

The Use of Digital Intelligence and Association Analysis with Data Mining Methods to Determine the Factors Affecting Digital Safety Among Thai Adolescents

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This research study seeks to provide an analysis of the factors which affect the digital safety of adolescents in Thailand. This study is undertaken in the context of digital intelligence, as well as to create a model of those factors using association analysis with a data mining approach. The input factors were assessed from an expert perspective. The creation of the model relied upon a process of data mining, which was comprised of four stages: data cleaning, integration, selection, and transformation. A total of 19,877 participants provided data for the study. In the model describing the factors affecting digital safety among adolescents in Thailand by using digital intelligence, the study findings revealed that correct classifications were made in 87.5 per cent of cases, while the remaining 12.5 per cent were incorrectly identified. The output units therefore had an accuracy of 0.87, recall of 0.875, and precision of 0.875. Meanwhile, the F-measure was recorded as 0.872. The model could then be employed with additional participants beyond those in the initial training set. Given that research studies in the social sciences seek to achieve correct classification rates in excess of 80 per cent, the accuracy level of 82 per cent was deemed acceptable for data mining.

Keywords: *Data mining, Decision tree, Digital intelligence, Digital safety, Psychology.*



Introduction

Digital Intelligence (DQ) can be defined as the cumulative measure of the cognitive, intellectual, emotional, and social capabilities which support individuals as they navigate the obstacles of the digital world. One important aspect of digital intelligence is digital safety, in the form of online risk management to counter the threats of deception, cyberbullying or damaging online content (Gilberto & Joanna, 2019). It is necessary for digital citizens to understand these concepts and online dangers by focussing on digital safety, just as privacy or security would be concerns in the real world (Mastur et al., 2020). Digital citizens must take measures to protect themselves from online threats, such as cybercrime, cyberstalking, cyberbullying, violent or sexually explicit content, or content which promotes hatred (Kurniawan Dwi Madyo et al., 2020). In Thailand, for example, cyberbullying is believed to be a significant cause of physical violence.

Adolescents can be classed as behaviourally problematic for Thai society because of the conflicts which arise in their families. Violence is relatively common in society in the form of crime, assaults, rioting or even terrorism, and these examples can lead to people behaving in an antisocial manner (Somrongthong et al., 2012). The Ministry of Digital Economy and Society reports that some adolescents have been observed to use online media for the purpose of humiliating or causing insecurity in others through their use of words or images, and also note that it is difficult to correct this behaviour. There are two main objectives in this study. The first is to perform an analysis of the factors which affect the digital safety of adolescents in Thailand, in the context of digital intelligence. Meanwhile, the second is to create a model which can describe the factors involved through the use of digital intelligence and association analysis combined with a data mining approach. The study will therefore demonstrate the links between personality, and personal attributes, and the other factors which influence Thai society, with the goal of determining an appropriate strategy to develop improved digital safety.

Research Ethics

The author participated in ethics training for research involving human subjects conducted by the National Research Council of Thailand (NRCT), and the Forum for Ethical Review Committees in Thailand (FERCIT). The course was completed on 14 May 2020 and was authorised by the Secretary-General of the National Research Council of Thailand (National Research Council of Thailand, 2020).



Research Objective

This research study seeks to provide an analysis of the factors which affect digital safety for adolescents in Thailand, in the context of digital intelligence, as well as creating a model of those factors using association analysis with a data mining approach.

Methodology

The method used to carry out this research study is described and explained, as follows:

The literature covering digital intelligence defines the quotient as “a comprehensive set of technical, cognitive, meta-cognitive, and socio-emotional competencies that are grounded in universal moral values and that enable the individuals to face the challenges and harness the opportunities of digital life” (DQ Institute, 2020). According to the DQ Institute, digital intelligence goes beyond simply developing the skills to use technology, and an awareness of the dangers faced by young people online and extends to cover every aspect of an individual’s digital existence. This encompasses the social and personal aspects of an individual’s use of technology, as well as their practical capabilities in using technology to facilitate daily living, and to mitigate the various security threats they face in the digital age (Digital Intelligence Quotient Institute, 2020).

In the modern world, the digital intelligence quotient is vital due to the abundance of technology. A failure to develop the skills and knowledge required to thrive in such a technology-driven environment would lead to individuals being excluded from much of modern-day life. The development of a strong digital intelligence quotient, which can be both measured and easily learned, must therefore, begin early in childhood (Raschke, 2003).

The digital intelligence quotient combines the intellectual, cognitive, emotional, and social capabilities which allow people to surmount the challenges they face within the digital world. It is a form of intelligence developed through human interaction with IT, and it can be argued that a better understanding of digital intelligence will shape the development of twenty-first century learning and teaching, and pervade every aspect of people’s lives and careers (Bulusu, 2012).

In a business setting, digital intelligence is the name given to describe information acquired via technology, as well as the use of that information through online marketing approaches. It is also a term which covers cyber security, and the role of the global commission in the context of internet governance. In this study, the digital intelligence quotient measures the human capacity for mixing knowledge itself with the method of knowing, and the capacity for effective interaction within community settings (Andriole, 2008).

Digital intelligence can be subdivided to encompass eight components: digital identity, digital use, digital security, digital safety, digital emotional intelligence, digital literacy, digital communication, and digital rights (Wannapiroon & Wattananaiya, 2017).

The improvement of people's digital intelligence quotient around the world is the aim of the Coalition for Digital Intelligence, which is a network comprising numerous related organisations across different sectors, and which can collaborate in both education and technology. Its foundation was the work of the Organization for Economic Cooperation and Development (OECD), in cooperation with the IEEE Standards Association, and the DQ Institute. Furthermore, it was launched with the support of the World Economic Forum in September 2018 (World Economic Forum, 2020).

The aim of this coalition has been to create a global framework, which is based on a common understanding of the language and definitions of the key aspects of digital literacy, along with an understanding of the skills which will be required of stakeholders around the world. Those parties most significantly affected due to the importance of their roles will be governments, technology businesses and providers, and educators (Pollard & Anzaldua, 2008).

Such a framework will require the endorsement of the relevant institutional stakeholders around the globe, with the agencies responsible for benchmarking standards most likely to play a key role. This would benefit all those working in the educational or technological fields by providing a single systematic framework with common standards towards which everyone can work cooperatively. This will provide synergy in problem solving through encouraging cooperation between and within different sectors, which are located across different industries (Digital Intelligence Quotient Institute, 2020).

Review of Earlier Works on Digital Safety

Mary (2017) reported that the main factors affecting digital safety include low levels of remorse and conscience, the need for excitement, recklessness in performing actions, no sense of life purpose, and having carried out harmful acts against young people. The Ministry of Digital Economy and Society (2017) notes that such individuals have a form of psychosis, which drives them to use online media for the purpose of harming others via their words or images. It is argued that these traits cannot easily be resolved to alter the behaviour. The traits that most commonly lead to the kind of online behaviour that is harmful to others includes low levels of empathy and remorse, boldness and a lack of inhibition, and egotism.

One vital consideration when examining the causes of psychosis was the type of variables which affect personality, and thus, lead to psychosis among Thai adolescents, when taking

into account the context of digital intelligence. A number of researchers have commented on these variables.

The variables pertaining to personality were described by Sorarak (2015) as gender, year of study, study grade point average (GPA), birth order, education of parents, and mean income of the family.

According to Sanguansap (2001), the variables determining personality were age, year of study, study GPA, number of brothers and sisters, birth order, religion, occupations of parents, congenital diseases, mean income of the family, accommodation during study, income obtained from parents, and the qualities of the school from which they graduated. Meanwhile, Lertrusdachakul (2015) observed that the variables affecting personality were gender, age, area of study, and the faculty they attended.

Chusai (2013) reported the relevant variables as gender, area of study, study GPA, accommodation during study, style of parenting, and funding of their studies. According to Noiraksa (2005), the variables included gender and age, marital status of the parents, education level of the parents, and the people in the household during childhood. Finally, Raicharoen (1996) listed the variables of gender and age along with the number of brothers and sisters, birth order, home country, education of the parents, occupation of the parents, and the mean level of family income.

Criteria Determining the Selection of Experts for Factor Analysis

A total of eleven experts were chosen to support the study through the provision of expert guidance. All had completed a relevant master's degree and had been working in the area of psychology for at least ten years.

Conclusions Regarding the Influential Factors Governing Digital Safety

A questionnaire was created for the purpose of gathering information from the experts, who were chosen to support the study. Their views of digital safety, which were also obtained via informal interviews, could then be combined for further analysis. This allowed the factors which affect digital safety among adolescents in Thailand to be determined. A total of 26 variables were reported by the experts, and these could be classified in three categories, as shown below:

1. *Personal data*: there were 17 variables which associated personal data with digital safety. These were age, gender, year of study, study GPA, the faculty attended, the subject studied, number of brothers or sisters, religion, birth order, home country,

style of parenting, mother's education, father's education, mother's occupation, father's occupation, mean income of the family, and the amount of money received from parents.

2. *Digital intelligence*: there were eight factors associating digital intelligence with digital safety. These factors were low levels of remorse, low levels of empathy, boldness, lack of inhibition, egotism, need for excitement, weak sense of life purpose, and harmful acts committed against young people.
3. *Tendency towards digital safety*: the final factor was related to the tendency towards digital safety and reported whether the participant had used online media for the purpose of hurting others through their words or images.

Development of the Questionnaire to Gather Data on the Factors Affecting Digital Safety in Adolescents in Thailand

A questionnaire was created covering each of the three fields and comprised 26 items, which addressed the 26 variables previously listed. For instance, the question on gender provided two answer options: male or female. The question on religion allowed for the respondent to choose among Buddhism, Islam, Christianity or 'other'. For questions related to the frequency of factors related to digital safety, the options included 'never', 'rarely', 'sometimes', 'frequently' or 'usually'. For the issue of digital safety tendencies, the options were limited to 'never' or 'once'.

Data Gathering

Random sampling was used to distribute the questionnaire via social networks to a total of 20,455 adolescents aged 16–25 in Thailand (Piromkul 2005). From these, 19,877 respondents who met the criteria for inclusion provided the data. These participants were then further subdivided into two groups of 9,642, and 10,235 people, depending upon whether they had never used online media to cause harm to others or whether they had, respectively.

Data Validation via Data Mining Techniques

There are four steps involved as follows:

1. *Data cleaning*: serves to remove any information which is not relevant to the matter at hand. In this study, the form can be completed using a drop-down menu, and therefore, errors cannot occur, so this step can be omitted.
2. *Data integration*: takes information from several different sources and then combines it into a single coherent location. In this study, integration involved

merging the data from the 9,642 participants who had never used online media to hurt others through their words or images, with the data from the 10,235 participants who did report using online media for damaging purposes. These data were merged to form a single database containing the information of 19,877 participants.

3. *Data selection:* involves choosing a suitable source and type of data to serve as the input for data mining. A consistent database was created in order to develop the model to assess the factors which affect the digital safety of Thai adolescents.
4. *Data transformation:* requires that raw data which appears in the English language form can be converted into the comma separated values (CSV) form, in order to use the data in Weka software.

Having completed the four steps mentioned, the researchers then deemed the database to be ready for further analysis. The data from 19,877 participants were included. These participants were further divided in an acceptable ratio of 1:1.06, such that 9,642 people had never used online media for the purpose of causing harm or insecurity to others through the use of words or images, while 10,235 people did report having used online media for these antisocial purposes (Ghavami, 2019).

Combining Association Analysis with a Data Mining Approach

1. The database was first divided into two groups. The first was a training set comprising 15,902 items of data, and the second was a test set comprising 3,975 data items. The principle of self-consistency was employed in creating the two groups in an 80:20 ratio.
2. The data mining approach employed a decision tree using Weka software in order to categorise the factors which affect the digital safety of adolescents in Thailand.
3. An evaluation of the factor categorisation from step two was then carried out using the values obtained for accuracy, recall, precision, and F-measure.

Analysis of the Factors Affecting the Digital Safety among Adolescents in Thailand

It was possible to categorise the relevant factors, which comprised 26 variables, into three different fields, which are explained, as follows:

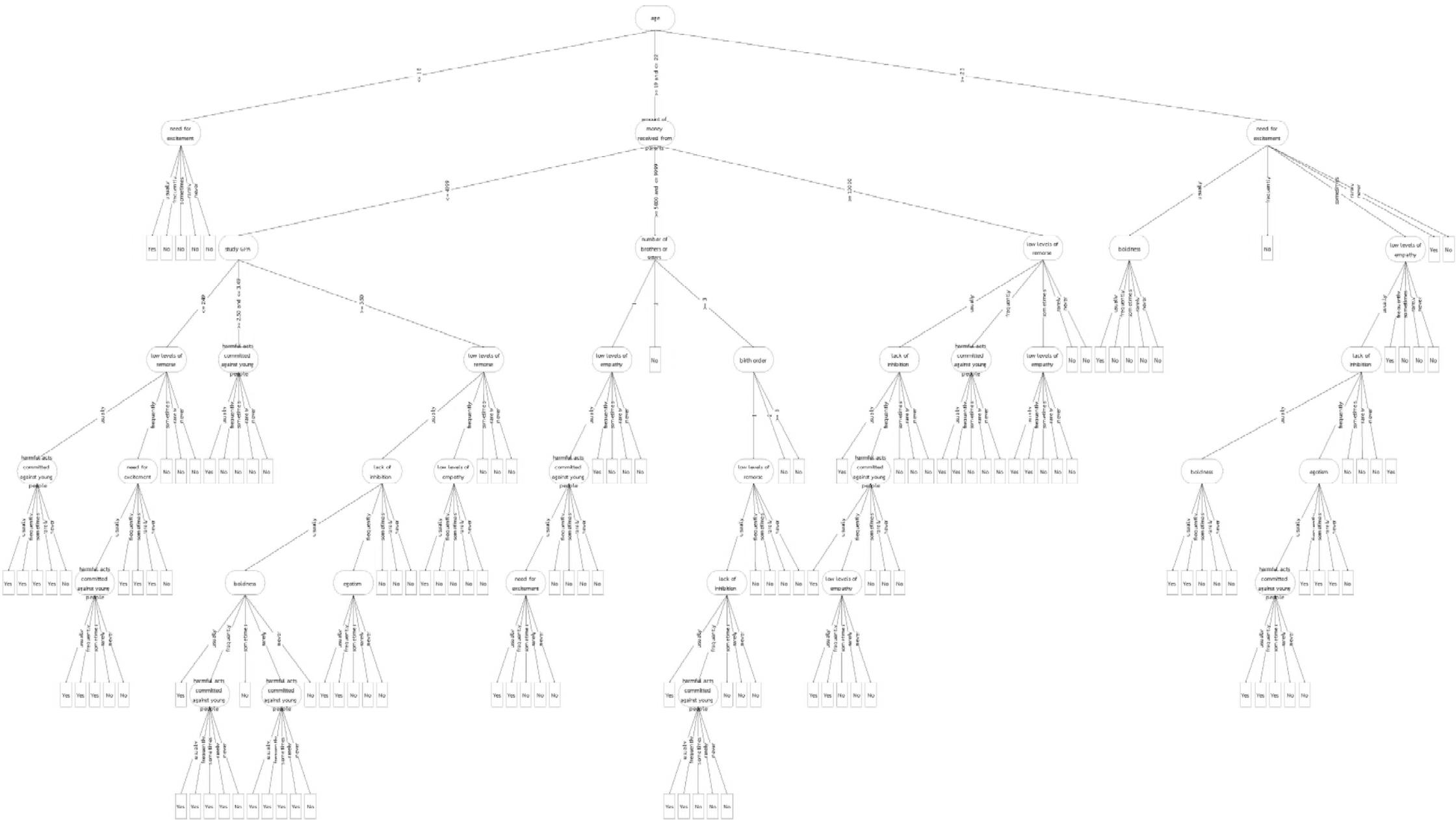
1. There were 17 variables which associated personal data with digital safety. These were age, gender, year of study, study GPA, the faculty attended, the subject studied, number of brothers or sisters, religion, birth order, home

- country, style of parenting, mother's education, father's education, mother's occupation, father's occupation, mean income of the family, and the amount of money received from parents.
2. There were eight factors associating digital intelligence with digital safety. These factors were low levels of remorse, low levels of empathy, boldness, lack of inhibition, egotism, need for excitement, weak sense of life purpose, and harmful acts committed against young people.
 3. The final factor was related to the tendency towards digital safety and reported whether the participant had used online media for the purpose of hurting others through their words or images.

Development of the Model using Factors Affecting Digital Safety among Adolescents in Thailand

Figure 1 shows the model which was developed in order to analyse the factors which affect digital safety among adolescents in Thailand.

Figure 1. Model of factors affecting digital safety among adolescents in Thailand



An example of an algorithm, which can be employed for the modelling of factors which affect digital safety among adolescents in Thailand, is also presented, as follows:

age \leq 18

| need for excitement = usually: yes
| need for excitement = frequently: no
| need for excitement = sometimes: no
| need for excitement = rarely: no
| need for excitement = never: no

age \geq 19 and \leq 22

| amount of money received from parents \leq 4,999
| | study GPA \leq 2.49
| | | low levels of remorse = usually
| | | | harmful acts committed against young people = usually: yes
| | | | harmful acts committed against young people = frequently: yes
| | | | harmful acts committed against young people = sometimes: yes
| | | | harmful acts committed against young people = rarely: yes
| | | | harmful acts committed against young people = never: no
| | | low levels of remorse = frequently
| | | | need for excitement = usually
| | | | | harmful acts committed against young people = usually: yes
| | | | | harmful acts committed against young people = frequently:

yes

| | | | | harmful acts committed against young people = sometimes:

yes

| | | | | harmful acts committed against young people = rarely: no
| | | | | harmful acts committed against young people = never: no
| | | | need for excitement = frequently: yes
| | | | need for excitement = sometimes: yes
| | | | need for excitement = rarely: yes
| | | | need for excitement = never: no
| | | low levels of remorse = sometimes: no
| | | low levels of remorse = rarely: no
| | | low levels of remorse = never: no
| | | study GPA \geq 2.50 and \leq 3.49
| | | harmful acts committed against young people = usually: yes
| | | harmful acts committed against young people = frequently: no
| | | harmful acts committed against young people = sometimes: no
| | | harmful acts committed against young people = rarely: no
| | | harmful acts committed against young people = never: no



				study GPA ≥ 3.50
				low levels of remorse = usually
				lack of inhibition = usually
				boldness = usually: yes
				boldness = frequently
				harmful acts committed against young people = usually:
yes				
				harmful acts committed against young people =
frequently: yes				
				harmful acts committed against young people =
sometimes: yes				
				harmful acts committed against young people = rarely:
yes				
				harmful acts committed against young people = never: no
				boldness = sometimes: no
				boldness = rarely
				harmful acts committed against young people = usually:
yes				
				harmful acts committed against young people =
frequently: yes				
				harmful acts committed against young people =
sometimes: yes				
				harmful acts committed against young people = rarely:
yes				
				harmful acts committed against young people = never: no
				boldness = never: no
				lack of inhibition = frequently
				egotism = usually: yes
				egotism = frequently: yes
				egotism = sometimes: no
				egotism = rarely: no
				egotism = never: no
				lack of inhibition = sometimes: no
				lack of inhibition = rarely: no
				lack of inhibition = never: no
				low levels of remorse = frequently
				low levels of empathy = usually: yes
				low levels of empathy = frequently: no
				low levels of empathy = sometimes: no
				low levels of empathy = rarely: no

| | | low levels of empathy = sometimes: no
| | | low levels of remorse = sometimes: no
| | | low levels of remorse = rarely: no
| | | low levels of remorse = never: no
| amount of money received from parents $\geq 5,000$ and $\leq 9,999$
| number of brothers or sisters = 1
| | | low levels of empathy = usually
| | | | harmful acts committed against young people = usually
| | | | need for excitement = usually: yes
etc.

Conclusion

Regarding the model describing the factors affecting the digital safety among adolescents in Thailand by using digital intelligence, the study findings revealed that correct classifications were made in 87.5 per cent of cases, while the remaining 12.5 per cent were incorrectly identified. The output units therefore had an accuracy of 0.87, recall of 0.875, and precision of 0.875, while the F-measure was recorded as 0.872. The model could then be employed with additional participants beyond those in the initial training set.

On the basis of the model, which presents the various factors that affect the digital safety among adolescents in Thailand — as observed in Figure 1 — by using the decision tree, it can be concluded that age is the most influential factor. Therefore, those respondents aged 18 or under who reported ‘usually’ having a need for excitement, would be significantly at risk of developing poor digital safety. Meanwhile, those aged 18 and under who reported ‘frequently’, ‘sometimes’, ‘rarely’ or ‘never’ having a need for excitement, were not at risk of developing poor digital safety. For those respondents aged 19–22 years old who received a monthly income from their parents, which did not exceed 4,999 baht, the most influential factor was study GPA. For those in the same 19–22 age group, who received 5,000–9,999 baht per month, the most important factor was the number of brothers and sisters. For those in the 19–22 age group who received more than 10,000 baht per month, a lack of guilt was considered the most influential factor. This analysis was then extended to cover all of the various factors, in order to reach a suitable conclusion for digital safety risk.

Discussion

The findings from this study concerning the factors affecting digital safety were similar to those reported in an earlier investigation, “The Study of Violence in Television Drama: Case Study of Lar 2017”, which listed family occupation, and low incomes levels as an incentive for crime, and hometown or birthplace as the key factors which affect behaviour patterns



(Kamoltham, 2018). Thus, the study findings revealed that correct classifications were made in 87.5 per cent of cases, while the remaining 12.5 per cent were incorrectly identified. The output units therefore had an accuracy of 0.87, recall of 0.875, and precision of 0.875, while the F-measure was recorded as 0.872. The model could then be employed with additional participants beyond those in the initial training set. Given that research studies in the social sciences seek to achieve correct classification rates in excess of 80 per cent, the accuracy level of 82 per cent, and the error rate of 18 per cent were deemed acceptable for data mining.

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