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Research Article

Systematic Review of Statistical Method Used in ICT Ethics Studies

Muhammad FadzrinOthman[a], Maslin Masrom[b], Rasheed Mohamed Kutty[c], Nik Nadzirah Nik Mohamed[d], Noorlizawati Abdul Rahim[e]

[a,b,c,d,e] Razak Faculty of Technology and Informatics, Universiti Teknologi Malaysia, Malaysia,

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Abstract:In any study or research, a research method plays an important role in obtaining good results. In this regard, statistical methods are essential for qualitative, quantitative, and mixed-method research. Generally, statistical methods involve mathematical formulas, models, and techniques used in analyzing raw research data. They extract information from research data and provides various ways to assess the robustness of research outputs. The findings could help researchers to better understand the appropriate statistical methods used for ICT ethics studies. The research field's growth contributes to various new methods in a study, especially in an ICT ethics issue. Each technique used brings different results to a study. As the research field develops and the number of studies increases, the scope of the areas expands**.**Therefore, this paper aims to investigate the use of statistical methods in ICT ethics studies. This study reviews the research done on ICT ethics for the years 2015 until 2020. The research questions addressed in this study are:1) What statistical method is used in the fields of ICT ethics studies?, 2) What application areas in ICT ethics studies use the statistical method?, and 3) What research methods (quantitative, qualitative, and mixed) were used in the fields of ICT ethics studies.The findings revealed that quantitative is the most research methodused, followed by qualitative and mixed. The inferential statistical method was most employed, followed by the descriptive statistical method and other methods. Also, non-parametric was the most technique used compared to parametric.

Keywords:ICT ethics, Statistical methods, Parametric, Non-parametric, Inferential statistics, Systematic review

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1. Introduction

According to Bardwaj*et al.* (2017),the quality of research depends on the applied methodology. There are three types of research methodology: qualitative, quantitative, and mixed. Qualitative research methodology refers to research that focuses on collecting and analyzing words (written or spoken) and textual data. In contrast, quantitative research methodology focuses on measurement and testing using numerical data (Jansen and Warren, 2020). Mixed methodology research includes qualitative and quantitative data collection approaches and interpretation of a single study (Creswell, 1999).

The research methodology plays an important role in a respective research study. In quantitative research methodology, one of the main branches is the statistical method. The statistical method is considered as the main factor to determine the quality of a study. There are multiple statistical methods, such as inferential, predictive, parametric, and nonparametric statistical methods. Each statistical method has different characteristics and is used differently to suit the research design of studies. For example, inferential statistics come from a general family of statistical models known as the general linear model. There are various ways to analyze data. This includes the t-test, Analysis of Variance (ANOVA), and Analysis of Covariance (ANCOVA) (Trochim and Donnell, 2002), while the predictive statistical method can be broadly classified into two categories: parametric and non-parametric. Parametric models make general and specific assumptions about the characteristics of the population used in creating the model, and non-parametric tests relate to flexible data and do not follow a normal distribution (Deogawanka, 2019).

While in qualitative, interviews are the primary source of data. Observations are popular in qualitative research, and they come in two forms. First, the findings arise when the phenomenon of interest happens naturally rather than the location itself. Second, Merriam and Tisdell (2015) claimed that observational data represents a first-hand encounter with the phenomenon of interest rather than a second-hand account of an interview. Merriam and Grenier (2019) asserted that the world of reality is not the fixed, single, agreed-upon, or measurable phenomenon assumed to be in positivist, quantitative research. There are different methods to collect the required data, including interviews, observations, focus groups, narratives, notes, reports, and archives review (Ghaljaie*et al.*, 2017).

According to Morse and Niehaus (2016), mixed methods of study include one central approach paired with one or more techniques focused on a second and related method, which may be used to answer the research issue by gathering or evaluating data. Mixed method research often involves the use of both qualitative and quantitative methods. Mixed methodologists present an alternative to the quantitative and qualitative traditions by advocating using whatever methodological tools are required to answer the research questions under study (Subedi, 2016). As the scope of research fields expands and new research areas develop, studies using statistical methods are applied to more application areas than ever before. This phenomenon also occurs in ICT ethics studies. As an example, the improvement of research software appeared as a new application area for the researcher. Different research question results in the new and various research areas.

Thus, this paper aims to investigate the use of statistical methods in ICT ethics studies. This study reviews the research done on ICT ethics for the years 2015 until 2020. The research questions addressed in this study are1) What statistical method is used in the fields of ICT ethics studies?, 2) What application areas in ICT ethics studies use the statistical method?, and 3) What research methods (quantitative, qualitative, and mixed) were used in the fields of ICT ethics studies.Quantitative, qualitative, and mixed research methods were explored in this study. This study's significance included the following whole picture of statistical methods used in the contexts of research topics and areas and understanding and selection of appropriate statistical methods to assist the researcher in their research topics.

2. Systematic Review

Systematic review can be broadly defined as a type of research synthesis that is conducted by review groups with specialized skills, who set out to identify and retrieve international evidence that is relevant to a particular question or questions and to appraise and synthesize the results of this search to inform practice, policy and in some cases, further research (Zachary et al., 2018).A systematic review is a literature review that is designated to locate, appraise and synthesize the best available evidence relating to a specific research question to provide information and evidence-based answers. The information can then be used in several ways. For example, to advancing the field and informing future practice research, the information can be combined with professional judgment to make decisions about how to deliver intervention or to make changes to policy (Boland et al.,2017).

Research is the effort to discover new knowledge and explore answers to scientific problems. The main motivation that encourages the researcher to undertake research findings is to develop and construct new knowledge. The number of studies advanced in every field is increased within the year. A key component in conducting quality research is the methodology. Various research methodologies exist for the researcher to adopt for study on specific research problems. Cho and Abe (2013) stated that statistics refers to a branch of mathematical procedures that deals with organizing, summarising, and interpreting information. The statistic is one of the most useful and powerful tools in data analysis. As a researcher to collect the data, collect sample data to answer specific quantitative research questions, statistical methods enable them to conclude a broader base of people, events, or objects rather than samples included in the study (Munro, 2005). The studies of scholarly journals have attracted researchers for decades. The long term and systematic study on journal give a clear understanding on the development and evolution of a certain discipline. Research studies on journal publications in a domain field can reveal the research topic trends, leading researchers, and research methods in that field.

According to Zhang et al. (2016), there are three categories of widely used research methodologies: quantitative, qualitative, and mixed research methodologies. Typically for the researcher to decide their research question, the researcher must determine whether it will be quantitative or qualitative (Connaway and Powell, 2010). Qualitative research with human beings involves three kinds of data collection: (a) in-depth, open-ended interviews; (b) direct observations; and (c) written documents. Interviews yield direct quotations from people about their experiences, opinions, feelings, and knowledge (Patton, 2005). Quantitative research encompasses various methods concerned with the systematic investigation of social phenomena, using statistical or numerical data (Watson, 2015). The mixed methodology is designed to answer the increasingly complex and multifaceted research questions using quantitative and qualitative measurements (Tashakkori, 2007).

This study's objectives are to investigate the use of statistical methods in research studies of ICT Ethics studies and determine the application of fields areas to which various statistical methods were applied. Then analyze the relationship between the statistical methods, application areas and provide insight into the temporal change patterns of statistical methods in the ICT ethics studies field. In this study, the three factors (statistical method, application area, and period) were defined. Statistical methods were classified into the following four categories based on the nature of the statistical methods and size of data types: (1) parametric inferential statistical methods, (2) non-parametric inferential statistical methods, (3) predictive statistical correlation methods, and (4) predictive statistical regression methods (Zhang et al., 2018). Based on the information cycle for ethical issues, the application areas were defined as follows: personal privacy, access right, copyrights, and piracy (Creswell, 1999).

Both statistical and application areas were extended to the second level of schema during the period. The independent variables were in the form of statistical methods and application areas. In contrast, the dependent variable has been defined as the statistical method's frequency in application areas.

3. Differences Among Quantitative, Qualitative, and Mixed-Methods Research

Research is the attempt to discover a new world of knowledge and explore answers to scientific problems(Olds, Moskal, & Miller, 2005) suggest that there are no right and wrong means of going about conducting a piece of research. However, researchers must pinpoint what they are doing and why, with, whom, where, and when they are undertaking a specific inquiry. Meanwhile, Almalki (2016) believes that there are three reasons for engaging in educational research: exploring current and potential issues, influencing policy decisions, and evaluating and progressing classroom practice. The research methodology is the path through which researchers need to conduct their research. It shows the course through which these researchers formulate their problem and objective and present their results from the data obtained during the study period (Evon et al., 2019). Research methods are the instruments and tools that researchers employ to administer any form of inquiry or investigation (Kenneth, 2008). Meanwhile, Buckley et al (1976) define research methodology as a strategy or architectural design by which the researcher maps out an approach to problem finding or problem-solving.

Quantitative methods are a good fit for deductive approaches, in which a theory or hypothesis justifies the variables, the purpose statement, and the direction of the narrowly defined research questions (Connaway and Powell, 2010). The purpose of quantitative studies is for the researcher to project their findings onto the larger population through an objective process. Data collected, often through surveys administered to a sample or subset of the entire population, allow the researcher to generalize or make inferences. Results are interpreted to determine the probability that the sample's conclusions can be replicated within the larger population. Findings are derived from data collected and measures of statistical analysis (Connaway and Powell, 2010).According to Babbie (2010) feature of this approach towards research is that the collection and analysis of information are conducted utilizing '… mathematically based methods…' and '…polls, or surveys… focusing on gathering numerical data and generalizing it across groups of people.'

Meanwhile, the qualitative research methodis suitable when the researcher or the investigator either investigates a new field of study or intends to ascertain and theorize prominent issues (Jamshed, 2014). and characterized by the collection and analysis of textual data (surveys, interviews, focus groups, conversational analysis, observation, ethnographies (Olds et al., 2005). Qualitative research involves the careful planning of a research design that encompasses all aspects of the study, from research questions to sampling to data collection and analysis.Qualitative methods are usually described as inductive. The underlying assumptions are that reality is a social construct, that variables are difficult to measure, complex, and interwoven, that subject matter is important. The data collected will consist of an insider's viewpoint (Almalki, 2016).

Mixed-method research appears as a third research method that involved the use of both quantitative and qualitative research methods (Sahin, 2019). According to Fetters and Molina-Azorin (2017), the first manual on the mixed methodology was published in 2003 and mixed-method research has gained momentum from the first published. Creswell (2012) also stated that the idea for combining quantitative and qualitative methods will provide a better and broader understanding of the research problem is the basic assumption of mixed-method research. According to Creswell & Clark (2007), there are four specific method designs for conducting mixed-methods research. First, triangulation design whose main purpose is to obtain different but complementary data on the same topic. The result from quantitative and qualitative research results was analyzed. Second, embedded design- this approach assumes a single data set is not sufficient and it is required primary data from qualitative or quantitative and secondary data assume by other data types. Third, explanatory design- which qualitative data helps explain and builds quantitative results. This design orientation is more to quantitative data because the data is the key element to start the process. Lastly, exploratory design- the qualitative data is the primary source of information.

4.Method

4.1 Primary Objective

The main objective of this study is to investigate the use of statistical methods in research studies of ICT ethics, to determine the application areas to which statistical methods were applied in ICT ethics studies, and analyze the research method used in ICT ethics studies, provide the temporal changes patterns of statistical methods in the ICT ethics studies.

4.2 Statistical Method

The main key factors in conducting this study are the statistical method. It covers all possible statistical methods used in the field and classifies them into three distinctive categories: inferential statistical methods,

predictive statistical methods, and other statistical methods. The other statistical method includes population distribution characteristics test methods. The descriptive statistical method was excluded from this study because they were not regarded as independent statistical methods in this study. In other words, papers that include only mean, mode, median, maximum, minimum, range, and standard deviation of a sample were not considered.

4.3 Time Span and Time Periods

It is necessary to discover the change in the research studies (ICT ethics) through the lens of time. This factor sheds light on the change patterns and the future trends of the applications of statistical methods in the field. This study spans 6 years, which from 2015 to 2020. The periods allow the researchers to conduct a temporal analysis on the statistical methods and application areas in the ICT ethics fields.

4.4 Data Collection

To conduct the proposed study, representative journals were selected. The journalsneed to meet the following conditions: theyshould be scholarly of research-oriented journals, and existed across the periods under study, Scopus coverage until the present, and were top-ranking journals in ICT ethics study. Based on the criteria, the international-based journal, that is, Journal of Information, Communication, and Ethics in Society was foundto meet all the criteria for this study, and statistical methods were used in the papers published in the journals. Table 1 shows the summary of the Journal of Information, Communication, and Ethics in Society.

Table 1 Summary of Journal of Information, Communication, and Ethics in Society

Profile feature	**Journal of Information, Communication, and Ethics in Society**
Focus	The wider social and ethical issues related to the planning, development, implementation, and use of new media and information and communication technologies.
Publisher Location	United Kingdom
Indexing and ranking	1.3 cite score 2019
Editor in chief	Professor Simon Rogerson
Publisher	Emerald

After the journalwas determined, all the research papers published in this journal from 2015 to 2020 were investigated. Items that are not researched, letters to editors, conference reports, reflections, advice to authors, and editorials and book reviews were not included in the investigation because they usually do not incorporate research methods. The related research papers in a journal were recorded, including the titles of the article, publication years, issue number, subject terms, and ethical and social issues. Keywords (such as ethics issue, statistical method, and research methodology) were used to minimize the research findings. The population of this study was research studies in Library and Information Science (LIS), and the sample was a representative set of research papers in the selected journals. After the corresponding statistical methods were identified, they were classified and recorded based on the statistical methods classification system (Zhang, 2016).

5. Results and Discussion

There were 187 papers in the Journal of Information, Communication, and Ethics in Society that used statistical methods in their studies from the year 2015 to 2020. Out of 187, the total number of research papers that used the statistical method for ICT ethics studies was 59 papers as shown in Figure 1. It indicates a trend towards more research in ICT ethics studies using statistical methods in their research from 2015 to 2017, and a slight decrease in 2018 studies in the later years.

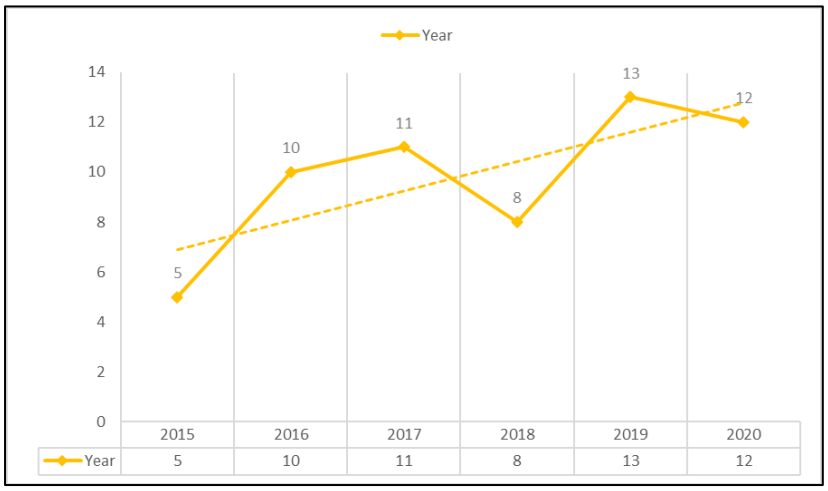

Figure 1 Research papers using the statistical method in ICT ethics study

Figure 2 shows descriptive data on the selected application areas: 1) privacy, 2) piracy, 3) access right, 4) cybercrime, 5) harmful action, 6) social impact, and 7) other related ethics issues (such as hacking, internet addiction, free speech, andcyberloafing). The figure illustrates the total number of research papers in their respective areas. Privacy, the most active application area with (n=16) among application areas. Access right achieves second place with (n=12), and accuracy isin third place (n=8). Harmful action takes fourth place (n=7). Piracy and social impact edge out on the same site with (n=6) issues. Other issues take the last position (n=4). It concludes that privacy is the most issue discuss in the ICT Ethics issue.

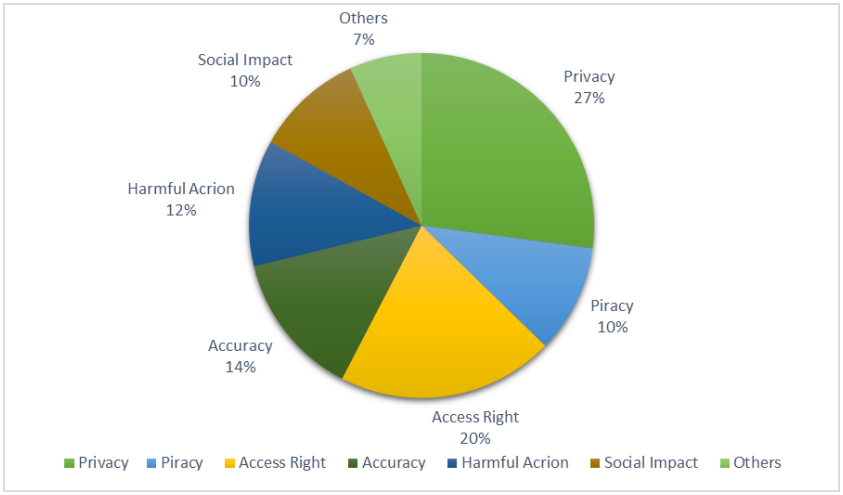

Figure 2 Applications areas in ICT ethics issue

The data for the research method category isshown in Figure 3. Figure 3 illustrates the total frequencies of using the quantitative, qualitative, and mixed-method in ICT ethics study. The data show that the quantitative research method is the highest (n=24) method used, followed by the qualitative method (n=21) and mixed-method (n=12). Figure 3 clearly shows that the mixed-method was the least method used in the field.

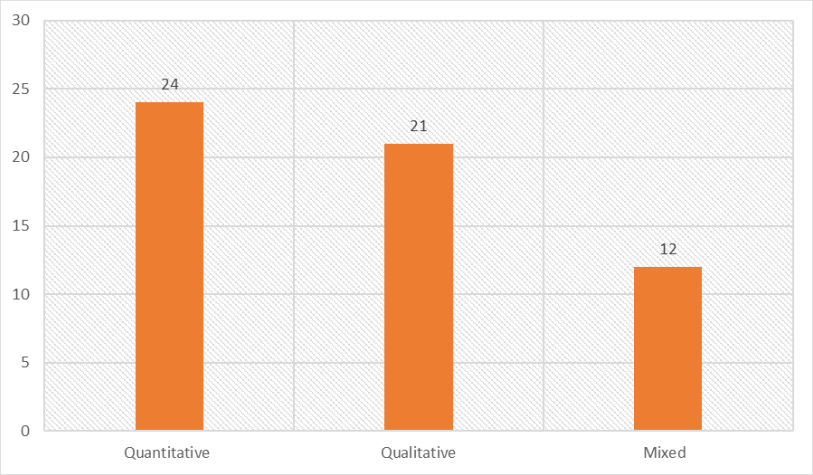

Figure 3 Total number of research methods used in the ICT ethics study

It covers all possible statistical methods used in the ICT ethics field and classifies them into three distinctive categories: inferential statistical method, predictive statistical method, and other statistical methods (i.e.descriptive statistical method, prescriptive statistical method, and exploratory data analysis). The other statistical methods include population distribution characteristics test methods, follow-up test methods used if a hypothesis is rejected, and result in reliability test methods (Olds, Moskal, & Miller, 2005). Figure 4 shows the total frequencies of using each type of statistical method. The data indicates that the inferential statistical method has the highest method used with (n=27) follow by the predictive statistical method (n=24) and the other methods (by (n=8).

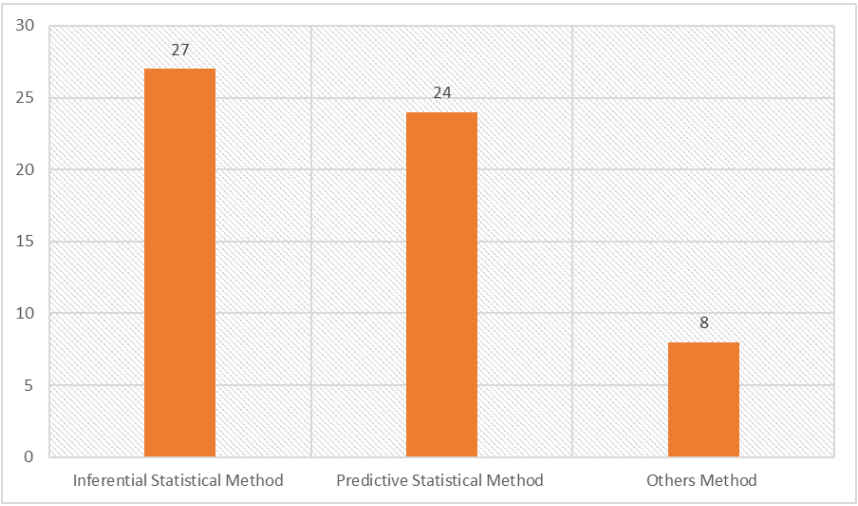

Figure 4 Total number of statistical methods used in the ICT ethics study

The statistical method was also sorted into parametric and non-parametric methods based on the scales of analyzed data (Olds, Moskal, & Miller, 2005). Figure 5 illustrates the total number of parametric and non-parametric methods use in the ICT ethics study. In this study, parametric methods (n=31) dominated over non-parametric methods (n=28).

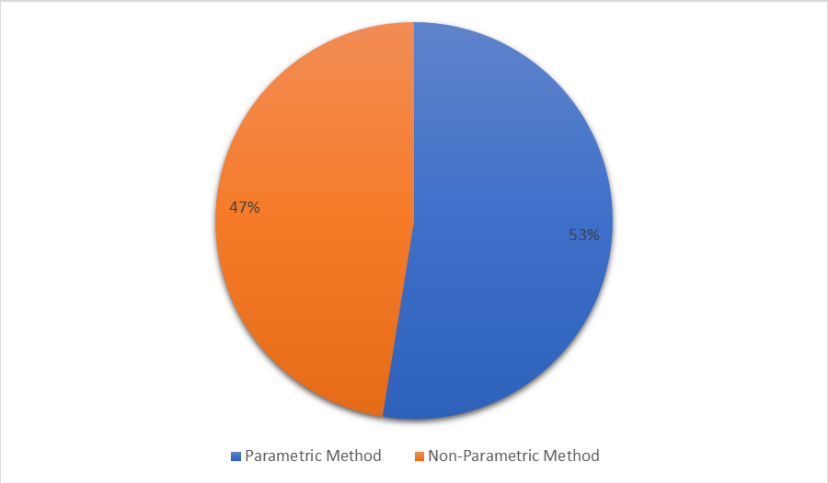

Figure 5 Total number of parametric and non-parametric methods use in the ICT ethics study

6.Conclusion

Statistical methods are commonly used in a quantitative study. They are used for analyzing data and drawing a clear inferential conclusion from the collected data. They are often used as a base for the researcher to communicate the research design, explain research findings, test hypotheses, and give the degree to which research results are reliable. The findings of this study provide a detailed picture of the statistical method uses in the contexts of research topics and application areas and offer a better understanding of the fields of ICT ethics studies. It reveals that quantitative is the most research methodology used, followed by qualitative and mixed methodology. The inferential statistical method was most employed, followed by the descriptive statistical method and other statistical methods. Non-parametric was the most technique used compared to parametric. These findings could assist researchers, educators, and practitioners in the ICT ethics field to understand how statistical methods are used and to which research areas statistical methods are applied, understand the patterns in the implementation of statistical methods, choose a suitable research methodology, andmake an appropriate decision on statistical method selection for their research problems. The future research directions on this study include, but are not limited to, increasing the number of the investigated journals in ICT ethics to gain a larger picture of the application of statistical methods in the field.

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