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Students' Acceptance of Drones Using the Knowledge, Attitudes, and Practice (KAP) Model

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ABSTRACT

Currently, drones are used for commercial, public safety, recreational, and scientific research purposes. Both short-term and long-term projections indicate the extensive adoption of drones in numerous industries. However, it is uncertain whether future generations will tolerate this high potential for drone congestion. This quantitative survey study investigated students' approval of drones by employing the Knowledge, Attitude, and Practise (KAP) model and reducing uncertainty with statistical analysis. A recent survey utilised the KAP model to determine the public's perception of drones. This survey instrument was completely redesigned to better comprehend students' knowledge, attitudes, and risk perceptions regarding forty distinct drone applications. The practise section was also redesigned to better comprehend how students use drones on a personal and academic level. The results indicated that drones are currently approved. Commercial and recreational uses are not permitted. Students view drones as a potentially dangerous technology that directly invades their privacy. Furthermore, students are unaware of the majority of prospective and current drone applications. The survey was disseminated to college and high school students to represent the younger generation of the population (113 completed surveys). Additionally, students must be informed about these strategies via the media and educational institutions. This may assist in transforming the perception of drones from destroying machines and privacy invaders to a technology beneficial to society.

Keywords: Drones; knowledge; attitudes; practice; perceptions

INTRODUCTION

Emerging technologies have the potential to significantly impact our lives and transform various sectors, especially with the combination of advanced hardware and software that enable new capabilities and applications. One such emerging technology is unmanned aerial vehicles (UAVs), commonly known as drones. A drone is an aircraft or submarine operated remotely without a human pilot (Kang et al., 2015; Henriksen et al., 2015). Drone is the most common term, but various other terms are being used interchangeably, such as Unmanned Aerial Vehicle (UAV) when used on land, Unmanned Aircraft System (UAS) when operated on air, and Unmanned Under-Water Vehicle (UUV) when employed underwater (Sattar et al., 2017). The term drone is used throughout this paper due to its familiarity as a common understandable term for the public. The use of drones has significantly increased across a variety of applications over the past few years due to their versatility, efficiency, and ease of use (Mohsan et al., 2023). This is due to the rapid advancement in the design and production of inexpensive and dependable UAVs and the growing demand for the utilization of such platforms, particularly in civil applications. Drones are equipped with advanced sensors, cameras, and GPS technology that enable them to perform a wide range of tasks with precision and accuracy. Thus, drones have found applications in various sectors, including precision agriculture monitoring, photography, filmmaking, delivery services, search and rescue, remote sensing and even military operations (Ghazali et al., 2022; Ghamari et al., 2022; Butcher et al., 2021; Luo et al., 2019; Hwang et al., 2019; Honarmand et al., 2021; Bendig et al., 2014).

The term drone originated from the US military, while UAV and UAS were adopted by some regulators of the US Federal Aviation Administration (FAA) (ICAO, 2011). The history of the first drone named Torpedo can be traced back to World War I. It was invented by the Dayton-Wright Airplane company for military applications (Ghamari et al., 2022). However, large-scale drone production started during World War II by a company called Reginald Danny. They produced almost 15,000 drones for the US Army (Ghamari et al., 2022). The main components found in drones are electric motors, fans, power distribution circuits, fan speed controllers, flight controllers, cameras, and batteries (Ramli et al., 2022). By fitting drones with scientific instruments such as sensors and cameras, they can become highly sophisticated tools in the coordination of advanced, potentially dangerous missions. Such a system now displays clear potential for immense societal benefits (Sauter, 2021).

Similarly, drones have become increasingly popular in Malaysia over the past decade and are used in a variety of industries for various purposes. The drone-flying trend in Malaysia started around 2014, including first-person-view and commercial drones (Nordin, 2022). When the mystery surrounding the disappearance of MH370 shocked the nation in 2014, one of the earliest recorded uses of drones in Malaysia occurred. Many parties offered drone inspections, especially unmanned underwater vehicles, including companies from abroad with zero costs (Muhammad Razif et al., 2022) in the spirit of humanity. However, offers from foreign companies can pose a risk to national security because not only is the aircraft debris being searched, but data on the country's geographical structure will also be exposed. Thus, Malaysia requires more expertise to be developed in the drone scene to meet national demands. Another example of popular drone use was by the Royal Malaysian Police (PDRM) that started using drones for monitoring compliance in public areas during the Conditional Movement Control Order (CMCO) in 2019 (BERNAMA, 2020). PDRM deployed the Air Operation (PGU) Drone Unit to monitor traffic during 'Op Selamat 19' in conjunction with the Chinese New Year holidays (BERNAMA, 2023) to address the issue of insufficient total strength of police throughout the country during festive seasons (Astro Awani, 2023). As a result, the use of drones in Malaysia is anticipated to increase in a variety of industries, and it is essential for the nation to develop its own expertise in the field.

Moreover, the COVID-19 pandemic accelerated the urgency of companies and various industries needing drones. From agriculture and construction to security and surveillance, drone technology is needed to provide innovative solutions to real-world problems. Malaysia seems committed to fast-tracking its potential in drone technology. According to the Malaysian Research Accelerator for Technology and Innovation (MRANTI, 2022), Malaysia's Drone Readiness Index (DRI) rose to 60% from 31% in 2022. Malaysia also topped the DRI 2023, rising from 30th in 2021 to 21st (MIDA, 2023). This sets Malaysia's drone industry on a growth path that might add RM50.71 billion to GDP and 100,000 jobs by 2030.

Although this progress is encouraging for the growth of the local drone market, there needs to be more drone related programs conducted to increase the knowledge, awareness, attitudes, and practice of drones among the younger generation. This is because drones are becoming more accessible to the general public and many younger people may be interested in drone use, especially for aerial photography and filming (Giones et al., 2017). Moreover, the price range of low specification drones in Malaysia on e-commerce platforms is affordable, starting from 20USD, which has increased drone ownership in the country. However, there is still a lack of research on how Malaysians perceive and accept drone technology (Herdel et al., 2021). Hence, it's vital to understand their perspectives. Knowing the younger generation's understanding and attitudes towards drones can greatly influence the adoption, development, and regulation of this technology.

Malaysia has a 76.0% urbanized population compared to its neighbouring countries which have lower proportions of urbanized populations – Indonesia (55.3%), Philippines (46.9%) and Thailand (49.9%) while Singapore has a 100% urbanized population (The World Bank, 2018). Thus, these findings may be generalisable to other Asian countries because Malaysia is an average country in terms of development and urbanization.

BACKGROUND

THE KNOWLEDGE, ATTITUDE AND PRACTICE (KAP) MODEL SURVEY

The Knowledge, Attitude and Practice (KAP) model was employed in this study. It provides a framework for analysing the public's fundamental models of drone technology, and we use this model throughout our research. Many other academics have utilised this paradigm to examine public attitudes to present and upcoming technologies, with the goal of better integrating them into society. Researchers using the KAP framework have investigated public elements such as new funding infrastructure systems, climate change reporting, farmer's personal protective equipment, and engineer safety gear (Bucknell et al., 2017; Colefax et al., 2019; Barnas et al., 2019; Bendig et al., 2014; Díaz-Varela et al., 2015; Shahmoradi et al., 2020; Thavasi et al., 2012; Norkaew et al., 2018; Van Tilburg et al., 2017). While the KAP model has been employed in some recent research into public opinion of drone technology, that research has been limited to the United States (Reddy et al., 2016; Aydin 2019) and Singapore (Lin Tan et al., 2021). The KAP model serves as a framework for this research.

DRONE GROWTH IN MALAYSIA

According to Ignatius (2023), the Ministry of Science, Technology, and Innovation (MOSTI) has also created the National Technology and Innovation Sandbox (NTIS) to accelerate the growth of Malaysia's drone industry. The NTIS priorities the development and testing of technologies in real-world settings. Through the NTIS, businesses can obtain support for commercialization financing, regulatory assistance, and market development. In this context, 25 applications for the use of drone technology have been approved for testing in various Sandbox initiatives. From 2020 to 2022, NTIS has provided approximately RM10 million in funding to 19 Malaysian drone companies. Most of the solutions provided by these drone companies are for agriculture, followed by medical delivery, infrastructure, and security surveillance. Drones are tested for a variety of applications, including irrigation, mapping, plant analysis, and warehousing, in these sandboxes.

In September 2022, the Malaysian government announced the Malaysia Drone Technology Action Plan 2022 – 2030 (MDTAP30) as a national agenda, led by Malaysian Research Accelerator for Technology and Innovation (MRANTI) under the Ministry of Science, Technology, and Innovation (MOSTI). The plan involves all DroneTech ecosystem partners, including key authorities such as the Civil Aviation Authority (CAAM), the Department of Survey and Mapping Malaysia (JUPEM), and Malaysian Communications and Multimedia Commission (MCMC), to ensure industry growth while maintaining safety standards. MRANTI serves as the coordinating agency and updates progress through the MED4IRN council's Emerging Technology Cluster Committee, formed under the Malaysia Digital Blueprint initiative.

There is no denying the fast expansion of drone activities throughout the most populous countries in the world. This circumstance encompasses activities pertaining to the military, commercialization, agriculture, tourism, and other related fields. The more recent advancements in drone operations were made to contain COVID-19 outbreaks. For example, drones were used to monitor social distance requirements and deliver medical supplies, blood, and even PPE suits (Greenwood, 2021). However, given that the drone is a machine, its improper usage has the potential to cause harm to both society and the nation as a whole. For this reason, the majority of nations have enacted certain regulations and laws governing how it can be used.

The United Kingdom, the United States of America, Japan, the United Arab Emirates, Brazil, Canada, South Africa, Ireland, and many more nations, including Malaysia, are among the countries that have built regulatory frameworks and issued legal notifications on drone flights because they take this matter seriously and have developed regulatory frameworks. Considering these developments, the government of Malaysia has enacted a set of legally binding regulations governing the operating of drones within the nation.

OBJECTIVES OF THE STUDY

It seems crucial to examine the knowledge, perception, and practice of emerging technologies as this may help strategize the effective adoption of the technology. This study replicates the study conducted by Aydin (2019) (with permission via e-mail). Thus, we aim to build on the findings of Aydin (2019) with our Malaysian sample. While many of the previous studies focused on the general public, in well developed countries such as the USA, Australia, Canada and even neighbouring Singapore, they did not focus on the students. Students who are younger may differ from the general public. According to Kaliyaperumal (2004), the KAP model describes what people know about certain things, how they feel and how they behave. The three topics that a KAP study measures are Knowledge, Attitude and Practice. The Knowledge possessed by a community refers to their understanding of any given topic. Attitude refers to their feelings towards this subject, as well as any preconceived ideas that they may have towards it. Practice refers to the ways in which they demonstrate their knowledge and attitude through their actions The KAP model can be used for any technology. For instance, Ahmad et al., (2020) used the KAP model to determine the adoption of green fashion innovation, Mostafavi et al., (2014) used this model to analyse public perceptions of innovative financing for infrastructure systems, Wasil et al., (2022) conducted a KAP at any time throughout farming activities, while Gadzekpo et al., (2018) applied a KAP model to analyse climate change reporting among media practitioner of African journalism. In this study, the KAP model is used as a framework to assess the various factors that influence Malaysian students' level of acceptance of drones, especially in terms of knowledge levels, attitudes towards drones, and level to which the students practice using drones.

THE RESEARCH QUESTIONS

The research questions are presented in Table 1. It was divided into three categories based on the KAP model. The null and alternative hypotheses with respect to the research questions are given in the results section of this paper. Some research questions did not require statistical hypothesis testing.

TABLE 1. Research questions

Category	Research Questions
Knowledge	Research Question 1: "*How do students learn about drones? What are the sources of information?"*
	Research Question 2*: "Do gender, drone usage, ownership of drone, or residence type affect awareness of drone applications?"*
	Research Question 3: *"Do students have knowledge on future applications of drones as much as on current applications?"*
	Research Question 4: *"Do students concern about future applications of drones as much as current applications?"*
Attitude	Research Question 5: *"Do gender, drone usage, ownership of drone, or residence type factors have impacts on perception of drones?"*
	Research Question 6: *"Do perceptions of risk differ for drones with cameras versus drones without cameras for students?"*
	Research Question 7: *"Does students' opinion change about drones if benefits and risks were illustrated?"*
	Research Question 8: *"Which uses of drones are most supported? Are there significant differences between support for commercial, public safety, hobby, and scientific research and teaching and learning uses?"*
Practice	Research Question 9: *"For what applications do students utilize drones?"*
	Research Question 10: *"For what applications do schools or universities utilize drones?"*

METHODOLOGY

INSTRUMENT

The survey instrument was adapted with permission from Dr. Burchan Aydin (via e-mail), who built on the KAP model by Reddy et al., (2016). Initially, a pilot test was distributed to 30 random subjects to determine the reliability of survey items. Considering the results of the pilot survey and feedback from the participants, a few questions were reworded and made bilingual (English and Malay language), with certain technical terms remaining in English as it is more familiar among students. To increase the reliability of the survey instrument, Cronbach's alpha values for a set of questions related to commercial, public safety, hobby, scientific applications and teaching and learning categories were analyzed. The Cronbach's alpha values for the final version of the survey are listed below in Table 2. For exploratory research, a Cronbach's alpha of at least 0.7 is recommended (Nunnally, 1978). This survey is a reliable instrument to measure public perception of drones based on the item reliability analysis; thus, could be replicated in future studies in Malaysia.

TABLE 2. Item Reliability (Aydin 2019)

Question Segment	Number of Questions	Cronbach's Alpha
Perception for Commercial	14	0.89
Perception for Public Safety Applications	15	0.93
Perception of Hobby Applications	2	0.8184
Perception of Scientific Research Applications	7	0.8626

The final version of the survey was administered at the beginning of a drone awareness workshop conducted at a local university. The workshop was conducted to create awareness and spark interest in drone sports among students from nine schools and students from the university. The workshop was conducted in collaboration with a government linked company that deals with drone training. – Both online and paper format of the survey were distributed to enable school students without mobile phones and university students with mobile phones to answer the survey. Overall, 110 participants completed the survey entirely. The survey had a screening question to prevent subjects who had never heard of drones from continuing the survey. Three subjects failed to pass this screening question. 62% of the respondents were male, 85.4% lived in urban or suburban areas, and 52.7% were school students. 36.1% of the participants or their families own a drone currently or have in the past. The age distribution is 52.73% from 13 to 18 years old and 47.27% from 19 to 21 years old.

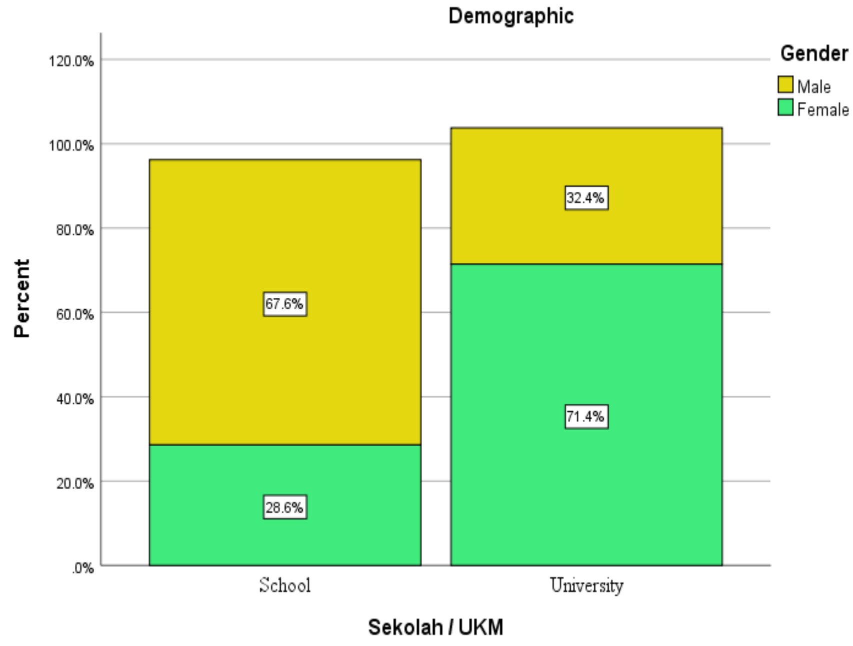

FIGURE 1. Percentage of male and female students

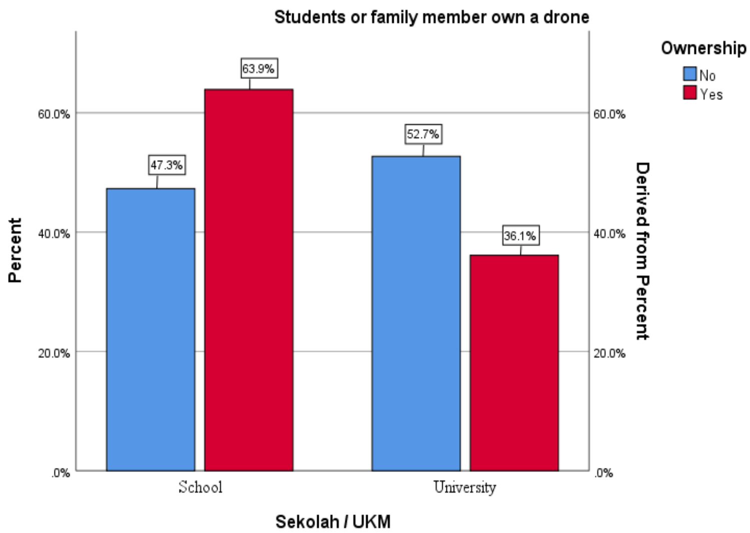

FIGURE 2. Analysis of drone ownership

PROCEDURE

The survey consisted of 133 items in total with three main sections: knowledge, attitudes, and practice. The survey took an average of 25 minutes to complete. Part 1 contained the demographics of the participants, including age, gender, school /institution name, and residence (urban, rural, or sub-urban). Part 2 of the survey was to find out participants' overall perspective on drone utilization for commercial, public safety, hobby, scientific research, and teaching and learning purposes. A Likert scale of 1–5 was used, where '1' means strongly disagree, and '5' means strongly agree. Part 3 and 4 were to find out the level of knowledge on drone application, history of drones, electronic and mechanical structure of drones, drone software programming, and drone laws and regulations using 12 true/false questions. Students could choose the "Not sure" option if they did not know the answer. Also, they were asked not to use search engines to find the answer. The last part of the knowledge section inquired about the awareness of the 39 applications of drones". Participants could answer either "I am aware" or "I did not know".

Part 6 covered the attitude section to find out the support for the same 39 applications. A Likert scale of 1–5 was used, where '1' means strongly oppose, and '5' means strongly support the use of drones for the specific application. Part 7 was to inquire about concerns regarding the risks of using drones. An open-ended question was used to gather information on other risks – besides those on this list. The entire survey is provided in Appendix A.

The last part of the survey was dedicated to gathering information on the use of drones. Questions inquired if the participants had a drone now or in the past, what application had he or she used the drone for, whether the schools had drones, and which application the school uses the drone for. The survey ended with a post-survey question that asked participants perceptions of drones for commercial, public safety, hobby, scientific research, and teaching and learning. This was a replication of the first question mentioned earlier. This question was added to be able to measure the impact of learning about the benefits and risks of drones on perception.

RESULTS

The data was found to be normally distributed when tested statistically. SPSS software version 26 was used to conduct the statistical analysis. The order in the survey structure will be followed for representing the results: knowledge, attitude, and practice.

KNOWLEDGE

The following research questions are addressed to further study the knowledge basis of students from secondary schools and the local university about drones. The specific aim is to replicate Aydin (2019) Reddy and DeLaurentis (2016)'s inquiry to see if anything has changed since they conducted the survey with respect to knowledge sources, especially in a developing country like Malaysia.

RQ 1: *How do students learn about drones? What are the sources of information?*

Descriptive analysis revealed that students learned drones mostly from social media followed by movies or television series.

The left vertical axis of the chart shows the Mean (the average number counts for each category), while the right vertical axis shows the cumulative percentage. This study identified even more discrepancy between the information sources compared to what Aydin (2019) found. Social media, mainstream news media and movies or television series covered 69.38% of the cumulative impact.

The next part is important for understanding if students who own a drone learn more about drones in any means. Or, do we have male students who don't know any more than the female students with regards to drones? The latter case would cause many issues.

RQ 2: *Do gender, drone usage, ownership of drone, or residence type affect awareness of drone applications?*

Null hypothesis: None of the factors affects the awareness.

Alternative hypothesis: At least one of the factors affects the awareness.

To normalize the data, percentages were calculated to assess an overall application awareness score for each participant. This awareness score was taken as the response variable. One way ANOVA was conducted to model the awareness. The gender, drone usage and drone ownership are a factor with 2 levels. The residence type had 3 levels: urban, suburban, and rural. ANOVA results showed that gender, drone ownership, drone usage and residence type were the significant factors at $\alpha=0.05$ (gender $p=0.642$, drone ownership $p=0.406$, drone usage $p=0.445$ and residence type p=0.119). Thus, the null hypothesis was rejected at α=0.05. This indicates that gender, drone ownership, drone usage or residence type affects the awareness of the drone usage.

The following research question in this line of inquiry is to compare students' knowledge of present-day and potential uses for drones. Drones' potential future applications are weighed against those we know about today.

RQ 3: *Do students have knowledge on future applications of drones as much as on current applications?*

Null hypothesis: Students are equally aware of the future versus current applications of drones equally.

Alternative hypothesis: Students knows about the current application of drones more than the future applications.

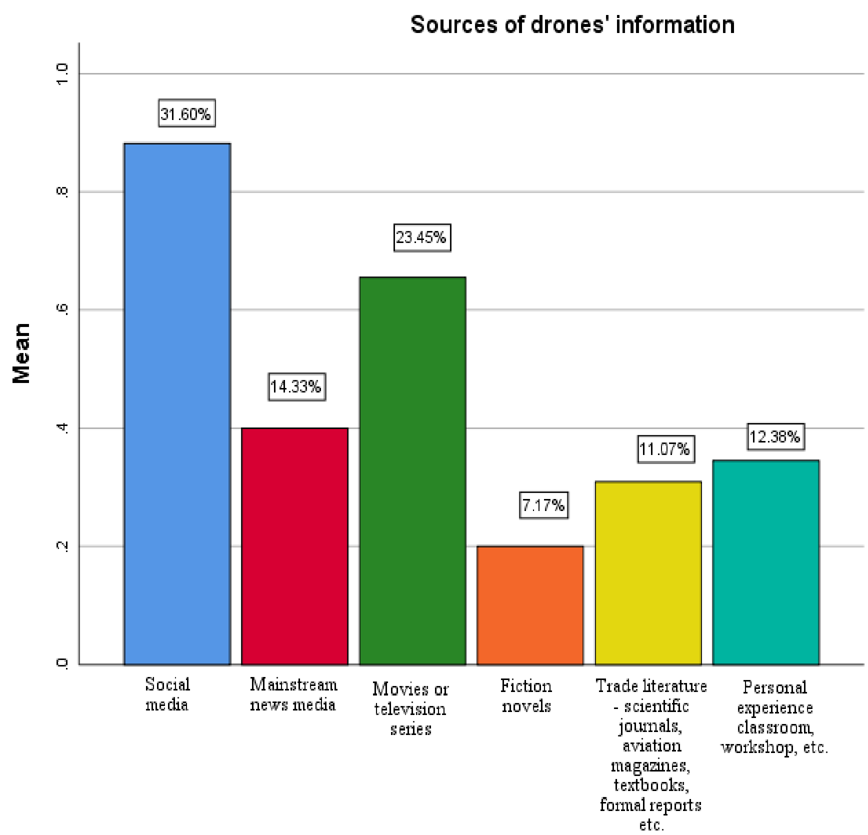

FIGURE 3. Bar chart of students' knowledge sources
(The categories used in this question are edited of the question on Aydin survey (2019) with permission)

All items in part 5 (Appendix A) were reviewed based on Malaysia's usage of drones. There are 19 applications of drones currently deployed in industries, and 21 more will be deployed in the future. The number of 'I am aware' selections was counted. An awareness percentage for each application was calculated by dividing the number of 'I am aware' selections to the total number of participant responses ('I am aware' plus 'I am not aware' selections for each application). Specifically, these results suggest that students know more about the current drone applications (55.67%), but lack awareness of the future of drone applications (49.43%). Figure. 4 presents the comparison of 'aware' versus 'not aware' for each application.

However, this study hypothesizes that there are differences between perceived knowledge and actual knowledge. The following research question and corresponding analysis address this issue.

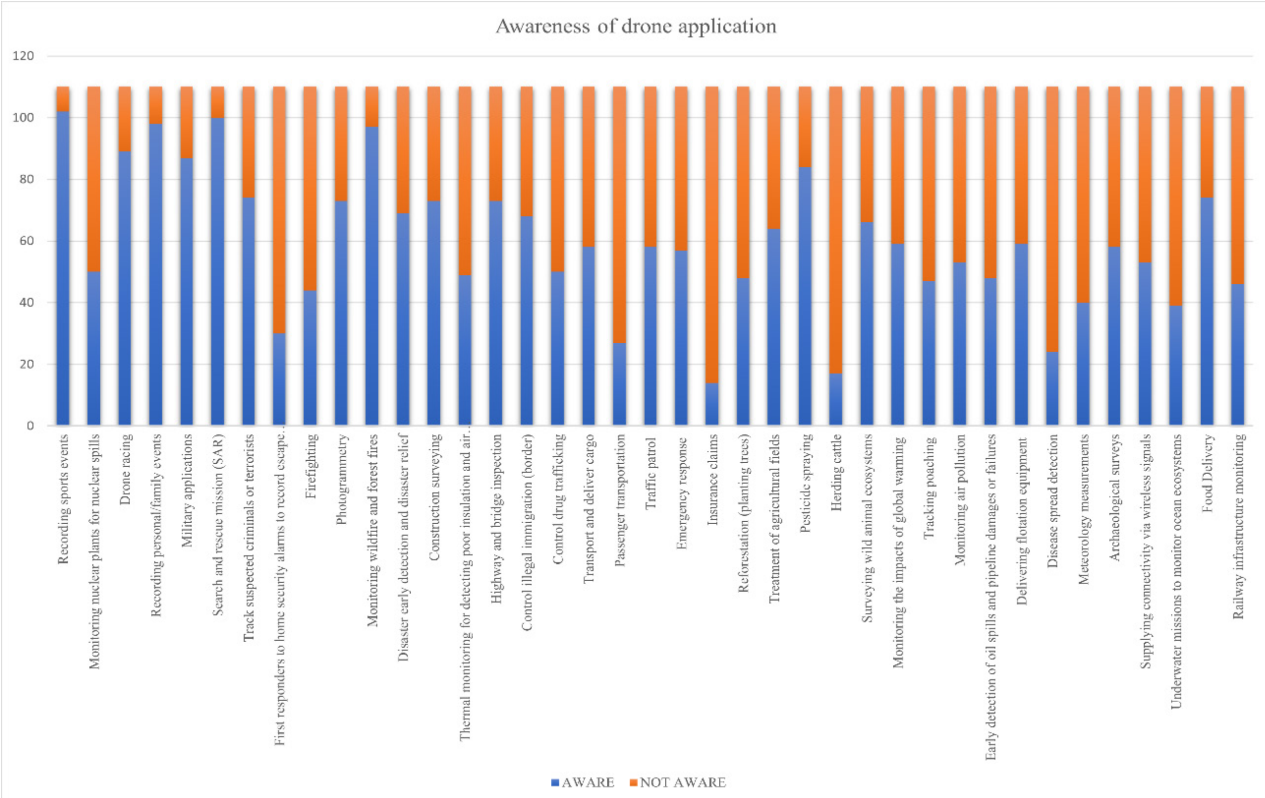

FIGURE 4. Students' awareness of drones applications
(Current application – 1,2,3,4,5,6,12,13,15,16,20,21,24,25,26,31,33,34,37)
(Future application – 7,8,9,10,11,14,17,18,19,22,23,27,28,29,30,32,35,36,38,39)

RQ 4: *Do students concern about future applications of drones as much as current applications?*

Null hypothesis: Students are concerned about future applications of drones versus current ones.

Alternative hypothesis: Students concern about the current application of drones more than the future.

Part 6 of the survey (Appendix A) to find out the support for the same 39 applications. A Likert scale of 1–5 was used, where '1' means strongly oppose, and '5' means strongly support the use of drones for the specific application. Part 7 was to inquire about their concerns regarding the risks of using drones. The descriptive statistics of students concern about drones' application are provided Table 3 to give an overall view of the samples.

TABLE 3. Descriptive statistic students concern about future and current drone applications.

Group	Mean	Standard Deviation	Median	Mode
Drones Applications	4.11	0.61	4.10	5
Concern	2.10	0.84	2.00	3

The descriptive comparison above is based on students' consideration upon drone application. In this part, respondents were given 39 items of current and future drone applications, and then they were asked to state in general terms, how they feel about the following application of drones. Based on Table 3, most of the students (mean) state 4 (support) for most of the drone application and 2 (concerned / worried) for how the drone will be deployed. Thus, this shows that students are as concerned about future applications of drones as they are about current ones.

ATTITUDES

RQ 5: *Do gender, drone usage, ownership of drone, or residence type factors have impacts on perception of drones?*

Null hypothesis: None of the factors affect the perception towards drones.

Alternative hypothesis: At least one factor affects the perception towards drones.

This perception score was taken as the response variable. One way ANOVA was conducted to model the perception. Gender, drone usage and ownership are a factor with two levels. The residence type had 3 levels: urban, suburban, and rural. ANOVA results showed that gender, drone ownership, drone usage and residence type were the significant factors at $\alpha = 0.05$, gender $p = 0.023$ is lower than significant factors, while drone ownership $p = 0.805$, drone usage $p = 0.752$ and residence type $p = 0.218$ are greater than significant factors. Thus, at least one factor affects the perception towards drones. This indicates that gender affect has impacts on perception of drones.

RQ6: *Do perceptions of risk differ for drones with cameras versus drones without cameras for students?*

Null hypothesis: Students perceive drones with cameras and drones without cameras equally.

Alternative hypothesis: Students perceive drones with cameras as riskier than drones without cameras.

Part 8 of the survey asked participants how risky they felt about 'drones with cameras' versus 'drones without cameras'. A 1 to 5 Likert scale was used where '1' means 'Extremely Risky', and '5' means 'Not risky at all'.

The descriptive statistics of perceptions of risk differ for drones with cameras versus without cameras for students are provided in Table 4 to give an overall view of the samples.

TABLE 4. Descriptive statistics of different perception(%)

Group	Mean	Standard Deviation	Median	Mode
Drones with cameras	3.58	1.726	3.00	3
Drones without cameras	4.02	1.877	4.00	4

The comparison above between drones with cameras and drones without cameras is based on the attitude quiz results in the previous part. In previous part of the survey, respondents were given 39 items list of current and future drone applications, and then they were asked to state in general terms, how risky do they feel the following application of drones with or without camera and Based on the table 3, most of the students (mean) state 3 (somewhat risky) for drones with cameras and 4 (moderately risky) for drones without cameras. Thus, students perceive drones with cameras riskier than drones without cameras.

RQ7: *Does students' opinion change about drones if benefits and risks were illustrated?*

Null hypothesis: Students opinions drones with cameras and drones without cameras equally.

Alternative hypothesis: Learning about the benefits of drones and the associated risks; public support for drones increases in at least one of the categories (commercial, public safety, hobby, scientific research and teaching and learning uses).

A parametric equivalent of paired sample T-test was conducted. It shows there is no significant change ($t = -1.82$, df = 109, $p > 0.005$). The test suggested that students opinions did not change before and after learning the benefits and risks of drones.

Now, let's examine which drone use category is more supported by the students by considering the results of question.

RQ8: *Which uses of drones are most supported? Are there significant differences between support for commercial, public safety, hobby, and scientific research and teaching and learning uses?*

Null hypothesis: Students support for drone applications in commercial, public safety, hobby, scientific research and teaching and learning use areas are all equal.

Alternative Hypothesis: Students shows support of drone uses based on the categories (commercial, public safety, hobby, scientific research and teaching and learning uses).

One way ANOVA was conducted to model most supported uses of drones, $F(df=10,99) = 3.333$, $p < 0.05$ are significant. Another point of view based on Figure 5 presents students' support for drone applications on a scale of 1–5, where 1 indicates strongly oppose, and 5 indicates strongly support. There are no drone applications rated below than 3 (neutral). Thus, the null hypothesis was accepted. This indicates that support for drone applications in commercial, public safety, hobby, scientific research, and teaching and learning use areas are all equally distributed.

Another point of interest in this study was to see how student perceived the risks associated with drones. Figure 6 presents students perception on a scale of 1–5, where 1 means extremely concerned, and 5 means not concerned at all.

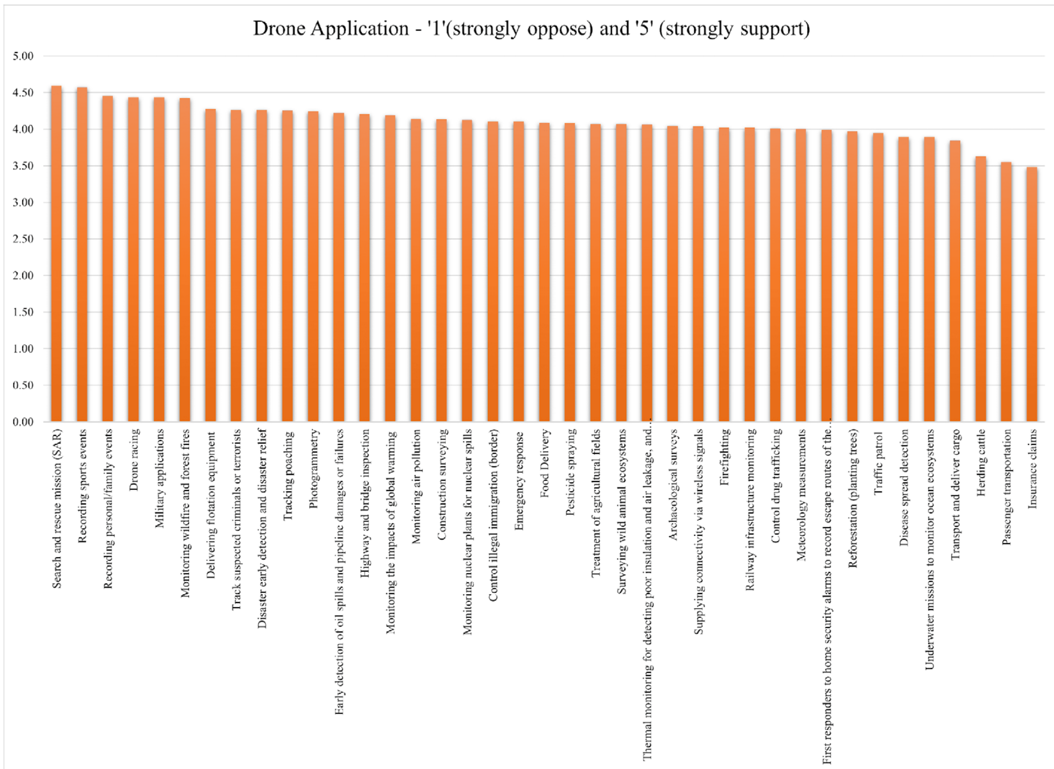

FIGURE 5. Students support for drone applications.

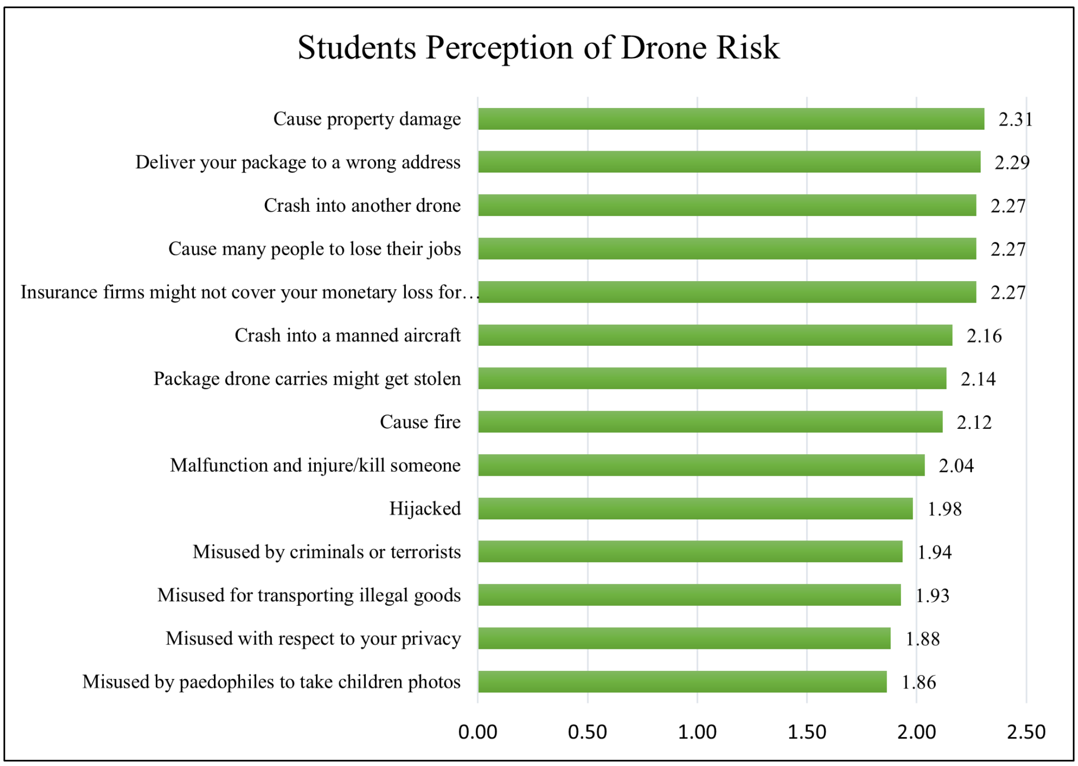

FIGURE 6. Students perception of drone risk

Based on Figure 5, the majority of students are very concerned that pedophiles might use drones to take photos of children for malicious purposes. As for that, most students concerned with all drone risks listed and causing property damage were rated as least concerned.

PRACTICE

In the previous study by Aydin (2019), the questions asked to the stakeholders were "For what applications do stakeholders utilize drones?" and "For what applications do companies utilize drones?". The stakeholders responded under the following categories: the commercial category mostly included stakeholders who conduct real estate photography, whereas the public safety category included stakeholders who use their drones for volunteer search and rescue missions. The scientific category had stakeholders using drones for research-based applications. Some respondents fell into multiple categories. Another KAP study by Reddy and Delaurentis (2016) asked the participants the "perception of practice" in the practice section of the survey. They asked the participants "would you utilize a service provided by drones for your own personal benefit", "please describe some applications for which you might use a drone for personal benefit", and how would you vote on a referendum to allow drones to operate in your city". These questions are more of attitudes/perception questions rather than real practice. Therefore, in this survey the questions are how they use or used drones personally and through school or university.

RQ9: *For what applications do students utilize drones?*

RQ10: *For what applications do schools or universities utilize drones?*

Out of 110 participant, 36 students or their family members own a drone. The students who responded to the survey practiced drones for applications under the following categories. As the Pareto analysis indicates, most of the students use drones for photography and videography, hobby or recreational purposes at a personal level and capturing family moments (See Figure 7).

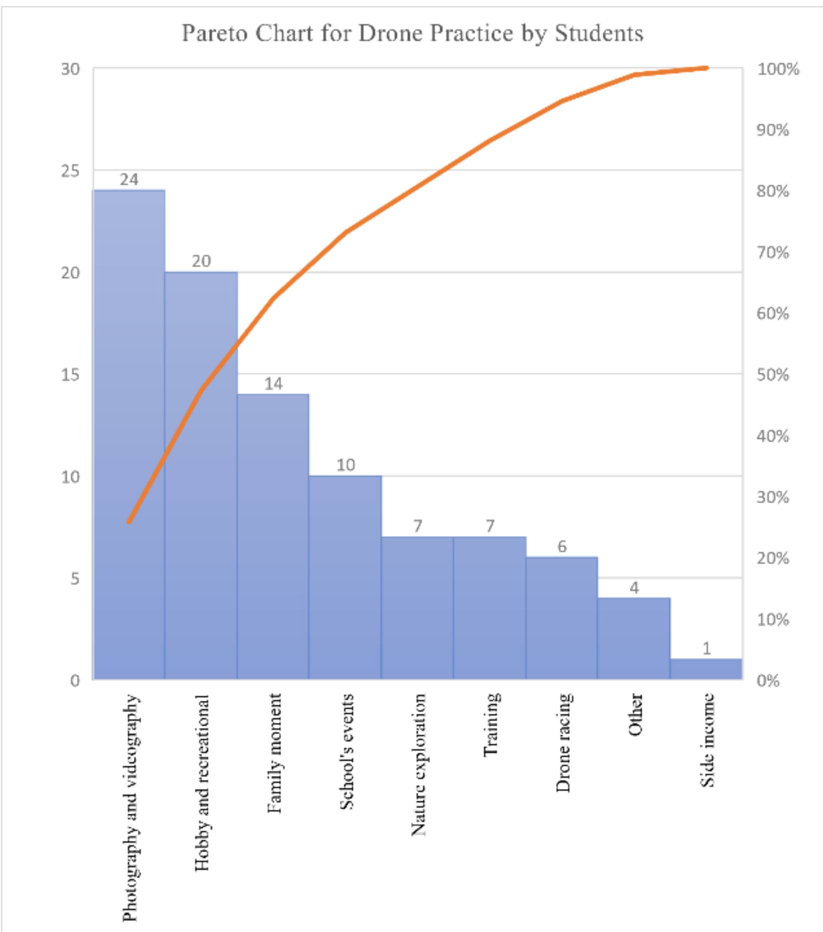

FIGURE 6. Students' practice of drones.

Moving from personal uses, respondents responded to the survey followed by practicing the following applications: school events, nature exploration, training, drone racing, other activities, and side income (business) purposes. The list included mostly commercial and personal uses.

There are 86 respondents who responded that their school or institution own a drone. As the Pareto analysis indicates, most schools and institution use drone for school events, photography and videography, and for teaching and learning purposes (See Figure 7). Some respondents fell into multiple categories.

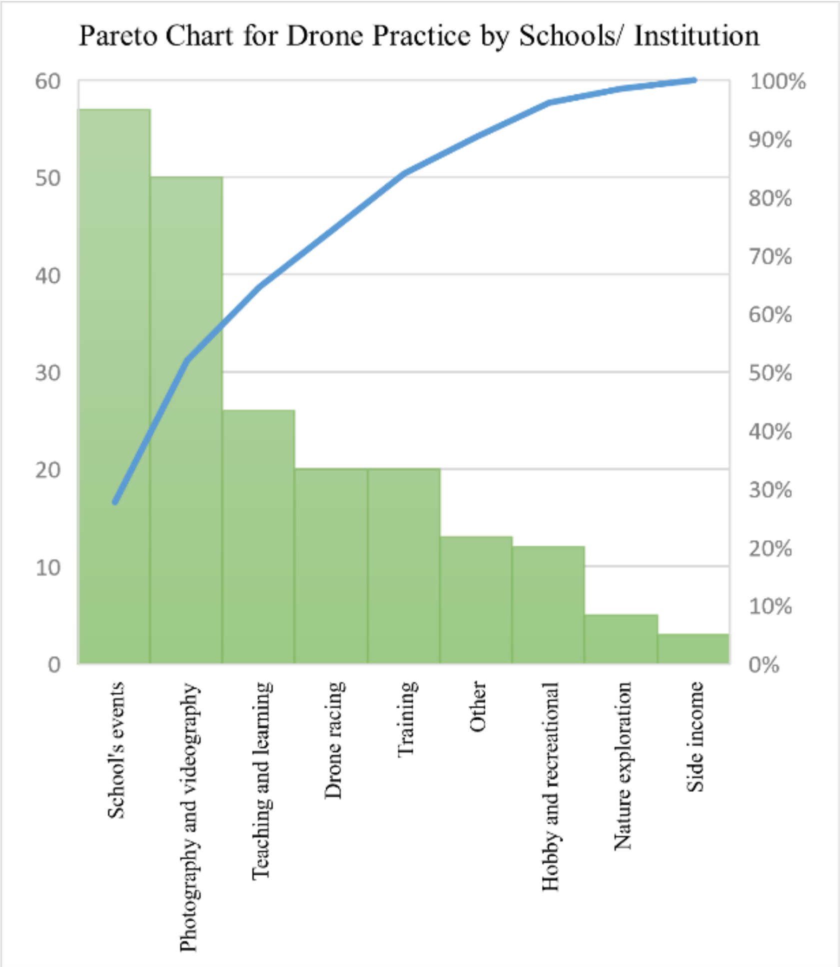

FIGURE 7. Schools / University' practice of drones.

Moving from school and institution uses, respondents responded to the survey with the following applications: drone racing, training, other activities that do not state, hobbies and recreational activities, nature exploration, and for side income or business purposes. The list included mostly educational activities and applications for the students.

DISSCUSSION

Drone technology is evolving rapidly, and its potential uses are growing significantly beyond what is now understood. Various research initiatives have been concentrated on enhancing drones' cargo capacity, flying, and hovering time, prevention of crashes, and signal range, as well as their other features and skills including swarm communication, artificial intelligence, and virtual reality enrichments are being carried out (Myasischev et al. 2022; Choi et al. 2020; Romero et al. 2022; Perez et al. 2020; Campion et al. 2018).

This article presents another point of view of drone technology that is not as popular as technical and takes a detailed look at the knowledge, attitudes, and practices (KAP) regarding drones. This study indicated that students discovered drones primarily through social media, movies or television series and mainstream news media. The way social media portray drones could have a significant impact on their level of acceptance among younger generations. The young generation accesses social media (TikTok, Instagram, Twitter, Facebook etc.) not only to socialize but also to gather information about current issues in Malaysia and the world today (Beninger et al., 2020). On social media, there are a movie or TV series short clips that use drones for the aerial view, as well as creative personal videography and marketing promotional videos (Izakova et al., 2021; Duani et al., 2018). Nevertheless, drones might be portrayed as devices for malicious purposes by the community, a toy that invades private territory, or even as lethal weapons (Sadat, 2013). Drones, just like any other device that can be misused for illicit purposes (Schneider 2019; Hamilton et al., 2017; Alwateer et al., 2020; Nassi et al., 2021).

Furthermore, will the mainstream media focus on the negative implications of drones, or will they emphasize their positive social effects? Will they only display drones that have been crashed by unskilled or irresponsible 'pilots', or will they also emphasize drone society's volunteer search and rescue (SARS) efforts? Social media or mainstream media coverage may influence the young generation's perception. An adequate understanding of policy, environmental, ethical and societal implications of drones lags far behind the progress of their science and technology (Aydin, 2019).

Drones are revolutionizing the world. The breadth of the technology will depend on drones' technology and on younger generations' acceptability. If knowledge on drone risk minimization and the advantages of drone technology is effectively cascaded to the young generation, Malaysia might be in line to fully utilize drone technology in the future (Konigsburg, 2022; Saini et al., 2021; Kamran Abid et al., 2021; Safwan, 2019; Norasma et al., 2018).

Knowledge of drone use is slightly influenced by factors such as gender, drone ownership, usage, and types of residence (Aydin, 2019; Lin Tan et al., 2021). As respondents of this study are students who voluntarily attended the drone awareness programme which means they may have some basic knowledge of drones but not in depth. When answering the survey, students were prohibited from referring to any online resources. They were required to answer the survey questions using their actual knowledge. The results showed that, only few students responded to the history about drone correctly and most of them ticked the 'not sure' option.

Specifically, there are differences between perceived knowledge and actual knowledge. Results suggest that students are more aware about the current drone applications (55.67%) but lack awareness on the future of drones' applications (49.43%). Through this study, it is evident that students need to gain more information about the future of drone technology in Malaysia. Moreover, the study has also found that students are not familiar with several terms related to drone applications (current and future). For instance, not many students are familiar with photogrammetry, in other words, techniques that use photographs to create accurate measurements, 3D models, or maps of objects or environments (Honarmand et al., 2021; Díaz-Varela et al., 2015). Without further explanation, students might consider photogrammetry as a future drone application. Most of the participants were not aware of future drone applications. For instance, very few students knew that drones could be used for insurance claims. Imagine remote areas where humans cannot access them; drones will take care of insurance claims for accidents caused by fire, human error, or natural disasters. Students were also not aware of drone applications in herding cattle. Drones will monitor and assist in directing the movement of cattle, and thus, this is an innovative approach to livestock management (Gnanasekera et al., 2021; Liu et al., 2021). Another potential future use that students are not aware of is disease spread detection and intervention. Picture drones quickly delivering vaccinations and other treatments to outlying places. Drones' quick response time to disease outbreaks will unquestionably save lives. Imagine drones bringing life preservers to people who are drowning or transporting first aid supplies like defibrillators to the scene of an accident (Wan et al., 2018; Waykar et al., 2021; Pathak et al., 2019).

Nevertheless, further applications of drones might cause unwanted events. Based on our research, we found that students support most drone applications, and they are concerned about future applications of drones as much as current ones. However, results show students perceive drones without cameras as riskier than drones without cameras. Drones equipped with cameras are now easily accessible at reasonable costs. These drones pose a privacy risk and should be treated accordingly.

Even if the drone does not come with a camera, users can easily connect one (Mitchell, 2014; Xie et al., 2018). It is obvious that a person could misuse drones' capability (aerial videography) for the wrong reason. Moreover, results showed students are concerned about law enforcement of authorities surreptitiously using drones to spy on society. Drones without cameras were seen as less dangerous than those with cameras in this survey, perhaps due to respondents' need for privacy. Nevertheless, students show their support for drone applications, even for future use. Based on the results of the study, support for drone applications in commercial, public safety, hobby, scientific research, and teaching and learning use areas is equal. There are no drone applications rated below 3 (on a scale of 1–5, where 1 indicates strongly oppose and 5 indicates strongly support).

Additionally, the survey results revealed that the majority of students were very concerned that pedophiles might use drones to take photos of children for bad purposes. As for that, most students are concerned with all the drone risks listed (on a scale of 1–5 where 1 means extremely risky, and 5 means not risky at all). Even the least risky items were on the risky zone of the scale. This clearly shows that the younger generation sees drones as a risky technology, presently. Drones could be risky machines if the 'pilot' lacks competency to handling, flying, and hovering the drone. Failure to do so will harm others.

Results showed, out of 110 students, 36 students or their family members owned a drone. The students who responded to the survey practiced drones for applications under the following categories. For example, most of the popular use of drones are for photography and videography, hobby or recreational purposes at a personal level and capturing family moments. Moving from personal uses, responded to the survey followed by applications: school's event, nature exploration, training, drone racing, other activities, and side income (business) purposes. The list included mostly commercial and for personal use.

On the other hand, there are 86 students who responded that their school or institution owns a drone, and most schools and institutions use drones for school events, photography and videography, and teaching and learning purposes. Some respondents fell into multiple categories. Moving from school and institution uses, respondents responded to the survey with the following applications: drone racing, training, other activities that do not state, hobbies and recreational activities, nature exploration, and for side income or business purposes. The list included mostly educational activities and applications for the students.

For future studies, drone safety analyses, including both qualitative and quantitative risk assessments, and the design of efficient risk response plans should be prioritized. The possibility that drones will become a nuisance (uncontrollable) to vehicles and the close proximity of operators are two factors that can affect public opinion on them. In addition, some scientific terms in the survey instruments need to be explained and generalized.

CONCLUSION

Is there a generational gap in readiness for widespread drone usage? Are the younger generations prepared for extensive drone applications? We conclude that the answer is probably "a preliminary positive result". However, more work is needed to educate younger generations, to promote the potential benefits and soothe their fears and concerns, particularly for drone applications in the local context. More intervention programmes at the school level and institution can be designed to increase the knowledge of drone applications. It will also be helpful if drone enthusiasts can help educators to integrate drone into the curriculum of various subjects including languages, mathematics or even geography.

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