CONSTRUCTING A FRAMEWORK FROM QUANTITATIVE DATA ANALYSIS: ADVANTAGES, TYPES AND INNOVATIVE APPROACHES

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(Received 15th June 2024; revised 16th August 2024; accepted 24th August 2024)

Abstract. Constructing a framework in research is the process of organising and structuring an intricate collection of facts, variables, or concepts in a manner that enhances the interpretation, analysis, and comprehension of their interconnections. Nevertheless, the absence of explicit procedures for constructing a framework may give rise to a problem statement for the present investigation. This study aims to refine advantages, types and innovative approaches in constructing a framework from a quantitative data analysis. This study suggests four innovative approaches for constructing a framework from quantitative data analysis, namely: (a) framework development from descriptive data analysis; (b) framework development from inferential data analysis; (c) framework integration from descriptive and inferential data analysis; and (d) framework simplification of the integrated framework. The design of these processes ensures accuracy and adherence to a reasonable order. In conclusion, the development of a framework based on quantitative data analysis offers a multitude of benefits for researchers and their endeavours. To enhance the accuracy and reliability of frameworks developed from quantitative data analysis, it is advisable to investigate the capabilities of machine learning and artificial intelligence (AI) in future studies.
Keywords: *framework, quantitative, descriptive, inferential, innovative*

Introduction

Constructing a framework in research is the process of organising and structuring an intricate collection of facts, variables, or concepts in a manner that enhances the interpretation, analysis, and comprehension of their interconnections. Frameworks serve as a strategic plan for doing research on a particular subject, directing the formulation of research inquiries, hypotheses, and methodologies. They serve the purpose of identifying crucial factors and their interconnections, classifying data, and enabling comparisons across different research projects. When developing a framework, researchers must meticulously evaluate the research topic, the nature of the collected data, the software and resources at their disposal, and the study's purpose. This is crucial in order to establish a framework that is both valid and trustworthy, as well as valuable and practical. Nevertheless, the absence of explicit procedures for constructing a framework may give rise to a problem statement for the present investigation. Researchers may have difficulties organising the data or concepts they are examining and making relevant findings and project developments if they lack a comprehensive knowledge of how to establish a framework. This phenomenon may also give rise to a dearth of uniformity in research methodologies, diminishing the trustworthiness and validity of investigations. Moreover, inadequately organised frameworks may fail to faithfully depict the connections between variables or concepts, resulting in erroneous conclusions and restricted applicability of findings. Hence, it is crucial to construct unambiguous methodologies for developing frameworks that can be universally used across diverse study domains to guarantee uniformity, precision, and dependability.

This study aims to refine advantages, types and innovative approaches in constructing a framework from a quantitative data analysis. There are various advantages that may be derived from refining certain steps in structuring a framework from a quantitative data analysis. Firstly, including a framework can enhance the study's validity by ensuring appropriate representation of relationships among variables. This phenomenon has the potential to enhance the dependability and applicability of research outcomes, thereby facilitating the advancement of more efficient policies and practices. Moreover, the use of well-defined and uniform procedures can enhance the efficacy of research procedures, resulting in decreased allocation of time and resources towards data organisation and analysis. The process of refining individual phases in the construction of a framework can enhance transparency in research, facilitating the accessibility of the approach to other researchers and fostering the repeatability of findings. Ultimately, the presence of precise procedures can aid in the detection of any inaccuracies and prejudices in the analysis, enabling the production of more precise and perceptive conclusions.

Review of past research

Various studies have emphasised the research on constructing a framework from quantitative data. In order to create a strong framework for analysing quantitative data, it is essential to incorporate several research procedures and approaches. Tang et al. (2021) underscored the significance of employing content analysis as a means to ascertain themes, theories, variables, and research frameworks, exemplifying the incorporation of qualitative methodologies within the analytical framework. Mirici and Şengül (2020) emphasised the process of converting data into numerical representation by examining existing scholarly works, demonstrating a systematic methodology for managing quantitative data. In addition, Avagianou et al. (2022) employed a sophisticated approach in the area by combining legislative framework research with quantitative data analysis. In addition, Radford et al. (2022) used the Conceptual Framework for Implementation Fidelity as a guiding tool for the gathering and examination of quantitative data, emphasising the importance of a well-organised framework in the data analysis process. In their study, Nwaiwu et al. (2020) undertook a comprehensive examination of existing scholarly works in order to establish a conceptual framework. They utilised confirmatory factor analysis as a methodological technique to assess the constructs under investigation, with a particular focus on including both qualitative and quantitative methodologies. Utilising a conceptual framework to direct the collection and examination of data may improve the thoroughness and excellence of research, as indicated by Radford et al. (2022) and Nwaiwu et al. (2020).

Furthermore, the study conducted by Gong et al. (2021) used both quantitative and qualitative data analysis techniques within an assessment framework, emphasising the need to ensure that the findings are consistent with the established framework. In their study, Berrett-Abebe et al. (2023) utilised a mixed-methods approach, specifically employing a convergent case study framework. This approach involved the integration of quantitative data and qualitative input to assess the efficacy of the collaborative process. The use of mixed-methods methodologies in research has the potential to yield more comprehensive and intricate findings while also bolstering the general credibility and validity of the research. Therefore, considering the integration of both quantitative and qualitative analytic methodologies is recommended, as shown in the studies

conducted by Berrett-Abebe et al. (2023) and Gong et al. (2021). Conclusively, putting together the results of these studies reveals that using quantitative data analysis to build a complete framework requires a methodical approach that includes qualitative elements, advanced methods, and is in line with the research goals to ensure a thorough analysis. In addition, it is crucial to give thorough consideration to the validity, reliability, and consistency of the data in order to guarantee that the framework effectively represents the phenomena being studied. Therefore, researchers must maintain a watchful attitude in gathering, analysing, and interpreting data while also being receptive to improving and modifying the framework as fresh insights arise.

Advantages of constructing a framework for research

The term "framework" pertains to the arrangement, methodology, or strategy employed to collect and arrange data for the purpose of doing research. A framework in research serves the function of directing the researcher's investigation, providing a framework for gathering and analysing data, and establishing a cohesive narrative for successfully conveying study outcomes. Here are a few common advantages of constructing a research framework.

Provides explicit direction: A research framework helps to establish a distinct direction and concentration for the investigation. Identifying the important factors and concepts for research helps narrow down the research topic. Explicit theoretical frameworks are critical in research because they provide explicit direction for the development of research inquiries, data collection, and data analysis (Hissa and Timulák, 2020). According to Adsul et al. (2022), Gamble (2020) and Eslava-Schmalbach et al. (2019), these frameworks provide significant advantages in domains such as health equality and organisational transformation. They assist researchers in establishing a targeted methodology, promoting transparency, and enhancing understanding of complex topics. Furthermore, the use of theoretical frameworks contributes to the progress of theoretical knowledge, provides a robust foundation for the examination of sustainability factors, and facilitates the identification and optimisation of organisational resources (Rodriguez, 2023; Shelton et al., 2020; Rockwell, 2019). In general, the application of frameworks not only ensures adherence to rigorous methodologies but also enables the methodical and organised advancement of knowledge across diverse study fields.

Facilitates the organisation and analysis of data: A framework provides a systematic approach to data collection and analysis by defining the specific categories of data to be gathered and outlining the appropriate methods for organising and analysing it. The use of a framework approach in research enables the systematic arrangement and examination of data, particularly when dealing with substantial quantities of text-based or qualitative data. It facilitates deep engagement with the data, self-reflection, and comprehension of participant perspectives and encounters (Hackett and Strickland, 2019). According to Zolnoori et al. (2020), framework analysis is a structured and flexible method that makes it easier to find mistakes in datasets and come up with rules that fix these mistakes. The process allows for the emergence of themes based on both research inquiries and participant accounts (Okeyo et al., 2019). Frameworks facilitate the analysis process by providing organisation and direction, resulting in a more profound understanding of the data and aiding in the identification of deficiencies for remedial actions (Jha et al., 2023). Frameworks play a critical role in data analysis by facilitating a systematic and perceptive research methodology.

Enables the process of interpreting data: By utilising a framework, researchers are able to methodically analyse the gathered data, detect recurring trends, and get significant insights from it. It offers a systematic method for evaluating data, allowing researchers to arrange, examine, and extract significant insights from their results. Researchers can successfully index and understand qualitative and quantitative data by employing interpretative frameworks (Withers et al., 2022; Powell et al., 2021). According to Villena-Agreda (2020) and Ronzani et al. (2022), these frameworks serve as a guiding framework for the organisation, interpretation, and analysis of data, facilitating the connection between theoretical viewpoints and research outputs. According to Ball and Regan (2019), these tools aid in the recognition of emergent themes, the delineation of concepts, and the interpretation of data, guaranteeing that the analysis maintains a strong connection to the input provided by the participants. Frameworks are of paramount importance in providing guidance for the process of data analysis, hence augmenting the robustness and dependability of research findings (Ahmad et al., 2020).

Assists in identifying research gaps: Research frameworks play a crucial role in assisting researchers in identifying gaps within the current body of research literature and guiding their efforts towards fixing these gaps. It has the benefit of identifying areas where research is lacking, which is essential for the advancement of knowledge. Researchers have the opportunity to expand understanding and provide guidance for future studies by addressing these gaps through the development of integrated frameworks (Nyanchoka et al., 2019). It is crucial to prioritise research by identifying gaps in order to determine its relevance and importance. This approach involves the active participation of key stakeholders (Pearce et al., 2022). According to Fun et al. (2019), co-creation frameworks offer valuable insights into the dynamics of cooperation and serve as a means to bridge the gap between research and practice. By conducting thorough evaluations and involving relevant parties, current frameworks may be improved to identify areas where research is lacking and provide direction for future inquiries (Prashar, 2022). Moreover, frameworks play a crucial role in systematically recording research gaps, hence allowing the identification of topics that warrant further investigation.

Improves the credibility of research: The legitimacy of research is enhanced by the implementation of a well-designed framework, which offers a clear and transparent procedure for doing research and provides a rationale for the inquiry. The utilisation of a research framework serves to bolster credibility through the provision of a systematic methodology for the organisation and analysis of data, resulting in conclusions that are more clear and easily comprehensible (Rubin, 2020). Frameworks of this nature play a significant role in enhancing the credibility of research by providing guidance in the establishment and evaluation of model credibility. This is of utmost importance for regulatory decision-making across diverse domains (Kuemmel et al., 2019). Moreover, frameworks can facilitate the identification of research deficiencies, the formulation of novel theoretical viewpoints, and the provision of strategic instruments for managers to make well-informed decisions (Rupasinghe et al., 2023). Researchers can enhance the overall credibility of their findings by placing emphasis on the significance of theoretical frameworks, which serve as guiding principles for their work (Rodriguez, 2023).

Efficient organisation of the findings: Frameworks facilitate the systematic arrangement of research findings in a manner that is easily understandable to both

scholarly and non-scholarly audiences, thereby improving their ability to grasp and respond to the outcomes. Researchers have the ability to effectively arrange knowledge by either expanding current frameworks or establishing new ones. Studies have demonstrated the effective expansion of the TOE framework to include other concepts, such as technical competence and organisational culture, which improves the comprehension of competitive advantage (Leong et al., 2023). Moreover, frameworks play a crucial role in assessing operational efficiency, particularly within the garment sector, by providing a succinct framework for evaluating resource utilisation (Jayawardena, 2020). According to Panpatil et al. (2023) as well as John Ben and Subramaniam (2019), these frameworks serve the dual purpose of organising information and providing insights into market performance, strategic management, and performance assessment across different settings. Hence, employing frameworks in research allows for methodical arrangement and examination of data, thereby promoting a more profound comprehension of intricate occurrences.

In essence, the use of a research framework serves a critical role in providing direction to the research endeavour, structuring data, and delivering findings. The act of enhancing the legitimacy and credibility of research serves to benefit various stakeholders, including academia, industry, policymaking, and community contexts, by offering valuable insights that may inform decision-making processes.

Types of framework in representing quantitative data

Besides conceptual, theoretical, analytical, and mathematical modelling frameworks, there exist supplementary frameworks, such as mindmaps and flowcharts, that are employed for the purpose of displaying quantitative data.

Mindmap framework: A mindmap is a visual representation of information in which thoughts or concepts are graphically organised in a radial tree-like configuration. Mindmaps are a valuable tool for visually displaying intricate data sets by hierarchically dividing data pieces into subsets, each including sub-points. Borgstede and Rau (2023) demonstrated the effectiveness of integrating qualitative types within quantitative dimensions in a mindmap framework for representing quantitative data. Cazorla et al. (2021) suggest that employing ostensives to display qualitative variables, rooted in anthropological theory, allows for exploring the possibilities associated with manipulating physical materials to represent statistical data. According to Kaur et al. (2019), the incorporation of qualitative and quantitative methodologies in research presents a range of approaches and amalgamations that can augment the process of data analysis. More than just microscopy, there are more ways to use quantitative cell representation in deep learning frameworks. One example is CNN-based cell analysis (Allier et al., 2022). According to Parmentier-Cajaiba and Cajaiba-Santana (2020), the use of visual maps and theoretically grounded frameworks is of utmost importance in the visual representation of qualitative data, as it serves to augment comprehension of intricate information.

Flowchart framework: A flowchart is a graphical depiction of a procedure that uses a predetermined set of symbols to symbolise certain stages in the process. Flowcharts are commonly employed as a means of visually depicting quantitative data since they effectively illustrate the many phases involved in data processing or the interconnections among distinct data points. A flowchart framework may be created to represent quantitative data by using different data gathering methods and levels of sophistication. According to Adelfio et al. (2019), the process may encompass many

levels, including fundamental statistics, advanced statistics, qualitative descriptions, and endogenous qualitative descriptions. According to Townsend et al. (2022), the framework synthesis technique, which was first developed for policy research, has the potential to facilitate the successful integration of quantitative and qualitative data. A full study of data may be performed by employing recognised theoretical frameworks that encompass both quantitative and qualitative features (den Bakker et al., 2019). These frameworks have the potential to facilitate the synthesis of various data types, thereby enhancing comprehension of intricate phenomena by integrating both quantitative and qualitative information (Withers et al., 2022).

Network framework: Researchers use the network framework to represent quantitative data with linked interactions among various variables. This paradigm depicts data using nodes and links that establish connections between variables, signifying their interrelationships. A network framework provides a resilient foundation for quantitative data representation. Numerous scholarly investigations have shown the importance of network models across several fields. For example, Zhang and Guanzon (2022) have employed Bayesian network models to structurally represent qualitative information for the purpose of quantitative evaluation. Furthermore, the AME framework presents a modular methodology for examining network data, but with potential limitations in capturing the complete range of network information (Hoff, 2021). Causal network models demonstrate enhanced capabilities compared to traditional Mendelian randomisation frameworks in comprehending omic data (Yazdani et al., 2022). This collection of references underscores the significance of network frameworks in the representation and analysis of quantitative data across many academic fields.

Decision tree framework: A decision tree is a graphical depiction of a problem-solving procedure that employs a hierarchical arrangement to illustrate the process of decision-making. Decision trees are a valuable tool for visualising quantitative data as they visually depict the location of decision points, which are determined by the results of several statistical tests. Decision tree frameworks are highly advantageous for describing quantitative data because of their straightforwardness, comprehensibility, and efficacy in several fields. The ALBATROSS framework and the Conditional Inference (CI) Trees approach are examples of frameworks that employ decision trees to represent choice heuristics and generate predictions using data (Manser et al., 2024; Källestål et al., 2019). According to Singh et al. (2022) and Teng et al. (2021), decision trees provide a systematic methodology in which internal nodes symbolise features, branches represent decision rules, and leaf nodes signify outcomes. This form facilitates both analysis and communication. Moreover, decision trees have demonstrated their versatility and extensive applicability in various domains such as video coding, fault diagnosis, and disease phenotyping (Li et al., 2020). The significance of explainability and transparency in decision-making processes is underscored by the incorporation of decision trees inside frameworks such as the Tree-Network-Tree (TNT) learning framework and the Circular Decision-Making Tree (Greer et al., 2022). In many applications, decision tree frameworks offer a resilient and adaptable approach for effectively managing quantitative data.

Overall, researchers can choose from a range of frameworks to represent quantitative data. The selection of an appropriate framework depends on the nature of the research question, the type of data, and the analytical approach. By using appropriate frameworks, researchers can effectively visualize and communicate the findings of their

quantitative data analysis. Hence, researchers must meticulously assess several frameworks and select the most suitable one for their study to guarantee that their quantitative data analysis produces precise, significant, and valuable outcomes.

Innovative approaches in constructing a framework from quantitative data analysis

This study suggests four phases of innovative approaches for constructing a framework from quantitative data analysis, namely: (a) framework development from descriptive data analysis; (b) framework development from inferential data analysis; (c) framework integration from descriptive and inferential data analysis; and (d) framework simplification of the integrated framework. The design of these processes ensures accuracy and adherence to a reasonable order. The following is a concise overview of these procedures.

Framework development from descriptive data analysis: The process of framework development starts with the identification of themes and patterns within the descriptive data. Subsequently, a conceptual model is constructed to elucidate the interrelationships among the variables. The use of Ritchie and Spencer's five-step framework analysis may be employed to construct a complete framework for the examination of qualitative data (Khanal et al., 2023). The use of novel frameworks derived from quantitative data might enhance this technique, as seen in the research conducted by Whittard et al. (2022), wherein the findings provided validation for the establishment of a quantitative value measurement framework. The integration of qualitative and quantitative data into frameworks, such as the one presented by Arribas-Bel et al. (2021) on Open Data Products, facilitates the conversion of raw data into formats that are suitable for analysis. Furthermore, the employment of a mixed-methods methodology, as exemplified in the research conducted by Nwaiwu et al. (2020), might facilitate the construction of a complete conceptual framework through the integration of systematic literature reviews and confirmatory factor analysis. The integration of qualitative and quantitative data is crucial for the development of comprehensive frameworks across many study topics.

(b) Framework development from inferential data analysis: The second phase of framework creation is the utilisation of inferential statistical methods to examine the associations among variables and enhance the conceptual model. According to Zheng et al. (2023), the process of constructing a framework based on quantitative data analysis entails the use of inferential procedures within a statistical framework. The use of statistical models in this technique serves to augment conventional analysis, thus establishing a novel framework for decision-making (Whittard et al., 2022). In different domains, including ecological studies (Tilberg and Dixon, 2022), educational research (Lugo-Armenta and Pino-Fan, 2021), and volcanic eruption modelling (Pacchiardi et al., 2021), the use of inferential frameworks is of utmost importance. According to Fonseca et al. (2021), these frameworks facilitate comprehension of intricate systems and provide guidance for decision-making procedures. Furthermore, the use of inferential frameworks holds considerable importance within several research approaches, including randomized-controlled trials (Aregbesola et al., 2021), palaeoclimate data analysis (Carson et al., 2019), and evolutionary biology (Ghirotto et al., 2021). Researchers can draw relevant insights and reach educated conclusions based on quantitative data by integrating inferential analysis into the building of frameworks.

Framework integration from descriptive and inferential data analysis: The third phase involves combining descriptive and inferential data to develop a more complete

framework that clarifies the relationship between the variables. The integration of descriptive and inferential data analysis is crucial when constructing a framework for quantitative data analysis. Ogari and Orwa (2021), Tamba and Cendana (2021), as well as Desire et al. (2019) effectively demonstrated the use of descriptive and inferential statistics for analysing quantitative data. These methodologies, frequently facilitated by software such as SPSS, provide a comprehensive analysis of the data. Researchers may gain significant insights and draw dependable conclusions from their data using these analytical methodologies, as demonstrated in several domains such as education, mathematics, and supply chain management.

Framework simplification of the integrated framework: In the final phase, the integrated framework is simplified through the process of streamlining its components and lowering its complexity while ensuring that accuracy is not compromised. In order to enhance the efficiency of integrating descriptive and inferential data frameworks in the context of quantitative data analysis, it is possible to employ a framework synthesis methodology. The approach employed in this study included the integration of quantitative and qualitative data, as evidenced by other scholarly investigations (Townsend et al., 2022). The enhancement of site planning and building design may be achieved by the implementation of a data integration and simplification framework, as proposed by Leng et al. (2021). According to Qiao et al. (2021), the application of dimensionality reduction methods can aid in the simplification and interpretation of intricate data prior to its integration into a supervised learning framework. This particular approach guarantees that the ultimate framework is optimised to facilitate efficient analysis of data.

In summary, these four phases offer a concise plan to assist researchers in creating and improving a thorough framework based on quantitative data analysis. It is essential to acknowledge that the process of constructing a framework may involve iteration, when researchers alternate between several stages while analysing and refining their findings. Furthermore, the capacity to construct a complete framework will also be contingent upon the calibre and dependability of the data employed in the investigation. The steps in constructing a framework from a quantitative data analysis have been simplified in *Figure 1*.

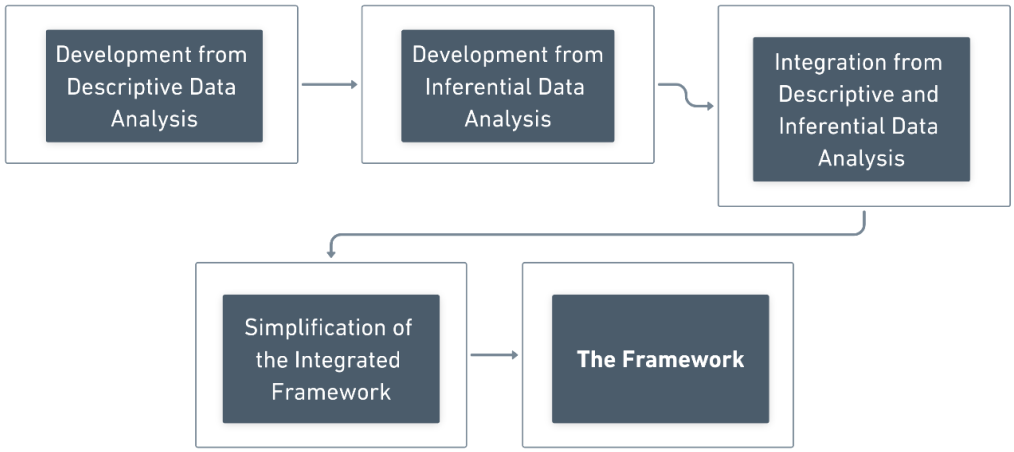

Figure 1. *Simplified version of phases in constructing a framework from a quantitative data analysis.*

Does the quantitative data analysis framework need expert validation?

The research outcome is dependent on the specific research settings. Supplementary experts commonly participate in the validation procedures of research frameworks in specific research settings like industry-based or governmental research. The individuals who may be involved in this process encompass technical reviewers, stakeholders, regulators, government officials, and collaborators. Incorporating their participation can significantly improve the quality of and potential impact of the research framework. Technical reviewers are capable of offering comments on the technical components of the research framework (Rank et al., 2020). In addition, stakeholders, including consumers, investors, and workers who have a significant interest in the study, can offer comments regarding the actual implementation and possible influence of the research framework (Eisman et al., 2021). Regulators and government officials, entrusted with overseeing and governing the industry or sector where the research is conducted, can provide comments on adherence to regulatory requirements within the research framework (Favaretto et al., 2023). In addition, the collaborators, who are individuals engaged in research or possess expertise in the relevant field, collaborate with the research team and offer valuable insights into the viability and potential significance of the study framework (Gasson and Bruce, 2019).

However, examiners can validate the research framework in undergraduate and postgraduate research settings once the completed theses are prepared for examination. This practice can save significant resources, be cost-effective, and be efficient. During the thesis examination, the examiners would evaluate the framework's quality, rigour, and validity, as well as other aspects of the research study (Man et al., 2020). Therefore, there is no significant need for undergraduate and postgraduate to validate their research framework during the research period. Nevertheless, it is important to acknowledge that the extent and degree of endorsement for the validation process would be contingent upon the characteristics of the research, the academic establishment, and the specific circumstances of the study. It is critical to acknowledge that the validation procedure for research frameworks is not a one-time occurrence. Instead, it is a continuous process that persists well beyond the research's completion and publication. Although depending entirely on examiners for validation may provide resource advantages in undergraduate and postgraduate research settings, it is essential to incorporate other sources of validation for research frameworks in further research settings. This is because their input has the potential to enhance the quality and applicability of the framework (Cox et al., 2022). Overall, it is advisable to actively pursue a range of viewpoints and seek validation from other experts, even after the thesis examination process. Ensuring that the research framework meets the expected criteria and benchmarks set by the industry or academic programme is essential.

In essence, the validation procedures for research frameworks may differ depending on the research setting, educational institution, and research circumstances. The inclusion of many experts in the validation process is of utmost importance in order to guarantee the quality, rigour, and potential effect of the research framework. View the validation process as a continuous and iterative procedure rather than a singular occurrence. This allows ongoing enhancement and fine-tuning of the research framework while also guaranteeing its compliance with the most up-to-date standards and optimal methodologies in the field of study.

Conclusion

In conclusion, constructing a framework based on quantitative data analysis offers a multitude of benefits for researchers and their endeavours. It may be beneficial to organise intricate data sets in a manner that is readily interpretable and enables more efficient comparisons and analysis. Various quantitative frameworks exist, each with distinct advantages and disadvantages. Researchers must carefully select the most suitable technique, taking into account the study's purpose, the data at hand, and the research topic. When developing a framework from quantitative data, it is critical to adhere to a series of processes. These phases encompass the selection of suitable software, identification of pertinent variables, formulation and testing of hypotheses, and assurance of statistical validity. Researchers can enhance policy decision-making, ease cross-study comparisons, and expand scientific understanding in their field by adhering to these measures. To enhance the accuracy and reliability of frameworks constructed from quantitative data analysis, it is advisable to investigate the capabilities of machine learning and artificial intelligence (AI) in future studies. Furthermore, scholars have the opportunity to examine the many factors that influence the choice of diverse quantitative frameworks across various academic fields, particularly within the realms of social sciences and health sciences. Moreover, assessing the influence of various factors within a framework and their interconnections may improve the framework's validity and precision, as well as yield more streamlined data analysis results. In conclusion, it is critical to conduct comparative investigations across different frameworks in order to determine their respective merits and drawbacks. This practice serves to enhance comprehension of the construction of frameworks based on quantitative data, thereby bolstering the credibility and reliability of study findings.

Acknowledgement

The author thanks the Academy of Contemporary Islamic Studies, Universiti Teknologi MARA, for technical support.

Conflict of interest

The author confirms that there is no conflict of interest involved with any parties in this research study.

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