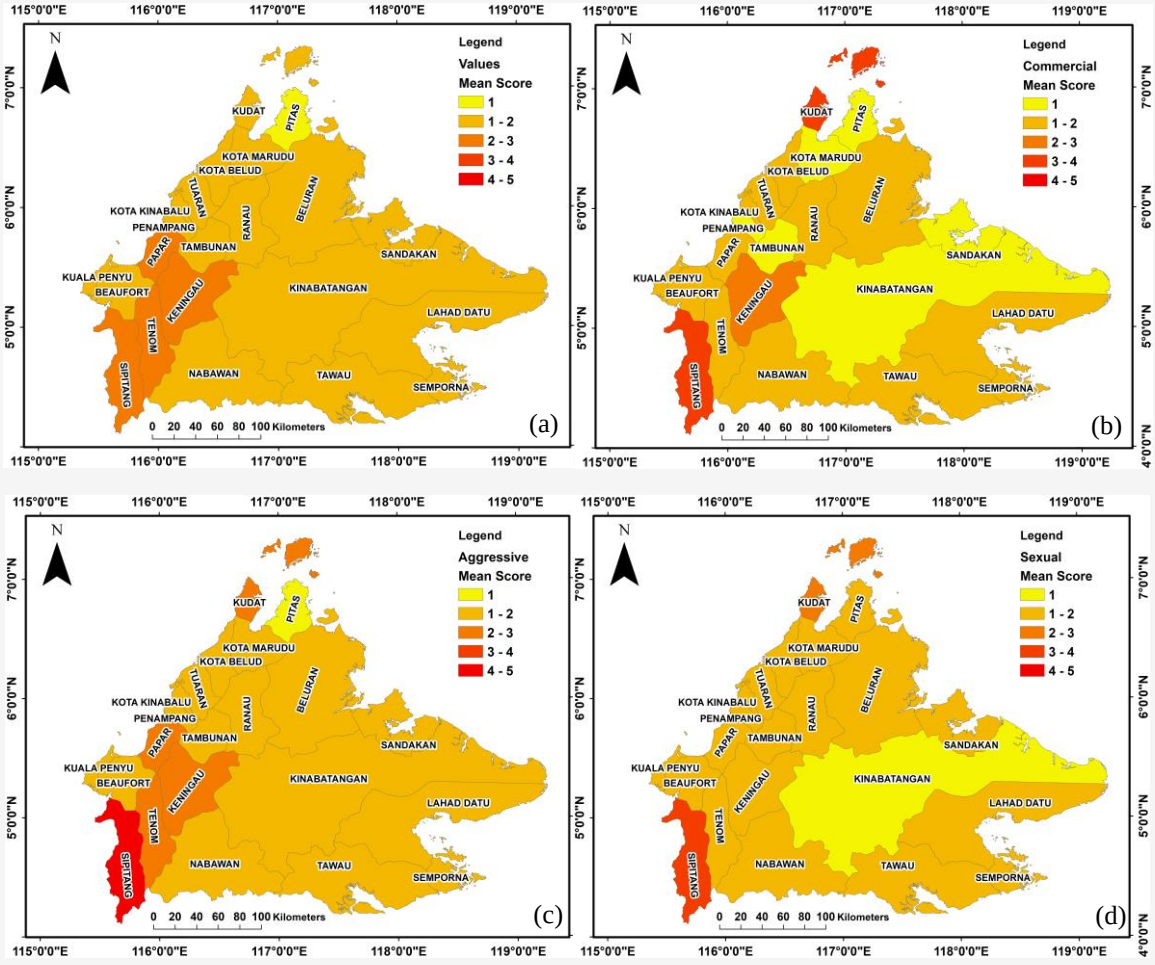


Figure 9: Mean scores map of internet content risk for children
(a) Aggressive, (b) Sexual, (c) Values, (d) Commercial

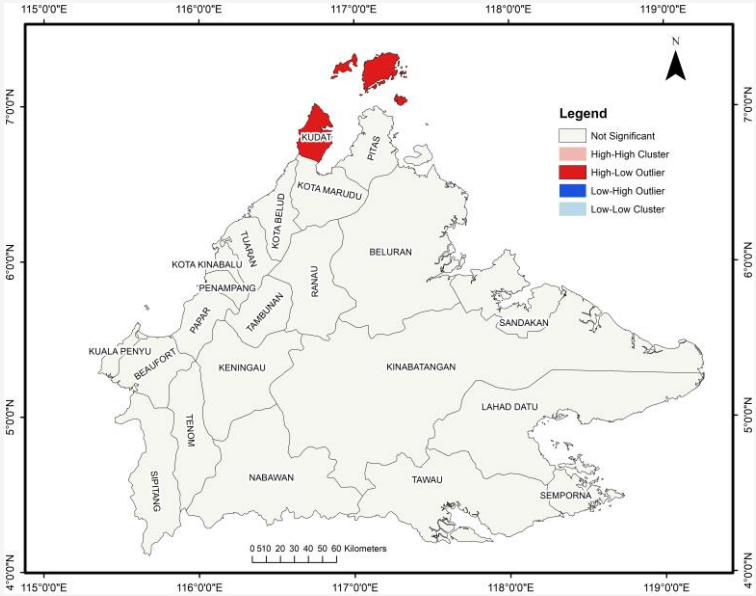


Figure 10: LISA for aggressive, sexual and commercial

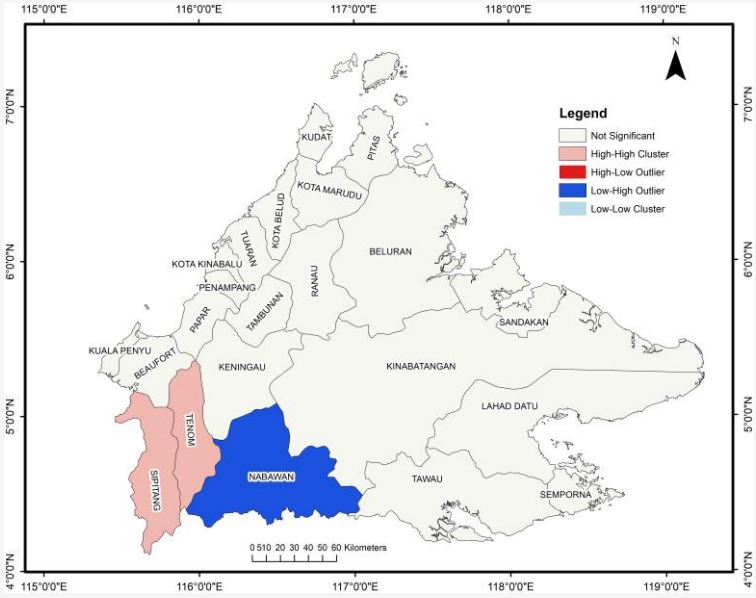


Figure 11: LISA for values

The results for the Value risk (Figure 11) are different. For Tenom and Sipitang districts, LISA displays High-High (HH) clusters, indicating that the area is significantly high clustered, while Nabawan produces Low-High (LH) outliers, indicating that the area indicates a low-risk value but is primarily surrounded by high values. The output of LISA clearly reflects the outcome from the Moran's I in which only the value risk shows some differences than the other risk due to the clustered pattern exhibit in Moran's I. The reason of this pattern will be outline in the discussion below.

6. Discussion

Based on the output, the district of Sipitang and Kudat indicate high risk level for most of the internet contents. For the case of local differences, Kudat, Sipitang, Tenom and Nabawan shows significant differences with their nearest surrounding districts. Although the internet coverage for all the areas is the same, but there seems to be a difference in terms of awareness in internet usage. Based on the discussion with the Malaysian Communications & Multimedia Commission (MCMC) authorities, the high-risk level most probably occurred due to lack of awareness among the children in the affected area. The MCMC authorities gives further explanation that during the Movement Control Order (MCO) in year 2020 and at that time most of the school students study online, the MCMC need to provide the internet service very fast especially in the rural area. Hence, most of the internet stations were setup hastily and unable to provide awareness campaign to all the districts due to the strict MCO regulation as that time. This explains why the local differences occurred in some districts especially in Kudat and Sipitang districts. The MCMC unable to do an awareness programme in that district and this cause the parents and children in that area do not know how to use the internet properly as they lack exposure and knowledge to it.

Consequently, most children in that area use the internet without proper supervision and guidance as they were not aware of the danger when surfing the internet in some website content. This statement is also supported by a report in which some children in Malaysia lack awareness on how to use the internet or do online activities properly [29]. In addition to that, they are also not aware of how to report to the authority regarding the cyberbullying and sexual risk that they are facing.

7. Conclusion

The result shows that the response can be seen clearly if analyze based on geography factor and mapped using GIS. Further analysis needs to be conducted by cross relationship with other parameters such as demography, income, and media social usage to display more information. Spatial modelling may also be useful for further analysis as it can provide more explanation regarding the level of risk for each internet content in the area. The outcome of this study can help the authorities to focus or identify which location or area that need to be spread awareness for internet usage and at the same time can also help the policy maker in making their decision in terms of rules and regulation specifically for internet usage.

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