Examining the Application of the Semi-Structured Interview Method in Public-Private Partnership (PPP) Infrastructure Studies

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Abstract

Public-Private Partnership (PPP) schemes are increasingly adopted to address infrastructure financing constraints and to support sustainable development objectives. In PPP infrastructure research, semi-structured interviews are widely used to capture in-depth perspectives from key stakeholders. Despite their extensive application, systematic understanding of how these interviews are designed, implemented, and reported remains limited. This study examines the application of semi-structured interview methods in PPP infrastructure research through a systematic literature review of studies indexed in the Scopus and Web of Science databases. The review evaluates research approaches, interview mediums, data collection and analysis techniques, software utilization, interview duration, participant selection criteria, sampling strategies, data saturation, and practices related to rigor and trustworthiness. The findings indicate that semi-structured interviews are predominantly employed within qualitative research designs and are frequently combined with thematic analysis and qualitative data analysis software. Face-to-face interviews and purposive sampling of experienced PPP stakeholders emerge as the most common practices. However, the review also identifies notable inconsistencies in the definition and reporting of data saturation and qualitative rigor across studies. This study contributes to methodological advancement by providing a structured overview of current practices and highlighting areas where clearer and more consistent reporting is required. The findings offer practical guidance for researchers and practitioners seeking to strengthen methodological rigor and transparency in PPP infrastructure research.

Keywords

Infrastructure, Method, Public-Private Partnership, Semi-structured Interview, Qualitative

INTRODUCTION

Countries around the world are engaged in infrastructure development to meet national objectives, including driving economic growth and enhancing public welfare [1, 2]. However, the process of infrastructure development is often constrained by the limited financial resources available to governments. As a result, the Public-Private Partnership (PPP) model serves as a viable alternative for infrastructure development, involving investors to support long-term public infrastructure needs [3, 4]. Moreover, researchers across various nations have shown significant interest in the implementation of this model for infrastructure development at the national level. In a broader context, studies on infrastructure development have contributed to success in multiple sectors, such as urban rail transportation [5, 6], airports [7, 8], road or highway [9, 10], water and wastewater improvements [11, 12], solid waste management [13, 14], renewable energy [15, 16], and social infrastructure sectors, including housing [17, 18], healthcare services [19, 20], sports facilities [21] and road facilities [22].

On the other hand, numerous researchers globally employ the semi-structured interview method across a range of studies. This method is particularly beneficial due to its flexibility, enabling the exploration of questions that may reveal new perspectives on previously unexplored issues [23]. It also provides participants with the opportunity to express their opinions openly, allowing researchers to gather comprehensive and in-depth information from diverse fields [24]. Additionally, semi-structured interviews are recognized as an effective approach because they go beyond fixed questions, allowing respondents to introduce other relevant topics. Compared to questionnaires, semi-structured interviews are often preferred in academic literature for their ability to capture more genuine insights into the subject of research [25]. This method is also favored over both structured and unstructured interviews, as it offers a deeper understanding of participants' perspectives while maintaining a high level

of objectivity. This contrasts with the limitations of structured interviews and the difficulties inherent in analyzing responses from unstructured interviews [26].

Consequently, a growing number of researchers worldwide, particularly those specializing in PPP infrastructure studies, have adopted the semi-structured interview method, leveraging its distinctive attributes. In the past five years, there has been a notable increase in interest surrounding PPP infrastructure research, as evidenced by the diverse infrastructure sectors examined across various countries, documented in prominent databases such as Web of Science (WoS) and Scopus. Although some studies have explored the application of semi-structured interviews, many have yet to provide a comprehensive analysis of the method's key characteristics, including the mediums used for interviews, the software tools applied, the duration of interviews, and the criteria for participant selection and sampling. Additionally, considering the qualitative nature of the semi-structured interview method, it is vital to account for differences in data saturation, rigor, and trustworthiness, especially in the context of PPP infrastructure studies.

The semi-structured interview approach are notable similarities and discrepancies in the ways data collection and analysis are executed. These differences may lead to divergent views on the practical application of semi-structured interviews in future PPP infrastructure research. This study further enriches the academic conversation by focusing on the application of semi-structured interviews specifically within PPP infrastructure research. While previous studies have examined the implementation of PPP projects and associated challenges using a variety of qualitative methods, there has been limited attention given to systematically evaluating the effectiveness and suitability of semi-structured interviews in extracting detailed insights from key stakeholders in PPP infrastructure projects. This research addresses this gap by concentrating on the methodological considerations of semi-structured interviews, contributing valuable insights to both the academic literature on qualitative research methods, especially semi-structured interviews method and practical applications in PPP infrastructure development.

A detailed and systematic approach is crucial for examining the application of the semi-structured interview methods in PPP infrastructure research through a Systematic Literature Review (SLR). SLR serves as a method for organizing and analyzing extensive literature while following established protocols, such as PRISMA [27, 28]. This approach enables the consistent extraction of information from diverse sources, ensuring research objectives are met while minimizing ambiguities in the data. This research concentrates on the application of the semi-structured interview methods in PPP infrastructure research conducted over the past five years (2020–2024). Data is drawn from reputable databases, including WoS and Scopus, which are widely recognized as authoritative sources for high-quality scholarly research. The initial stages of the study describe the selection and determination process for articles serving as primary references in the SLR. This is followed by a comprehensive analysis and discussion of the findings concerning the application of the

semi-structured interview methods in PPP infrastructure studies.

RESEARCH SIGNIFICANCE

This study provides a systematic analysis of semi-structured interviews in PPP infrastructure research, offering insights into interview design, implementation, and reporting practices. The findings help researchers enhance methodological rigor, while also guiding policymakers and practitioners in applying reliable qualitative semi-structured interview approaches to support effective PPP infrastructure development.

METHODOLOGY

Conducting a systematic review of a topic offers several advantages. It allows for a focused examination of the subject under investigation, enabling the acquisition of in-depth and more comprehensive information. This approach also facilitates the identification of trends in how the topic is discussed, utilized, or updated over time, thereby allowing for projections regarding its future development and relevance [29, 30]. Furthermore, a systematic review of a topic or research area provides more comprehensive support in addressing research objectives compared to unsystematic or random reviews. It can also be used to compare different topic reviews, evaluate various aspects or trends of a topic over time ranging from historical and current perspectives to future projections whether in terms of its application or its combination with other topics [31-33].

This SLR was conducted over the past five years, from 2020 to November 13, 2024, with the aim of obtaining the latest discussions from the reviewed literature. The SLR was systematically and meticulously organized following established procedures to provide opportunities for innovation or new discussions in future studies on PPP infrastructure using the semi-structured interview methodology. Additionally, it aims to enhance the future application of findings identified in this research. The PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) procedure was adopted to ensure a systematic literature review following several steps or criteria, including identification, screening based on defined criteria, eligibility assessment, and abstraction or synthesis of selected review articles [28, 34]. The PRISMA procedure has been proven effective as a systematic review approach, yielding comprehensive, inclusive, and in-depth results on various topics [35]. Therefore, the adoption of the PRISMA protocol in this study is expected to support the findings related to PPP infrastructure studies employing the semi-structured interview methodology. Further details about the PRISMA protocol are provided in Figure 1.

A. IDENTIFICATION

The first step in the PRISMA process involves the identification phase in conducting a systematic literature review, which requires the use of at least one reputable database to ensure the research objectives are achieved and to maintain the quality of the study's findings [28, 36]. In

this research, the systematic review of the topic utilized two reputable databases, namely Web of Science (WoS) and Scopus. These databases are widely recognized by researchers globally as competent references with above-average quality and are even utilized in university ranking systems by various ranking institutions. The identification process employed the keyword "PPP Semi-structured Interview" to represent studies on PPP infrastructure using the semi-structured interview methodology in both WoS and Scopus. This process resulted in a total of 141 articles from Scopus and 102 articles from WoS.

B. SCREENING

The first step of the identification process yielded a total of 243 articles, consisting of 141 Scopus-indexed articles and 102 Web of Science (WoS)-indexed articles. These identified documents were subsequently advanced to the second step (see Figure 1), namely the screening stage.

During the screening stage, the articles underwent further examination based on exclusion criteria established for this study [37]. The purpose of defining these criteria was to ensure the systematic review remained focused, aiming to produce findings aligned with the research objectives [38]. The publication year was selected as the primary screening criterion, with the range set from 2020 to November 13, 2024, as this period is considered representative for research involving the use of semi-structured methods in PPP infrastructure studies. In this screening stage, additional criteria were applied to document types. Only journal articles were included, while non-journal documents such as books, book chapters, and conference proceedings were excluded. Furthermore, the language criterion was set to English to avoid potential ambiguities arising from translations during the interpretation of the articles. After completing the screening phase, a total of 114 documents were identified, comprising 58 Scopus-indexed documents and 56 WoS-indexed documents.
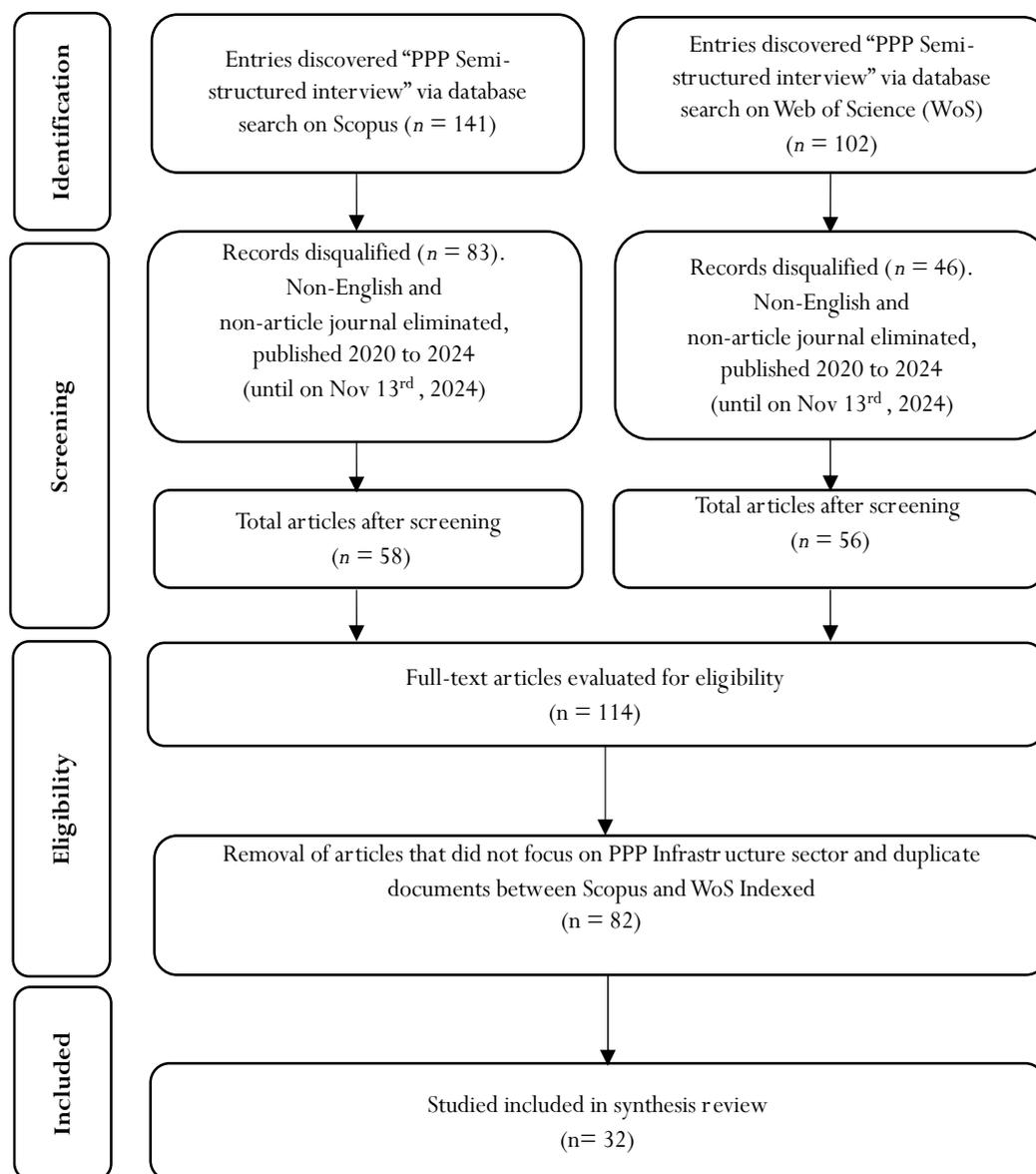

Figure 1 Flow diagram PRISMA procedure adopted

C. ELIGIBILITY

Following the screening stage, the process continued with the eligibility stage. During this stage, the articles collected from the previous step across the two selected databases, Scopus and WoS, were manually evaluated. This evaluation ensured the alignment of the articles' topics with the objectives of this research, thereby guaranteeing high-quality findings [27, 38]. The outcome of this step was the identification of 32 articles that matched the research objective, specifically the application of semi-structured interview methods in PPP infrastructure studies. Additionally, all selected articles underwent a manual review to maintain consistency with the research objectives. It was ensured that the articles were relevant to the context of PPP in infrastructure studies. Articles featuring PPP terminology unrelated to infrastructure studies were excluded from the systematic literature review database. Furthermore, since both Scopus and WoS databases were used, duplicate documents were identified and removed when the same article appeared in both databases. Lastly, in the eligibility stage, manual evaluation included reviewing titles, abstracts, keywords, and a quick review of the methodology section. This process ensured that the selected articles explicitly utilized semi-structured interview methods in PPP infrastructure studies. The results of this eligibility stage will proceed to the abstraction and inclusion stages.

D. DATA ABSTRACTION AND INCLUDE

In the previous eligibility stage, a manual assessment of relevance resulted in 32 articles being selected for the final stage, namely abstraction and inclusion. In this stage, a comprehensive and meticulous systematic review was conducted for each selected article. This process involved identifying categories relevant to the research objectives by examining specific elements [39] such as the title, type of research, research location, and specific categories related to the use of semi-structured interview methods in PPP infrastructure studies.

RESULTS AND DISCUSSIONS

A. CATEGORY BY YEAR, PUBLISHER AND RANKINGS

A total of 32 selected articles on the topic of using semi-structured interview methods in PPP infrastructure studies, sourced from two high-quality databases, Scopus and WoS, were reviewed in detail and systematically following the PRISMA procedure outlined in the methodology section. This approach ensured consistency and alignment with the research objectives. As shown in Table 1, research on the use of semi-structured interview methods in PPP infrastructure studies is predominantly published by journals based in the United Kingdom (UK), accounting for 41%, followed by Switzerland at 25% and the United States

of America (USA) at 13%. Additionally, journals from the Netherlands (9%), Malaysia (6%), and India and Poland (3% each) also contributed to the publications. The leading journals in this domain include Sustainability, Buildings, Engineering Construction and Architectural Management, and the International Journal of Construction Management.

The selected articles are of high reputational quality, as evidenced by their journal impact quartiles. More than half (53%) of the systematically reviewed journals are ranked in Q1, followed by 34% in Q2, with 9% and 3% in Q3 and Q4, respectively. This indicates that the collection of systematically reviewed articles on the use of semi-structured interview methods in PPP infrastructure studies is, on average, of high quality. This is expected to yield robust research findings aligned with the research objectives. Furthermore, the consistent use of semi-structured interview methods in PPP infrastructure studies is reflected in the high quality of the articles in which they are published.

B. CATEGORY BY RESEARCH LOCATIONS AND SECTOR INFRASTRUCTURE

The PPP scheme serves as a mechanism to accelerate the development of sustainable infrastructure by involving the private sector as a partner to achieve mutually beneficial goals [4, 66]. Figure 2 shows that the research locations are predominantly in Asia and Africa, where there is a significant need for adequate infrastructure development to support economic growth. The use of semi-structured interviews in infrastructure studies also includes engaging PPP experts or local infrastructure specialists as part of achieving the research objectives. In Asia, Iran leads with 9%, followed by China, Malaysia, and Turkey, each at 6%. Subsequently, Indonesia, India, the Philippines, Myanmar, Mongolia, Thailand, Kazakhstan, and Japan contribute 3% each. In Africa, Ghana leads with 9%, followed by Tanzania at 6%. Additionally, South Africa, Zambia, Mozambique, Ethiopia, Lesotho, Nigeria, and Egypt each account for 3%. Beyond Asia and Africa, research locations are also identified in Europe, the Americas, and Australia, with Chile, the UK, and Australia each contributing 3%. Meanwhile, research utilizing semi-structured methods in PPP infrastructure studies has significantly contributed to various infrastructure development sectors, as illustrated in Figure 3. The healthcare and general infrastructure management sectors lead with a contribution of 19%, followed by water and wastewater at 16%, and housing and roads at 9%. Subsequently, the renewable energy and building sectors each account for 6%. The remaining sectors, including transportation, public toilets, tourism infrastructure, solid waste management, and education infrastructure, each contribute 3%. Consequently, experts from each infrastructure sector were extensively involved in discussions addressing research issues to achieve the objectives of PPP schemes using the semi-structured interview method.

Table 1 Category by Year, Publisher and Rankings

Authors (Year)	Code Article (A)	Title of Journal	Journal Impact Quartile	Country Publisher
Dolla and Laishram [40]	A1	Journal of Infrastructure System	Q2	USA
Helmy, et al. [41]	A2	Journal of Open Innovation: Technology, Market, and Complexity	Q1	Switzerland
Azami-Aghdash, et al. [42]	A3	Chinese Journal of Traumatology	Q2	USA
Damoah, et al. [43]	A4	International Journal of Construction Management	Q1	UK
Kavishe and Chileshe [44]	A5	International Journal of Construction Management	Q1	UK
Castelblanco, et al. [45]	A6	Sustainability	Q1	Switzerland
Casady and Peci [46]	A7	Economic Research-Ekonomska Istrazivanja	Q2	UK
Gebremeskel, et al. [47]	A8	Engineering Construction and Architectural Management	Q1	UK
Chileshe and Kavishe [23]	A9	Built Environment Project and Asset Management	Q1	UK
Mouraviev [48]	A10	Nispacee Journal of Public Administration and Policy	Q3	Poland
Deladem, et al. [49]	A11	Tourist Studies	Q2	USA
Jotaworn, et al. [14]	A12	Sustainability	Q1	Switzerland
Azzopardi, et al. [50]	A13	Lancet Regional Health-Western Pacific	Q1	Netherlands
Haqq and Gultom [51]	A14	Journal of Financial Management Of Property and Construction	Q2	UK
Abdullahi, et al. [52]	A15	Smart and Sustainable Built Environment	Q1	UK
Asamoah, et al. [53]	A16	Research in Transportation Business and Management	Q1	Netherlands
Etemadi, et al. [54]	A17	Journal of Education and Health Promotion	Q2	India
Li, et al. [55]	A18	Systems	Q1	Switzerland
Sinkala, et al. [56]	A19	Public Works Management & Policy	Q3	USA
Zulu, et al. [26]	A20	Journal of Engineering Design and Technology	Q2	UK
Lima, et al. [57]	A21	Infrastructures	Q2	Switzerland
Dai, et al. [58]	A22	Buildings	Q1	Switzerland
Akhtar, et al. [59]	A23	Buildings	Q1	Switzerland
Lop and Ismail [60]	A24	International Journal of Sustainable Construction Engineering and Technology	Q4	Malaysia
Gharaee, et al. [24]	A25	Journal of Water and Health	Q2	UK
Budayan, et al. [25]	A26	Engineering Construction and Architectural Management	Q1	UK
Khan and Khan [61]	A27	Sustainability	Q1	Switzerland
Ongel, et al. [19]	A28	International Journal of Construction Management	Q1	UK
Jayasuriya, et al. [62]	A29	Transportation Research Interdisciplinary Perspectives	Q1	Netherlands
Alexander [63]	A30	Journal of Health Organization and Management	Q2	UK
McGuire, et al. [64]	A31	Annals of Global Health	Q2	UK
Aron, et al. [65]	A32	Planning Malaysia	Q3	Malaysia

B. CATEGORY BY RESEARCH LOCATIONS AND SECTOR INFRASTRUCTURE

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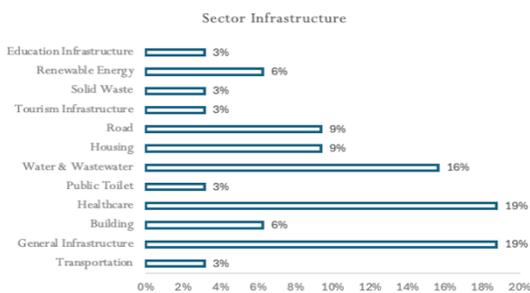

Figure 2 Detail Research Location in this Research

Figure 3 Detail Sector Infrastructure used Semi-Structured Interview Method

C. CATEGORY BY RESEARCH APPROACH, DATA COLLECTION AND ANALYSIS METHOD

Research articles utilizing the semi-structured interview method in PPP infrastructure studies demonstrate that qualitative research approaches dominate, accounting for 75% (see Figure 4), followed by mixed methods at 25%. This is understandable, as qualitative research philosophy interprets the world through words [67, 68]. This approach aligns with the nature of semi-structured interviews, which delve into respondents' insights to explore new perspectives or emerging issues [69], requiring expert opinions to address specific problems. Meanwhile, the semi-structured interview method in PPP infrastructure studies can also be applied in combination with mixed methods. Here, the role of semi-structured interviews often focuses on validating or establishing variables or indicators, as demonstrated by Jotaworn, et al. [14], Ongel, et al. [19], Damoah, et al. [43]. Consequently, the semi-structured interview method can complement quantitative approaches, facilitating the integration of mixed methods.
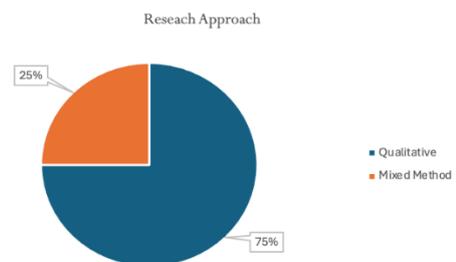

Figure 4 Ratio Research Approach in this Research

Subsequently, the data collection method employed in this study, utilizing semi-structured interviews in the context of PPP infrastructure research, as presented in Figure 6, predominantly relies on the interview protocol, accounting for 75%. This ratio reflects the qualitative research approach adopted in the study. Meanwhile, a combination of data collection methods involving both the interview protocol and questionnaires constitutes 25%, further representing the mixed-method research approach previously discussed.
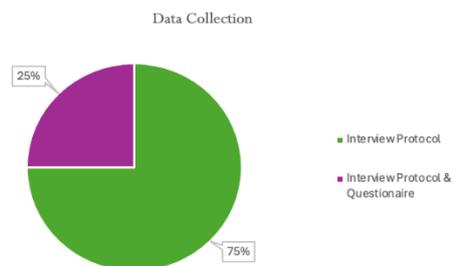

Figure 5 Ratio Data Collection in this Research

In terms of data analysis, the use of semi-structured interviews in PPP infrastructure research is predominantly characterized by thematic analysis,

accounting for 53%. Thematic analysis is widely employed in qualitative approaches due to its ability to interpret interview responses from experts by coding the data and drawing conclusions based on identified themes [70, 71]. This is followed by content analysis at 22%, qualitative and modeling analysis at 13%, thematic and statistical analysis at 6%, and 3% each for qualitative & statistical analysis and content & statistical analysis. An interesting observation is that several qualitative analysis methods can be combined with quantitative approaches (mixed methods), such as through the integration of modeling analysis and statistical analysis. The ratios of data analysis methods used in the application of semi-structured interviews in PPP infrastructure research are presented in Figure 6.
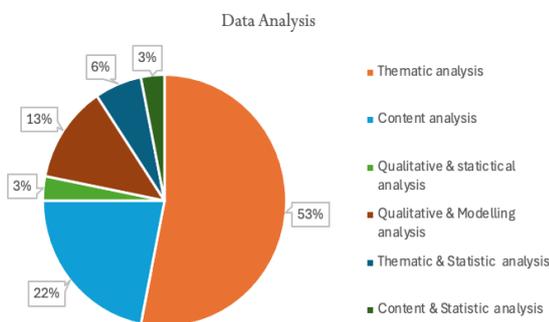

Figure 6 Ratio Data Analysis in this Research

D.   CATEGORY BY CO-OCCURRENCE AND CO-AUTHORSHIP ANALYSIS

This study conducted an analysis based on keywords or co-occurrence within selected articles from two databases (WoS and Scopus) using the PRISMA process, as previously described. The co-occurrence analysis was visualized using VOSviewer software, which illustrates the use of keywords in research employing semi-structured interview methods within PPP infrastructure studies. This analysis is significant because keywords represent a primary focus of a study, necessitating a clear depiction of co-occurrence analysis [33, 72]. The benefit of this analysis lies in its ability to identify thematic domains or research topic trends related to the use of semi-structured interview methods in PPP infrastructure studies.

The mapping of co-occurrence in this study reveals trends illustrated in Figure 7. Research on the use of semi-structured interview methods in PPP infrastructure studies from 2020 to 2021 focused on themes such as local government, governance approaches, private partnerships, developing countries, housing, projects, and Hong Kong. From 2021 to 2022, the focus shifted to topics such as public-private partnerships, critical success factors, infrastructure, performance, waste management, Indonesia, delivery, systems, and impact. Meanwhile, from 2022 to 2024, the research emphasized themes including success, frameworks, public-private partnerships, management, criteria, systems, allocation, and management. Co-authorship analysis was conducted to examine the collaboration relationships among researchers in studies using the semi-structured interview method in PPP infrastructure research (see Figure 8). The academic collaboration network, collaboration patterns among researchers involved in publications within a specific field, how researchers work together on research projects, and emerging trends in researcher partnerships are analyzed in this study with the aim of providing further insights [72, 73]. The co-authorship in this research from 2020 to 2022 involved Saadati, Sadeghi-Bazargani, Azami-Aghdash, Mohseni, and Gharaee. Meanwhile, from 2023 to 2024, researchers Gholami, Aghdash, and Dewey were involved.
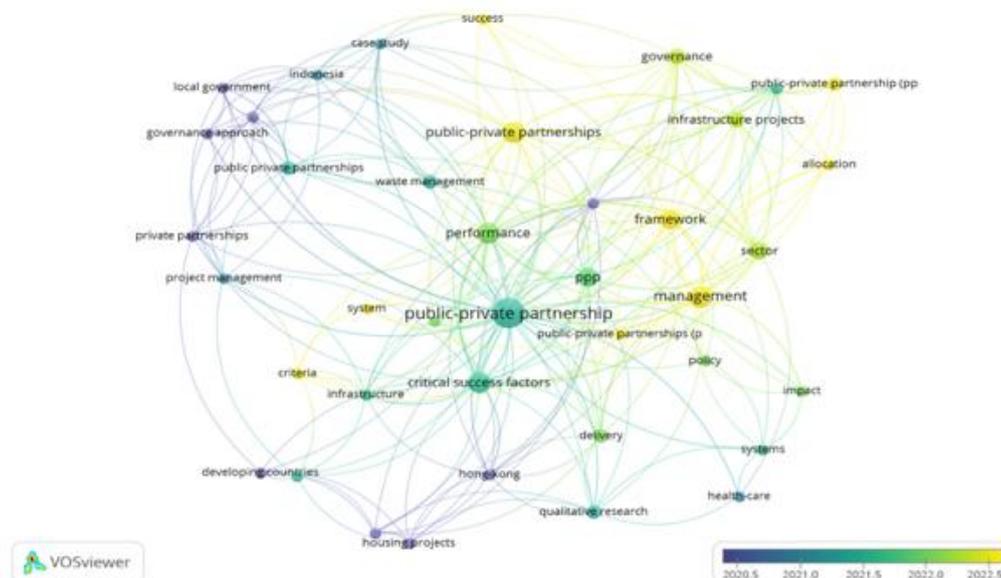

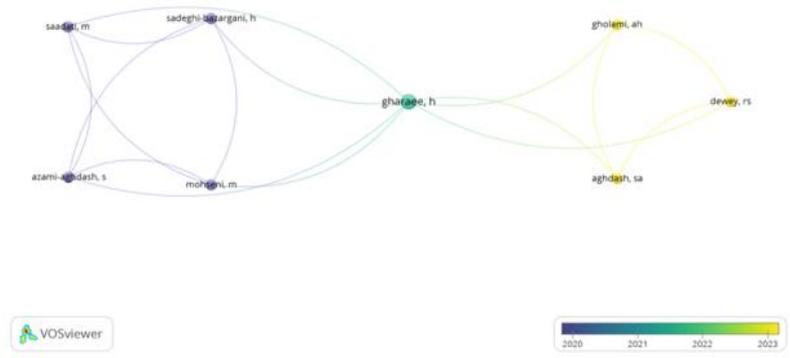Figure 7 Mapping Co-occurrence in this Research

Figure 8 Mapping Co-authorship in this Research

E CATEGORY BY SEMI-STRUCTURED INTERVIEW METHOD APPLICATION (MEDIUM OF INTERVIEW, SOFTWARE UTILIZATION, AND TIME DURATION)

In the semi-structured interview method, data is collected from participants through interviews conducted either conventionally (face-to-face) or online/virtual [59]. In this study on the use of semi-structured methods in PPP infrastructure research, 31 articles were identified that discussed the medium of interviews, with the majority (94%) conducted face-to-face and 6% online (see Figure 9). Face-to-face interviews have the advantage of exploring gestures and building rapport with participants, while online interviews offer greater flexibility and reduced costs, such as eliminating transportation expenses [26]. Furthermore, online interviews began to gain popularity after the COVID-19 pandemic and may be increasingly adopted in the future. Both face-to-face and online methods have their respective advantages and disadvantages. Therefore, the choice of medium should be adjusted to suit the context, distance, and agreement between parties to ensure the research findings align with the study's objectives. In research application of the semi-structured method in PPP infrastructure studies, 11 articles mentioned the use of software for qualitative data analysis. As shown in Figure 10, NVivo emerged as the most popular software, used by 82% of researchers, followed by Atlas Ti and MAXQDA, each at 9%. In qualitative research, many researchers use software to facilitate the analysis of large amounts of textual data, especially when interviews have extensive durations. Additionally, such software assists in visualizing findings, making it easier to interpret results. On the other hand, using software in qualitative research, particularly with semi-structured interviews, also enhances objectivity, as the analytical process can be traced and reviewed by others if necessary. The choice of software depends on the context, preferences,

and features required by researchers, ensuring that the research findings align with the objectives of the study.
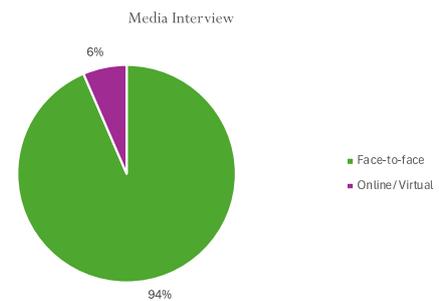

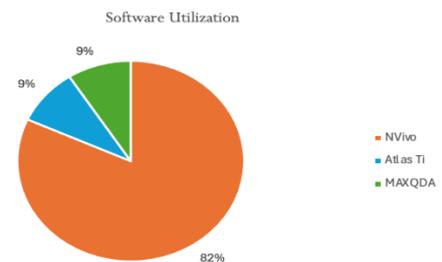Figure 9 Medium of Interview Usage in this Research

Figure 10 Software Utilization in this Research

The semi-structured interview method requires a certain time duration for the interview process [69]. In research utilizing semi-structured interviews in PPP infrastructure studies, 17 articles discussed the time duration involved in their interview processes. Most researchers, on average, conducted interviews lasting more than 60 minutes (41%), followed by averages of less than 45 minutes and 45 to 60 minutes, each accounting for 29% (see Figure 11). The duration depends on factors such as the number of questions in the interview protocol, the responses provided by participants, and the interaction between the parties involved [68, 74]. Therefore, researchers can estimate

the time duration by conducting a pilot study interview beforehand, ensuring consistency in the context of the interview protocol during the actual interviews.
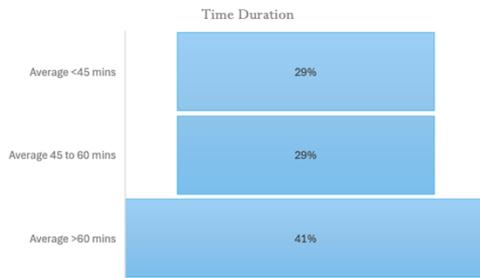

Figure 11 Average Time Duration for Semi-structured Interview

F. CATEGORY BY SEMI-STRUCTURED INTERVIEW METHOD APPLICATION (PARTICIPANT, CRITERIA, SAMPLING)

A key element of the semi-structured interview method is determining the number of participants, the criteria for selecting them, and how to identify or choose a sample that aligns with the research objectives [67]. In qualitative research, there are no specific requirements for the number of participants, nor is there a prescribed sample size. While sample size is an important consideration for obtaining reliable results, the primary focus should be on the depth of the data rather than the frequency within the sample size [25]. Moreover, a large sample size is not a decisive factor in the quality of qualitative research. Studies with relatively small samples can still uncover a broad range of core issues if participants possess relevant experience with the phenomenon being studied. This highlights that the rich, detailed knowledge from a carefully selected small sample is a significant strength of qualitative research [26]. As shown in Table 2, the number of participants ranges from a minimum of 3 experts to a maximum of 39 experts. However, the average number of participants in studies using the semi-structured interview method in PPP infrastructure research tends to be between 10 and 20 experts. In terms of sampling strategies, purposive or judgment sampling is a non-random technique where participants are selected based on specific characteristics or attributes that are relevant to the research goals [58, 69]. With purposive sampling, the researcher deliberately chooses individuals with the necessary experience, knowledge, or expertise related to the study. In the studies reviewed, all utilized the purposive sampling approach for conducting semi-structured interviews in PPP infrastructure research (see Table 2). The criteria established by researchers, as shown in Table 2, vary considerably, but common elements include the involvement of the public and private sectors, academia, and NGOs. These criteria are essential because they help control the variation among participants [44]. Thus, the number of participants alone does not guarantee the quality of the findings. Rather, ensuring the appropriate selection of expert criteria is equally critical.

Table 2 Details Participants, Criteria, and Sampling

Code	Participants	Sampling	Criteria
A1	34	Purposive/ Judgement	• The respondents mostly come from public, private, advisory sectors, and concessionaire (SPV) organizations. Interviews involved personnel with 5 to 25 years of experience.
A2	32	Purposive/ Judgement	• The participants were PPP practitioners from public and private sectors, directly involved in PPP projects during the O&M phase, with an average of 8 years' experience in managing such projects.
A3	12	Purposive/ Judgement	• The stakeholders include SPVs, EPC companies, O&M companies, and Multilateral Development Bank (MDB).
A4	8	Purposive/ Judgement	• The criteria focused on engaging project staff to understand community relations and how partners managed community engagement and building initiatives during implementation.
A5	10	Purposive/ Judgement	• Participants were from the Government PPP unit and related organizations in Zambia with at least 3 years of PPP project experience.
A6	15	Purposive/ Judgement	• Participants were eligible if they had extensive experience with PPP contracts in Mozambique, working with governments, regulators, and utilities. Their expertise and affiliations ensured reliable opinions.
A7	12	Purposive/ Judgement	• Participants were from the two main partners: the public sector and private partners.
A8	6	Purposive/ Judgement	• Participants included a company leading PPP healthcare projects in Turkey, selecting experts based on their project experience, responsibilities, and roles.
A9	21	Purposive/ Judgement	• The stakeholders involved in the project tourist toilets are tourists, private entities, and the public sector.
A10	3	Purposive/ Judgement	• The stakeholders in water environmental treatment PPP projects include the public sector, private entities, and academics.

Code	Participants	Sampling	Criteria
A11	10	Purposive/ Judgement	• Professionals with over 5 years of experience in road PPP projects, with roles in academia, project management, contract management, consulting, government, or O&M contracting.
A12	12	Purposive/ Judgement	• Professionals with at least 5 years of experience in high-level management of PPP projects in South Africa (SA). The participants included private partners, public partners and transaction advisors
A13	10	Purposive/ Judgement	• Practitioners from both the public and private sectors.
A14	14	Purposive/ Judgement	• Executives, senior managers, the Tax Administration and the municipality.
A15	19	Purposive/ Judgement	• Two professional groups both public and private partners, with roles in PPP projects and significant experience, having at least five years of experience in PPPs.
A16	13	Purposive/ Judgement	• Employees from middle and senior management involved in managing the partnerships.
A17	3	Purposive/ Judgement	• Expert with at least 20 years of experience in the Ethiopian construction industry and over 10 years in PPP projects.
A18	10	Purposive/ Judgement	• Top management from the public and private sectors, researchers, PPP advisors, and consultants were included to provide insights into HPPP practices.
A19	24	Purposive/ Judgement	• Organizations in Kazakhstan with expert knowledge or practical experience in PPPs and a willingness to share their insights.
A20	17	Purposive/ Judgement	• Specific contractors or organizations were contacted through their companies (PMPs and contractors) and relevant ministries, departments, and agencies (clients).
A21	15	Purposive/ Judgement	• Health system experts and individuals familiar with PPP models, with at least 3 years of experience, senior executive roles, and PPP-related experience, who were willing to participate in the interview.
A22	15	Purposive/ Judgement	• Both public and private sectors, such as Tourism Enterprises, the National Commission on Culture, Ministry of Tourism, Culture and Creative Arts, Environmental Protection Agency, Forestry Commission, NGO, and the Tourism Authority.
A23	Not mention	Purposive/ Judgement	• Expertise in solid waste and tourism.
A24	32	Purposive/ Judgement	• Public and private sector participants, along with young people, across Mongolia (10 stakeholders), Myanmar (10 stakeholders), and the Philippines (12 stakeholders).
A25	26	Purposive/ Judgement	• The executive team, department heads, and staff at facilities.
A26	22	Purposive/ Judgement	• Stakeholders include academics, government officials, and organizations with at least 2 years, Iranian nationality, native Persian speakers, and willingness to participate.
A27	20	Purposive/ Judgement	• The stakeholders include medical schools, universities, private organizations, health experts, and researchers.
A28	16	Purposive/ Judgement	• The project involves the government, private sector, and consultants.
A29	25	Purposive/ Judgement	• Stakeholder organizations in Nigeria's energy sector, with participants holding at least a managerial position and 3 years of work experience.
A30	5	Purposive/ Judgement	• The public sector in Malaysia has expertise and experience in PPP projects, with all participants knowledgeable in PPP and e-tendering.
A31	39	Purposive/ Judgement	• The stakeholders include the public sector, private sector, NGOs, and transaction advisors.
A32	13	Purposive/ Judgement	• Egyptian experts with at least 5 years of experience in PPP education projects

G. CATEGORY BY SEMI-STRUCTURED INTERVIEW METHOD APPLICATION (DATA SATURATION)

The determination of sample size in semi-structured interviews is closely linked to the concept of saturation. In qualitative research, sample size is commonly determined by achieving saturation, the point at which data collection no longer yields new themes, insights, or information [75]. This indicates that the collected data is sufficient to comprehensively address the research question, making additional data collection unnecessary [69]. Consequently, when participant responses begin to show consistent or repetitive patterns with previous responses, the data is considered to have reached saturation. In qualitative studies, sample size is not necessarily a primary concern, regardless of whether it is large or small. Instead, emphasis is placed on the richness and depth of the data collected rather than the frequency or number of participants [42]. A larger sample size does not automatically enhance the quality of qualitative research; the key factor lies in the relevance of participants' experiences to the phenomenon under investigation. The focus is on obtaining in-depth and meaningful insights from purposefully selected participants [44]. Additionally, managing variation within the participant sample is an important consideration, particularly in semi-structured interview methods [50]. In PPP infrastructure research using semi-structured interviews, the saturation model is predominantly employed to determine sample adequacy. Saturation is achieved when no new themes or codes emerge, as explained by Saunders, et al. [76]. Nevertheless, some researchers extend sampling beyond the saturation point to enhance the reliability of the findings [24, 62]. A total of 13 articles examining data saturation in semi-structured interviews within the context of PPP infrastructure research are summarized in Table 3.

Table 3 Detail Data Saturation

Code	Data Saturation
A3	• Data saturation was reached with 22 experts in this study. The process continued until data saturation was achieved, indicating that no new data was anticipated.
A4	• The sample size was not set in advance, but saturation was reached when no new challenges appeared.
A5	• In this study, saturation occurred after the 10th interview, leading to the end of data collection. The concept of saturation is that once it is achieved, the results can be generalized, and a sample size of 5 to 50 interviews is usually sufficient to reach saturation.
A9	• While the sample size may be small, saturation was reached due to the early stages of PPP in Tanzania.

Code	Data Saturation
A10	• The sample size was suitable, as data saturation was achieved after approximately 20-21 interviews, and further interviews were unlikely to yield new insights.
A16	• Despite the small sample size, this did not undermine the study's strength, as the information gathered reached saturation for presentation and analysis.
A17	• The sample size was determined by reaching information saturation, with sampling concluding once no new codes were identified.
A20	• Although the sample size was small, the interviews in this study generated recurring comments on most themes, suggesting data saturation.
A22	• The number of respondents for each type was decided using the information saturation technique, which involved conducting interviews until new perspectives stopped emerging.
A23	• Data saturation was achieved with 30 participants.
A25	• 15 participants were initially sampled until information saturation was reached, meaning no new data was expected. However, sampling continued with 20 individuals to ensure enhanced reliability.
A29	• No new codes emerged after the 17th interview, signifying that saturation was achieved. As a result, no further interviews were conducted beyond the 19 participants in the sample, as confirmed by the content analysis of the interview data.
A31	• Due to the diversity in respondent demographics, all interviews were coded instead of stopping when saturation was reached in specific themes.

H CATEGORY BY SEMI-STRUCTURED INTERVIEW METHOD APPLICATION (DATA RIGOR AND TRUSTWORTHINESS)

In the application of semi-structured interviews for PPP infrastructure research, it was discovered that three articles address the application of rigor and trustworthiness in qualitative research. These two factors are essential in qualitative studies as they guarantee the reliability and accuracy of the findings [24]. Rigor refers to the carefulness and precision in the research process, while trustworthiness includes the credibility, dependability, transferability, and confirmability of the data [54]. Without rigor and trustworthiness, the findings of qualitative research may be questioned, undermining their validity. Together, these elements ensure that the research results are not only pertinent but also valid and accountable, offering assurance that the findings faithfully represent the views

and experiences being investigated [42]. A detailed summary of rigor and trustworthiness is provided in Table 4.

Table 4 Detail Data Rigor and Trustworthiness

Code	Data Rigor and Trustworthiness
A3	• Rigor and trustworthiness were enhanced by applying four criteria: credibility and confirmability were ensured through extended involvement, expert feedback, and validating interview summaries with participants to address any mistakes; dependability was achieved by involving two researchers in coding; and transferability was strengthened through expert insights and purposive sampling.
A17	• Rigor and trustworthiness were assessed using four criteria: credibility, transferability, dependability, and confirmability. Credibility was ensured through triangulation, member checks, prolonged engagement, and adequate time for data collection. Transferability was achieved by including participants from different backgrounds and providing detailed descriptions. Dependability involved having qualitative researchers review and validate the study process and results. Finally, coding and theme extraction were carried out by two unbiased researchers to ensure objectivity.
A25	• Rigor and accuracy were enhanced through a structured approach involving credibility, confirmability, dependability, and transferability. Credibility and

Code	Data Rigor and Trustworthiness
	confirmability were achieved through extended engagement, expert reviews, and respondent validation by allowing participants to review and correct interview summaries. Dependability was ensured by having two researchers participate in the coding process, while transferability relied on expert opinions and purposive sampling. The study also incorporated mixed methods and emphasized transparency and researcher consensus.

I. CATEGORY BY SEMI-STRUCTURED INTERVIEW METHOD APPLICATION (COLLECTING DATA PROCESS AND ANALYZING PROCESS)

Qualitative research, especially those utilizing semi-structured interviews, involves varying approaches to data collection and analysis, depending on the research questions and goals. In the context of applying semi-structured interviews to this PPP infrastructure study, insights are derived from 20 articles that provide an in-depth analysis of the data collection and analysis methods used by the researchers, with summaries shown in Table 5. Furthermore, while the same semi-structured interview method is employed, there are both similarities and differences in the ways data collection and analysis are approached, which can be adapted or combined to suit the specific needs and objectives of each study.

Table 5 Summary of Data Collection and Analysis Process in this SLR

Code	Collecting Data Process	Analysis Data Process
A1	Interviews were conducted using a case study protocol, combining conversational questioning with probes to gather relevant data and experiences.	Open and axial coding were applied to the transcripts, with qualitative scores assessing evidence strength.
A2	Interviews with education experts in Egypt were conducted to identify key themes related to the research objectives.	Interviews were analyzed with thematic and content analysis, using NVIVO codes to identify key themes from the responses.
A3	Participants consented, interviews were in Persian, and transcriptions were done immediately.	Content analysis identified themes in the data, involving code extraction, theme refinement, and reliability checks.
A4	Participants were invited via official letters, and interviews were held at convenient locations and recorded as preferred.	Interview data were analyzed in NVivo12 using thematic analysis, involving coding, theme identification, and interpretation.
A5	Transcripts were emailed for confirmation and feedback, with digital signatures ensuring security and transparency.	Content analysis uses three approaches to interpret meaning, revealing differences between public and private interviewees.
A7	After the first interviews, questions were updated, some answered by phone. Interviews were recorded, transcribed, and reviewed	After the interviews, data was coded into categories and smaller units for analysis.

Code	Collecting Data Process	Analysis Data Process
A9	Interview transcripts were sent to participants for verification and feedback, improving the data's accuracy and credibility.	The data was analyzed using content analysis, focusing on the five stages of innovation: awareness, interest, evaluation, trial, and adoption.
A13	Ethics approval and participant consent were obtained, and interviews were recorded, transcribed, and verified for accuracy.	Transcripts were analyzed, validated in workshops, coded in NVivo 12, and recommendations checked for accuracy.
A14	Interviews were in Indonesian or English, with data verified by comparing responses from different sectors.	Narrative analysis created project timelines, with coding linking issues to delays and failures in a conceptual map.
A15	Interviews were recorded and transcribed, then coded to identify key barriers and analyzed through content analysis	Interviews were transcribed and analyzed, with technical codes grouped into themes.
A16	The semi-structured interviews used preset and follow-up questions, with consent and confidentiality agreements signed.	Qualitative data analysis involved transcribing interviews, organizing notes, and developing themes to present the findings clearly.
A17	Participants were interviewed at their workplaces over five months, with consent and confidentiality, and transcriptions done immediately.	The interviewer transcribed the interviews, identified initial codes, and worked with the team to finalize codes, themes, and sub-themes.
A19	Participants received a briefing and consent letter, and their identities were protected with codes. The coded data was then confirmed by them.	Themes were used to analyze transcripts, organizing statements into codes refined with both primary and secondary data.
A20	Participants agreed to recorded interviews about PPP project challenges, which were transcribed with Amberscript.	The data was analyzed by grouping words, organizing codes, and using themes to develop new theory.
A23	The protocol was shared with respondents and updated based on their feedback, including both open and closed questions for extra insights.	The analysis of PPP modes and risks had six steps: understanding data, creating and refining themes, and presenting results using different coding methods.
A25	Interviews were held at participants' workplaces, recorded with consent, and transcribed immediately.	Content analysis identified patterns in the data, with codes and themes refined for reliability.
A26	Twelve out of fourteen professionals participated, with extra questions asked based on their responses and interest.	The interviews were transcribed, key ideas identified, codes developed, and themes named based on related codes.
A29	Interviews explored participants' involvement and strategies in stakeholder management in PPP projects over the past five years.	Thematic analysis identified themes from surveys and data on economic infrastructure, while concept mapping organized interview data.
A31	Interviews were recorded, demographic data collected securely, and participants gave verbal consent. Data was anonymous.	Demographic data were summarized, and interviews were transcribed and analyzed in NVivo using both inductive and deductive coding.
A32	Participants consented after being informed, and interviews were recorded for analysis.	Participants were anonymized, and transcripts were checked for accuracy. Key themes were identified for further analysis.

CONCLUSIONS

This study systematically examines the application of semi-structured interview methods in PPP infrastructure research published between 2020 and 2024. By reviewing 32 high quality journal articles indexed in Scopus and WoS, the study provides an integrated assessment of how semi-structured interviews are designed, implemented, analyzed, and reported across diverse infrastructure sectors and geographical contexts.

The findings indicate that semi-structured interviews are predominantly employed within qualitative research designs, with a substantial number of studies integrating them into mixed method approaches to support variable development and validation. Face to face interviews remain the most frequently used medium, reflecting their ability to capture contextual depth and facilitate rapport building, while online interviews are increasingly adopted due to their flexibility and cost efficiency. Thematic analysis emerges as the dominant analytical technique, often supported by qualitative data analysis software, particularly NVivo, which enhances analytical transparency and methodological rigor. Participant selection consistently relies on purposive sampling strategies, emphasizing professional expertise and experiential knowledge rather than sample size, in accordance with established qualitative research principles.

Despite the widespread adoption of semi-structured interviews, the review reveals notable inconsistencies in the reporting of data saturation, rigor, and trustworthiness. Although many studies reference saturation as a criterion for sample adequacy, its operationalization is frequently insufficiently articulated. Likewise, explicit discussions of credibility, dependability, transferability, and confirmability remain limited across the reviewed literature.

These findings contribute to methodological advancement by clarifying both strengths and limitations in current research practices. From a practical perspective, the study offers guidance for researchers, policymakers, and practitioners in designing robust qualitative investigations capable of capturing nuanced stakeholder perspectives in PPP infrastructure projects. However, the review is constrained by its focus on English language journal articles and a five year publication window. Future research should prioritize clearer reporting standards, examine regional and sectoral methodological variations, and explore the potential of digital tools to further enhance the rigor of semi-structured interview applications in PPP infrastructure research.

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