

How to Improve the Validity and Reliability of a Case Study Approach

Cátia Quintão
Pedro Andrade
Polytechnic Institute of Gaya, Portugal

Fernando Almeida
University of Porto & INESC TEC, Portugal

ABSTRACT

The case study is a widely used method in qualitative research. Although defining the case study can be simple, it is complex to develop its strategy. Furthermore, it is still often not considered to be a sufficiently robust research strategy in the education field because it does not offer well-defined and use well-structured protocols. One of the most frequent criticisms associated with the case study approach is its low validity and reliability. In this sense, this study aims to concisely explore the main difficulties inherent to the process of developing a case study, also attempting to suggest some practices that can increase its reliability, construct validity, internal and external validity.

Keywords: Case Study, Reliability, Research Methodology, Validity

INTRODUCTION

Qualitative research methodologies broadly describe a set of strategies and methods that have similar characteristics to each other. In a qualitative

methodology, we have an interactive model of data collection and analysis and the use of various sources through a combination of methods that seek to capture the subjective dimension of social phenomena. According to Queirós et al. (2017), the striking feature of this methodology is that the questions to be investigated are undefined from variables or hypotheses previously formulated. Therefore, the qualitative methodology aims at exploring, describing, and understanding the phenomena in all their complexity. Moreover, close and prolonged contact with those involved in their natural environment is privileged (Yin, 2017).

Qualitative research is essentially used to understand the underlying motives, opinions, and motivations (Hancock & Algozzine, 2016; Stake, 1995). Furthermore, it can also be used to discover trends in thinking and opinions (Merriam, 2009). In this type of research, information about a problem is provided, or it helps to define research hypotheses later. Qualitative research gathers data from a narrative form, interviews, or observations that can be coded using, for example, thematic analysis. In this method, the answers are usually not objective (i.e., the results obtained are not counted numerically). Another characteristic factor of qualitative research is it directs the investigation to cases or phenomena where contextual conditions are not known or not controlled. Additionally, typically the sample is small, and respondents are encouraged to feel comfortable giving their opinion on issues related to the subject of study.

The terms method and methodology are often used indiscriminately. Kothari (2013) states the method is linked to the ways of proceeding to achieve a certain goal, while methodology represents a science whose goal is linked to the study of the method. In this way, the methodology aims to apply the most appropriate methods to produce knowledge in a scientific area. Several methods can be employed in qualitative methodology, as indicated by Queirós et al. (2017): (i) observation; (ii) ethnography; (iii) field research; (iv) focus groups; or (v) case studies. The case study is a qualitative method that generally consists of a way to deepen an individual unit. It serves to answer questions that the researcher does not have much control over the phenomenon studied. It is a tool used to understand the form and the reasons that led to a certain decision. According to Yin (2017), the case study is a research strategy that comprises a method that encompasses specific approaches to data collection and analysis.

A frequent criticism associated with case studies is their validity and reliability (Riege, 2003; Street & Ward, 2012). The trustworthiness in a case study approach, which includes both the validity and reliability dimensions, is a fundamental element so that the findings obtained by the case study can

be credible, confirmable, transferable, and dependable (Mcglain, 2008). The empiricism and subjectivism of the researcher, namely through his/her emotional involvement with the field of work, means that the process of data collection and interpretation may be potentially biased. Leung (2015) also stresses the presence of the observer in the data collection process can create a dynamic that can modify the subjects' usual reactions. In contrast, reactive reactions may arise among stakeholders that run counter to the expectations that the observer expects to meet. In this sense, and given the high use of qualitative methodologies in the education field, it becomes pertinent to explore ways in which the validity and reliability of a case study can be increased, seeking to identify and critically explore the position of several authors on this subject. Through this study, the aim is to provide concise and practical study material to help researchers apply case study techniques more robustly. It may assist researchers in interdisciplinary areas in conducting a case study approach, in which several branches of knowledge may be used together following a specific theme and a common goal.

CONCEPTUAL PERSPECTIVE

Case studies inherit the typical characteristics of qualitative research. In this sense, the case study also contains the fundamental steps concerning the processes of collection, analysis, and interpretation of information from qualitative methods, with the particularity that the fundamental objective of the research is the intensive study of one or a few cases. Nevertheless, in a case study, quantitative data can be used to quantify occurrences of a given phenomenon, but in which the context is not controlled by the researcher. Table 1 provides an overview of the phases of a case study. The last two phases occur in parallel and cannot be isolated.

The adoption of case studies offers numerous advantages, as highlighted by Yin (2017). The main advantage is its high applicability to human situations and contemporary contexts of real life. Furthermore, it offers a deep and at the same time broad and integrated vision of a social unit, complex, composed of multiple variables. Therefore, researchers from various fields use the case study method for various purposes. Case studies can be used to understand a phenomenon in depth by gathering the opinion of several people as well as discovering a new phenomenon from the interaction with the participants.

Case studies are widely used in interdisciplinary areas (Klaassen, 2018; Okamura, 2019). The objective is to use several complementary sources of evidence to obtain multiple perspectives on a phenomenon. With

this, the perception of the investigator becomes more comprehensive and trustworthy (Yin, 2017).

Table 1:

Case study phases (adapted from Yin, 2017)

Phase	Description
Research goal	Clear and precise definition of the subject to be explored. Furthermore, the factors that determine or contribute to the occurrence of the phenomena must be identified.
Research design	In the case study design, the process of selection of the case studies, protocols, and procedures should be defined. It emerges that case selection criteria are essential for the quality of results and should be carefully defined in advance.
Data preparation and collection	Establishing contact with the individuals or organizations targeted by the case study. Conducting the interviews and collecting the associated material.
Analysis of cases and between cases	The information from each case study should be identified and categorized. Unnecessary information should be discarded. There should be a process for triangulation and synthesis of data between study cases.
Elaboration of reports	Individual reports should be produced for each case study. The final report is developed at the end, and the review of this report concludes the process of developing this process.

According to Greef et al. (2017), interdisciplinarity can be understood as the mutual exchange and reciprocal integration of several sciences, in which the construction of knowledge results from the conjunction of several areas of knowledge. In this sense, interdisciplinarity in education involves the integration of disciplines, intending to promote the association of several areas around the same theme. There are several challenges faced by teachers and pedagogical coordinators to implement interdisciplinarity in higher education practice. The identified challenges covered multiple areas such as resources, materials, time, logistics infrastructure, and teacher training (Pountney & McPhail, 2017; Styron,

2013). The interdisciplinarity methodology requires that the teacher be a learner of diverse knowledge, who knows how to deal with students from different socio-cultural contexts, and with the other teachers in the educational institution. Carr et al. (2018) stressed that interdisciplinarity does not have a defined method that can serve as a guide for the teacher in its application, although it is possible to design frameworks to evaluate its application. In this sense, the adoption of a qualitative methodology supported in case studies will help teachers to understand the context in which each practice succeeds and identifies strategies and procedures that can be discussed and replicated with the necessary adaptations to each local context of their higher education institution.

Despite the large number of scientific studies published using case studies, several difficulties persist in their design and operationalization. Often the case studies are also perceived as offering low reliability and generalization difficulties. Despite the relevance of these elements in a case study, they end up being ignored by researchers. In a case study, and as highlighted by Yin (2017), the following situations must be ensured: (i) construct validated, so that the researcher can correctly evaluate the studied concepts; (ii) internal validity, to ensure that there is adequacy of the inferences to the obtained data; (iii) external validity, which derives from the capacity of the results to represent the studied phenomenon; and (iv) reliability, related to the possibility of replication of the study by another researcher. The replication issue becomes relevant in multiple case studies, where a literal replication logic can be used to predict similar results, or a theoretical replication logic where contrasting results are sought for predictable reasons (Ridder, 2017).

DISCUSSION

The case study can be used for two main purposes: exploratory and descriptive (Yin, 2017). The exploratory study contributes to clarify a situation where information is scarce. The level of investigation is less rigorous than in a descriptive case study and can be used in a preliminary phase of a longer project. The descriptive approach is intended to understand the events. The objectives are well defined, with formal procedures structured and directed towards problem-solving or evaluation of alternatives. This approach aims at a complete understanding of the phenomenon.

Each case study is set in a unique context. Therefore, the methodology may be restricted to the investigation of a single case. However, Mariotto et al. (2014) state that this option is only valid when the

case is extreme or critical, or when it reveals a phenomenon in which one intends to explore its behavior over time. However, multiple studies are considered more convincing and robust because they allow analysis between cases (Baxter & Jack, 2008). While individual analyses consolidate the information from each case, the analyses between the cases identify patterns, providing elements for the construction of hypotheses and the development of theories.

While defining the case study may be simple as a strategy, its implementation is complex. The first factor to consider is the validity of the construction. Accordingly, in a study case, multiple sources of evidence must be used and a process of triangulation of the data, review of the reports of the interviews conducted by the interviewees, and a logical chain of events must be defined. The first two factors are directly related to the quality of the data and its treatment, while the last factor provides information to readers about the development processes of the work, from its beginning to the conclusions. In the triangulation process, Fusch et al. (2018) refer to the importance of using different sources of data, namely by conducting interviews with multiple participants or multiple archive sources. As it is generally not possible to replicate a case study under the conditions in which it occurred, its reliability is fundamentally demonstrated by the triangulation of data. This process originates from the application of several data collection instruments, evidence chaining, and rigor in all procedures performed throughout the research. Shoaib & Mujtaba (2016) state that data triangulation is a fundamental point of evaluation of methodological rigor. Additionally, Yin (2017) suggests the existence of four types of triangulation: (i) data triangulation through the use of multiple data sources; (ii) researcher triangulation through the involvement of different evaluators; (iii) theory triangulation through the adoption of multiple perspectives on the same data set; and (iv) methodological triangulation through the adoption of different complementary methods.

Furthermore, it is also important to consider the validity of an investigation. This validity is normally divided into internal and external validity. The former is particularly important in explanatory case studies, in which the researcher is seeking to demonstrate relationships and cause and effect between the elements. It is internal validity that assures the researcher that the results can be accepted based on the research design. However, its relevance is not significant for descriptive and exploratory research. In internal validity, the key issue is to ensure the researcher can construct a plausible causal argument that is rigorous enough to support the research results.

The external validity is strongly dependent on the established cases and the protocol. Here it is fundamental to explain that the phenomena studied can be replicated in other environments. The objective is not a statistical generalization, something that is not possible in single or multiple cases, but to look at their analytical generalization. In analytical generalization, we seek to have a process of generalization of empirical observations into theory, rather than population (Levy, 2008). Good practices to ensure external validity include: (i) presentation of the reasons for the case study selection; (ii) presentation of the context of each case study; and (iii) identification of patterns that allow the subsequent generalization of the results obtained.

The reliability is related to the process of replication of studies. Studies involving multiple cases should follow a replication rather than a sampling logic. Multiple experiments with similar or contradictory results can be considered. For this purpose, a protocol and a case database are required. The protocol establishes the rules that are followed in the field, while the databases contain all the material collected by the researcher for each case. In the protocol, some techniques can be used to increase the reliability of the study case, such as recording the interviews, coding the responses, or employing analytical methods of data analysis. Moreover, the researcher should consider the format in which he will collect the data, the structure, and the technological means he/she intends to use. The case study may use a variety of ways to collect information, depending on the nature of the case and with the aim of making it possible to cross-study, or analysis angles. Marrelli (2007) states that among the instruments of information collection are the diary, questionnaire, individual and group interviews, and documentary sources.

Finally, following Meyer's (2001) approach, a hypothetical case was defined to explain the application of reliability and validity issues to a case study. In this sense, we considered an example to explore the impact of COVID-19 in higher education institutions. Table 2 presents a set of elements that should be considered.

The adoption of multiple case studies involving multiple participants is highlighted as being a more robust approach than using a single case study (Mills et al., 2010; Towgood et al., 2009). Qualitative investigations of multiple case study bias have distinct advantages and disadvantages compared with a single case study. The rationale for single case strategies, in general, cannot be satisfied with multiple cases. A single case strategy in the COVID-19 example could be useful to understand in depth the unique challenges posed to a higher education institution.

However, it is likely that the rare or unusual case, the critical or revealing case will not arise in the context of a single case. Accordingly, it is important to consider multiple sources of evidence. The adoption of multiple case studies should be carefully thought through to ensure that multiple analyses have a specific purpose within the global scope of the investigation. In this sense, the adoption of multiple cases in the COVID-19 example should include educational institutions of different typologies (i.e., public/private; university/polytechnic) and dimensions (i.e., number of students/teaching staff).

Table 2:
Example of a reliability and validity analysis

Issue	Description
Construction validity	Multiple cases should be used involving several participants. Students, teachers, and people in management positions at universities should be involved. This is intended to have multiple perspectives on the challenges posed by COVID-19 in universities.
Internal validity	A relationship is established between the emergence of COVID-19 and the measures of social isolation that have affected both students and students. As a result, higher education institutions had to close down their activities and offer distance learning using online collaboration tools.
External validity	Four case studies were selected considering the different typologies of a higher education institution: (i) public university; (ii) private university; (iii) public polytechnic institute; and (iv) private polytechnic institute. Each of these locations offers its own specificities considering its legal framework and type of courses offered. Each higher education institution is located in different districts of Portugal with different levels of economic and social development.
Reliability	Individual interviews with academics and group interviews with teachers and students were used for data collection. The thematic analysis carried out based on semi-structured interviews identified similar and contradictory themes between the case studies.

Thematic analysis is a commonly used method for analyzing semi-structured interviews. Other alternatives are feasible like grounded theory, interpretative phenomenological research, or representation through cognitive maps (Alase, 2017; Tie et al., 2019; Weisberg & Newcombe, 2018). In the example of Table 2, we propose the adoption of thematic analysis. This method has characteristics similar to procedures traditionally adopted in qualitative analysis. Thematic analysis can be used both through an inductive approach and based on the data collected in the interviews with students, teachers, and administrative staff, as well as using the deductive or theoretical approach, which can build a pre-established set of themes (e.g., teleworking, videoconferencing, remote teaching, distance assessment, etc.). The second approach is more appropriate in areas of research that are more consolidated in the scientific environment and in which the themes can be obtained from other previously published studies.

CONCLUSIONS

The adoption of case studies is one of the most used methods of investigation in education. Researchers cannot control events and who interact with them, but the research process allows us to have a scientific basis for dealing with these situations logically and appropriately. The case study is a complete method that covers the activities of planning, data collection, and analysis. It aims to understand the event under study and, at the same time, develop more generic theories regarding the observed phenomenon.

The case study is grounded on a logic based on the interpretation of a phenomenon of social reality concerning its data and evidence. However, several processes are essential for its results to have validity and reliability. In this sense, the design of an approach based on case studies requires skill and sensitivity of the researcher to meet these requirements, ensuring that the results of the work are accompanied by methodological rigor and accepted in the scientific community.

In the process of using a case study, the reliability and validity of the process and the results achieved must also be analyzed. For this purpose, several criteria should be considered, such as construction validity, internal and external validity, and reliability. By fulfilling these criteria, it can be guaranteed that the study methodology was planned in a logical way, where all components relate to each other in a structured way. Additionally, this approach allows the investigation to be effective and the desired results to be achieved.

This study is relevant by addressing concisely the feasibility and reliability process of a case study. It is intended to be a study that helps educational researchers to define more rigorous and robust methodological processes in educational studies that employ case studies. For this purpose, it is discussed how a case study should be designed to offer the validity of the construction, internal validity, external validity, and reliability.

REFERENCES

- Alase, A. (2017). The Interpretative Phenomenological Analysis (IPA): A Guide to a Good Qualitative Research Approach. *International Journal of Education & Literacy Studies*, 5(2), 9-19. doi: 10.7575/aiac.ijels.v.5n.2p.9
- Baxter, P., & Jack, S. (2008). Qualitative Case Study Methodology: Study Design and Implementation for Novice Researchers. *The Qualitative Report*, 13(4), 544-556.
- Carr, G., Loucks, D. P., & Blöschl, G. (2018). Gaining insight into interdisciplinary research and education programmes: A framework for evaluation. *Research Policy*, 47(1), 35-48. doi: 10.1016/j.respol.2017.09.010
- Chun Tie, Y., Birks, M., & Francis, K. (2019). Grounded theory research: A design framework for novice researchers. *SAGE Open Medicine*, 7, 1-8. doi: 10.1177/2050312118822927
- de Greef, L., Post, G., Vink, C., & Wenting, L. (2017). *Designing Interdisciplinary Education: A Practical Handbook for University Teachers*. Amsterdam, Netherlands: Amsterdam University Press.
- Fusch, P., Fusch, G. E., & Ness, L. R. (2018). Denzin's Paradigm Shift: Revisiting Triangulation in Qualitative Research. *Journal of Social Change*, 10(1), 19-32. doi: 10.5590/JOSC.2018.10.1.02
- Hancock, D. R., & Algozzine, B. (2016). *Doing Case Study Research: A Practical Guide for Beginning Researchers*. New York: Teachers College Press.
- Klaassen, R. G. (2018). Interdisciplinary education: a case study. *European Journal of Engineering Education*, 43(6), 842-859. doi: 10.1080/03043797.2018.1442417
- Kothari, C. R. (2013). *Research Methodology: Methods and Techniques*. New Delhi, India: New Age International Pvt Ltd Publishers.
- Leung, L. (2015). Validity, reliability, and generalizability in qualitative research. *Journal of Family Medicine and Primary Care*, 4(3), 324-327. doi: 10.4103/2249-4863.161306
- Levy, J. S. (2008). Case Studies: Types, Designs, and Logics of Inference. *Conflict Management and Peace Science*, 25(1), 1-18. doi: 10.1080/07388940701860318

- Mariotto, F. L., Zanni, P. P., & Moraes, G. H. (2014). What is the use of a single-case study in management research? *Revista de Administração de Empresas*, 54(4), 358-369. doi: 10.1590/S0034-759020140402
- Marrelli, A. F. (2007). Collecting data through case studies. *Performance Improvement*, 46(7), 39-44. doi: 10.1002/pfi.148
- Mcglain, S. (2008). The trustworthiness of case study methodology. *Nurse Researcher*, 16(1), 45-55. doi: 10.7748/nr2008.10.16.1.45.c6752
- Merriam, S. B. (2009). *Qualitative Research: A Guide to Design and Implementation*. Hoboken, New Jersey: Jossey-Bass.
- Meyer, C. B. (2001). A Case in Case Study Methodology. *Field Methods*, 13(4), 329-352. doi: 10.1177/1525822X0101300402
- Mills, A. J., Durepos, G., & Wiebe, E. (2010). *Encyclopedia of case study research (Vols. 1-0)*. Thousand Oaks, CA: SAGE Publications.
- Okamura, K. (2019). Interdisciplinarity revisited: evidence for research impact and dynamism. *Palgrave Communications*, 5(141), 1-9. doi: 10.1057/s41599-019-0352-4
- Pountney, R., & McPhail, G. (2017). Researching the interdisciplinary curriculum: The need for ‘translation devices’. *British Educational Research Journal*, 43(6), 1068-1082. doi: 10.1002/berj.3299
- Queirós, A., Faria, D., & Almeida, F. (2017). Strengths and Limitation of Qualitative and Quantitative Research Methods. *European Journal of Education Studies*, 3(9), 369-387. doi: 10.5281/zenodo.887089
- Ridder, H. G. (2017). The theory contribution of case study research designs. *Business Research*, 10, 281-305. doi: 10.1007/s40685-017-0045-z
- Riege, A. (2003). Validity and reliability tests in case study research: a literature review with “hands-on” applications for each research phase. *Qualitative Market Research*, 6(2), 75-86. doi: 10.1108/13522750310470055
- Shoaib, S., & Mujtaba, B. G. (2016). Use It or Lose It: Prudently Using Case Study as a Research and Educational Strategy. *American Journal of Education and Learning*, 1(2), 83-93. doi: 10.20448/804.1.2.83.93
- Stake, R. E. (1995). *The Art of Case Study Research*. Thousand Oaks, CA: Sage Publications.
- Street, C. T., & Ward, K. W. (2012). Improving validity and reliability in longitudinal case study timelines. *European Journal of Information Systems*, 21(2), 160-175. doi: 10.1057/ejis.2011.53
- Styron, R. A. (2013). Interdisciplinary Education: A Reflection of the Real World. *Systemics, Cybernetics and Informatics*, 11(9), 47-52.
- Towgood, K. J., Meuwese, J. D., Gilbert, S. J., Turner, M. S., & Burgess, P. W. (2009). Advantages of the multiple case series approach to the study of cognitive deficits in autism spectrum disorder. *Neuropsychologia*, 47(13), 2981–2988. doi: 10.1016/j.neuropsychologia.2009.06.028
- Weisberg, S. M., & Newcombe, N. S. (2018). Cognitive Maps: Some People Make Them, Some People Struggle. *Current Directions in Psychological Science*, 27(4), 220-226. doi: 10.1177/0963721417744521

Yin, R. K. (2017). *Case Study Research and Applications: Design and Methods*. Thousand Oaks, CA: SAGE Publications.

CÁTIA QUINTÃO, B.Tech, is a researcher at ISPGAYA. She works in the IT industry as software developer. Her major research interests lie in the area of cybersecurity, network management, and databases. Email: ispg2018100273@ispgaya.pt

PEDRO ANDRADE, B.Tech, is a researcher at ISPGAYA. He works in the IT industry as system administrator and network manager. His research interests include network configuration, and internet of things. Email: ispg2018100238@ispgaya.pt

FERNANDO ALMEIDA, PhD, is a professor and researcher at University of Porto and INESC TEC. His research interests include software engineering, innovation, and research paradigms. Email: almd@fe.up.pt

Manuscript submitted: February 22, 2020

Manuscript revised: June 13, 2020

Accepted for publication: July 22, 2020
