



The Potential of Using Critical Incident Technique to Improve Design Research: A Compilation Study

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Abstract. Critical Incident Technique (CIT) is a research approach in which the research subject was asked to remember and explain a period when a specific behavior, activity, or occurrence influenced (either positively or negatively) a specified outcome. For the incident to be critical, the event should have a causal relationship with the result. Due to its uncommon use in design research and the lack of references in the design area, we saw an opportunity to develop a study about CIT, specifically in Design. In this chapter, we explored the current theoretical frameworks from several areas that adopt CIT. Based on the findings from the CIT context, a more focused literature review was conducted to understand the existing CIT in other areas and the potential to integrate it in design research. It is essential to state that the scope of our study is CIT will be used in the exploratory phase in research about design research. A strengths, weaknesses, opportunities, and threats (SWOT) analysis was carried out to see a problem and provide inputs for considering solutions. A compilation study was developed to determine the potential of using this method in design research. The result is that Critical Incident Technique could be viewed as an opportunity to improve the design research process, giving it the sense of design thinking to escalate its ability to understand the problem. At the same time, it can be useful with a multidisciplinary approach of education and design research for comprehensive research processes to develop interventions for effective education strategies.

Keywords: Design research · Critical Incident Technique · Research methods · SWOT

1 Introduction

Most design hypotheses start from conditions of high uncertainty, contributing to a scarcity of definitive solutions but rather of constant improvements. This phenomenon determines that research in Design should have a more linear approach, supported by analytical and experimental methods, that is, it should be research supported by mixed methods, where qualitative methods help to argue or foster new ideas previously raised by quantitative methods. Sometimes the problem lies in the quality of the information

raised by problems that tend to be answered with incomplete solutions because they start from uncertain conditions [1]. For example, in the learning activity, teachers sometimes have difficulty designing learning tools to improve student engagement, which is a key aspect in improving the quality of teaching, where any critical incident is an unplanned event that occurs during a lesson. It is interpreted as a problem or challenge in a particular context rather than a routine occurrence. We realized that using a method that spontaneously facilitates critical understanding moments would be ideal for identifying the problems we have to answer as design researchers. Cash [2] claimed that design research is becoming increasingly weak in comparison to other fields; without intervention to improve empirical, theoretical, and methodological rigour, there is a real risk that the field will be superseded and become outdated due to a lack of effects. He added that design research risks being replaced by other fields eager to include design science in their assets. Despite the potential for design research to expand on these parallel discoveries by developing theories that other researchers can use, little evidence of this occurs [3]. Meanwhile, Buchanan, R. [1] refers that the discipline of Design is present in several professions and academic areas, but because they have different origins, they do not share identical methodologies or philosophies. Sometimes, in order to unite for the common good, they conceive and plan together, but the approaches to the same themes diverge because they want different results.

Design research is often indicated for critical goals, even when there is no clear definition of success, or designing adequate indicators of success is part of the overall problem. Kelly [4] claimed, "If the problem has a known or standard solution, and there is general agreement on when to apply the solution, and the solution has been regularly successfully applied in various settings, design-based research is probably a poor use of resources." In this respect, design research is a methodological approach that supports an investigation of a learning design.

It is a general approach to form strategic studies more efficiently. The Design-Based Research Collective [5] argued that "design research can help create and extend knowledge about developing, enacting, and sustaining innovative learning environments." Tung [6] claimed that design research is about engaging in open dialogue with people in order to better understand them. "It is about finding stories, understanding motivations, uncovering delightful moments and unmet needs, and most importantly, having a genuine curiosity about how others experience the world" [6]. Thus, Critical Incident Technique (CIT) is the chosen method because it is considered a unique method in design research but has an interesting approach.

The use of critical incident technique, data collection technique and factors related to data analysis have changed over the years. Forms of the CIT have been in existence since the 1930s and were further developed by Colonel John C. Flanagan during World War II. CIT is a set of procedures used for collecting direct observations of human behavior that have critical significance and meet methodically defined criteria. It was originally content to distinguish between effective and ineffective work behaviors of US military personnel performing a variety of military activities. In order for the incident to be critical, the participant must be confident that the event had a causal relationship with the outcome (which is the focus of the study). The CIT could help designers to study about the user's/individual's experience toward a product or service that ended

well or poorly [7]. In this chapter, we address the relationship and the possibility of this technique applied in design research, which could be used in the empathize process in the exploratory phase.

2 Design Research

According to [1], Design is multidisciplinary in several academic areas and professions, but because they do not come from the same origin, they use different methodologies. Sometimes, when these areas combined with respect and understanding of each other's work, they tend to join efforts and create or use identical methods throughout the process. The result of these unions of different areas tends to illuminate the existence of problems that were not previously revealed and that, only by uniting different areas, could be understood. This idea that in investigations, some of the initial problems are not defined, has been discussed throughout the evolution of the discipline of Design.

Design research appeared in the 1960s from a conference on Design methods. Its society, Design (based) research Society, aims to acknowledge the study of and research into the process of designing in many areas [8]. During that time, society's purpose is to act as a form of educational view of the process of designing. At that time, design research initially arises when educators want to improve learning from an informed theoretical perspective [9]. It is focused on the educators' functional experience, from the recognition of significant instructional issues to the iterative nature of the proposed solutions. Design research has more potential value than action research because it seeks practical solutions to educational problems, searching for design knowledge.

Regarding its definition, Nigel Cross [10] defined "design-based-research has to be the development, articulation, and communication of design knowledge, which it could be from people, processes, and products." He added that design research is "the investigation of this human ability – of how people design." Design research learns about the empirical studies of designer activities and the nature of design ability from theoretical reflection. Hence, it strongly relates to considerations of how individuals learn to design, which specifically explores the development of design capability and how that development could ideally advance design education.

As presented by Buchanan [1], it was mentioned by Horst Rittel in the 60's, that the design methodology tends to be a linear process, divided into two phases: Problem Definition and Solution. The problem definition is an analytical sequence that determines the elements of the problem and specifies the necessary requirements for its solution. On the other hand, the latter is a synthetic sequence of combinations between the requirements and the final implementation plan. Rittel also mentioned that one of the problems in this type of linear methodology is that usually the class of problems are poorly formulated, starting from insufficient and confusing information, resulting, of course, in solutions that are not very efficient to respond to real problems.

Therefore, Wang & Hannafin [11], stressed the same idea that a theory's value is measured to extend the views, inform and improve practice. Explicitly, they summarized the characteristics of design research, which are divided into five aspects: pragmatic, grounded, interactive, iterative and flexible, integrative, and contextual, respectively. According to Plomp [12], systematic evaluation of the iterations phases contributes to

theory building. The cyclic and iterative processes involved in design-based research align with the authentic Design of learning environments and theory building [13].

In this way, and realizing that the role of the designer is to find ways to solve problems we encounter in everyday life, it was determined that we have to look at other ways of doing research, in other areas, and learn from them. In essence, design research is the art of observing what people say and do, and then using intuition to reasonably perceive what they think and feel.

3 Critical Incident Technique: The History and the Origin

As mentioned above, the use of the Critical Incident Technique (CIT) was based on behavior in the early days and was applied in psychological state or experience studies [14]. However, in 1953, Leor Eilbert also used psychological state and experience studies. The CIT was first established as a qualitative research method during the Second World War. The technique has been developed precisely to pinpoint facts and describe behavior in critical incidents and events, in which Flanagan [15] began with defining critical flight crew behavior. It has been emphasized that this technique will develop more accurate results on detecting people's specific behaviors in a plot than traditional research. Studies support that CIT is indeed a reliable, valid method [16, 17].

Flanagan [15] refers to the "incident" as a description of any observable human activity/activity. He noted that CIT could use it to create training requirements for a job, maximize efficiency and improve equipment design. The term "critical" refers to behavior in events that play a critical or important role in determining the outcome. With this technique, effective or ineffective adaptations are revealed by focusing and analyzing incidents [14, 18–20]. This technique is also seen to be defined by different nomenclatures. These are critical incidents reporting (More & Unsinger, 1987), critical incidents technique (Kunak, 1989), critical incidents (Pope & Vetter, 1992), critical incidents analysis (Gould, 1999), critical incident exercise (Rutman, 1996) and critical incident study technique [21]. According to the incident investigated, these different nomenclatures are generally the names used by researchers rather than being random [22].

Although there have been many debates about whether the critical incidents technique has a qualitative aspect, it has been determined thanks to its features [15, 18] qualitatively. These features; CIT is qualitative research in terms of being under natural conditions, including a researcher, involving the participant's observation or asking open-ended qualitative questions, based on induction of data analysis and focusing on the participant's perspective [15, 23].

However, Flanagan [15] emphasized five basic steps of CIT: setting goals, setting plans and specifications, collecting data, analyzing data, interpreting data, and disseminating results. The application process of the critical incidents technique is as follows: (1) determining the problem and determining the overriding question; (2) determining the data collection methods; (3) defining the types of events (effective/ineffective, best/worst, extreme/atypical); (4) direct and retrospective data collection, recording review, asking open-ended questions, and regular interview techniques [14, 20].

Moreover, in CIT, the number of critical incidents is more important than the number of participants. Therefore, the data collection process should be terminated when the data

is sufficient [15, 24]. For the CIT method, the most common method of data summation is interviews [20, 25].

Because it was emphasized that the interviews allowed research for in-depth answers [20]. The critical incidents technique has been used for a long time to learn about knowledge and cognitive processes because of its versatility and strengths [26]. Flanagan [15] emphasizes the power of the method to report facts about behavior rather than “a collection of comments, ratings and ideas based on general impressions”.

Remarkably, CIT method has been used successfully to learn cognitive processes in a wide variety of disciplines: communication, nursing, counseling, teaching, medicine, marketing, psychology, and social work [14]. Later, under the influence of the positivist method, this methodology emerged to be used in social sciences and other sciences [14, 18].

4 Critical Incident: The Analysis

From the study above, we analyze the strengths and weaknesses of CIT if it is applied to design research with SWOT analysis. Firstly is Strength. This method can help to (1) understand the problems from the first-hand participant, (2) emphasis on more-important issues rather than less-important issues, and (3) the participant could speak their needs so it will fit in the research goals. Secondly the Weakness(es) are (1) lack of references from previous studies; (2) The possibility of the unreal answer from the participant (3) The question should be very specific that can arise from the memory from the specific incident; (4) Can raise uncomfortable questions to the participant. Thirdly this method has the Opportunity to be a (1) Novelty research approach because it is an uncommon method in design research; (2) could enrich the qualitative method in design research; (3) and dispute the opinion of the lack of intervention in design research, so CIT can improve empirical, theoretical, and methodological rigour. Lastly the Threat in using CIT method is other methods might want to duplicate or inspired by CIT. So that they improve the method with more flexible technique with less effort in time.

5 Findings and Discussion

The literature review has shown that the CIT method affects many areas. Although areas such as service and Education commonly use the method and reach valuable research results, cases in Design are limited. As shown in Table 1, the CIT method has been used from very specific areas to much more general areas.

This also refers to the usability and applicability of the CIT method. If the CIT method increases in the prevalence of educational Design and Design research, valuable research results can be found in these areas. The frequent usage of the CIT technique in the education area and its positive outcomes imply that it is possible to generate strong research findings by employing the CIT approach with the collaborative efforts of educators and design researchers. At the beginning of the CIT process, the researcher must carefully prepare the questions because CIT questions are different from regular questions. The critical incident technique (CIT) is a useful methodology to uncover critical requirements for people. When using the CIT, ensure that the researchers are

Table 1. Characteristics of Design-based-research by Wang and Hannafin [11] (p.7)

Characteristics	Explanations
Pragmatic	Design-based research refines both theory and practice. The value of theory is appraised by the extent to which principles inform and improve practice.
Grounded	Design is theory-driven and grounded in relevant research, theory and practice. Design is conducted in real-world settings and the design process is embedded in and studied through design-based research.
Interactive, iterative, and flexible	Designers are involved in the design processes and work together with participants. Processes are iterative cycle of analysis, design, implementation and redesign. Initial plan is usually insufficiently detailed so that designers can make deliberated changes when necessary.
Integrative	Mixed research methods are used to maximize the credibility of ongoing research. Methods vary during different phases as new needs and issues emerge and the focus of the research evolves. Rigor is purposefully maintained and discipline applied appropriate to the development phase.
Contextual	The research process, research findings, and changes from the initial plan are documented. Research results are connected with the design process and the setting. The content and depth of generated design principles varies. Guidance for applying generated principles is needed.

clear on the kind of incidents that are wanted to study. It is important to prepare what methods in CIT will be used, such as interviews, focus groups, or surveys to get an accurate picture of the usability of systems, products, or services. While design research is sometimes amorphous, ambiguous, and frustrating, CIT could be seen as an approach to ultimately reducing the risk of designing the wrong solution and creating room for innovative user-centered solutions. While it is advised that professionals in Education and Design work together to examine design research using a multidisciplinary approach, examples in this field are limited in the general literature. As a result, employing the CIT method in conjunction with a multidisciplinary approach to contribute to the literature is recommended.

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