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Science Education Research Methodology: A case study investigating the correlation between construction, safety, accident, and the effectiveness Construction Industry Development Board (CIDB) Green Card Training Program

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ABSTRACTS

This paper discusses the detailed research methodology for science education research. Using the questionnaire, it can make the data analysis easier and more effective as all the information obtained can be revised and the answer is correct because the respondent only needs to choose the answer as stated. The construction of presenting the questionnaires is very important to get the results that meet the objectives of the study. The interview also plays a role to use as a support result for questionnaires. This paper describes the research methods to ensure the validity and trustworthiness of the findings is discussed.

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1. INTRODUCTION

Social scientists, especially those who work with science education, have abandoned the erroneous choice between qualitative and quantitative data, preferring instead to focus on the combination of the two that best utilizes each's strengths. The issue then becomes determining when he [sic] should use one technique and when he should use the other (Merton & Kendall, 1946). Given that the qualitative/quantitative issue has been debated for almost half a century, you might wonder why another article on the subject is necessary. Many university courses and research texts, on the other hand, continue to talk about research in terms of 'qualitative' or 'quantitative' methodologies. When research is characterized in such terms, it may cause misunderstanding among undergraduate students, first-time researchers, and early-career researchers.

For the untrained researcher, the study process is already a difficult proposition, and the constant disagreement and contradictory information only adds to the complexity. This is worsened by laypeople who ask researchers whether their research is qualitative or quantitative regularly. We hope that by writing this article, they will be able to help first-time and early-career researchers make informed decisions about the type of study they should conduct, the process of conducting a research project, and the debates in the literature about theoretical frameworks that underpin research. There will also be a discussion of related definitions and constructions.

This paper includes the necessary research methods that are required in collecting and analyzing the data obtained. Besides that, this paper also reviewed the population and sample population, the instrument of the study, and data analysis. Emphasis has been given to the critical stage in this research, which are data collection, data analysis, and data evaluation. Choosing and using the appropriate research methodology is very important so as not to miscalculate and misanalyse the study.

2. METHODS

We used a literature review for obtaining the data. The data were then summarized to get an explanation. Several references were used, including Anger *et al*. (2009), Endroyoa *et al*. (2012), Ge Gervais (2003), Jafari *et al*. (2014), Juárez-Carrillo *et al*. (2017), Huber (2016), Pinto *et al*. (2011), Crosby and Lester (2007), Tam and Fung (2012), Tovar-Aguilar *et al*. (2014). We also used some literature on websites, such as http://www.dosh.gov.my/index.php/en/occupational-accident-static, Retrieved on 1 January 2018.

3. RESULTS AND DISCUSSION

Tracking the previous record, and conducting an interview. The main subject of this study is to review the research methodology in the case of the effectiveness of the Construction Industry Development Board (CIDB) Green Card Safety Training Program for improving safety at the construction site. The results gathered from pre and post-training programs were compared with the statistic of accidents reported. This helps to determine if there is a reduction in terms percentage of accidents. The reduced number of NCR, Penalty System, and also understanding of the workers about safety.

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The questionnaires were distributed to the participants (general workers) who are entirely involved in the construction project. The comprehensive input from the site management such as the engineer, project manager, supervisor, and site supervisor support the results gathered through the qualitative method (interview). The data from the questionnaires will be analyzed using Statistical Package for Social Science (SPSS) version 21.0 and Microsoft Excel.

3.2. Research Design

This study has been carried out using both qualitative and quantitative methods. Questionnaires have been used to collect data regarding workers' basic knowledge of safety. The management personnel were interviewed concerning the documents required for the study. This method helps to enrich the data for this study. The questionnaires will be distributed among the respondents and the completed questionnaires will be returned and analyzed to gather information and findings to make conclusions and suggestions.

3.3. Procedure in Conducting Research

This study started with a discussion with the supervisor that was assigned for this research to set the topic and the specialization of the scope of the study. The approval from the supervisor to carry out the research was received once the topic and scope has been finalized. After the objective and scope has been finalized, a set of questionnaires was designed to begin the pilot studies. The purpose of this pilot study is to obtain a high degree of validity on the capabilities of the items identified by the researcher. First and foremost, the completed set of questionnaires was agreed upon by the supervisor and was submitted to another two lecturers for evaluation.

The questionnaire is highly valued and fit to be distributed to the respondent. Next, a letter of authorization from the Universiti Technology Malaysia (UTM) will be obtained. This serves as the letter of application to conduct the study. Once all the approval is received, the questionnaire will be distributed to the respondents before and after the training session in the class. The questionnaire will be collected and the final step of the study is to make data analysis from the gathered questionnaires to deliver the result. Raw data has been analyzed using the IBM SPSS Software.

The interview is a method designed to get a clear picture of the research objectives and questions (Bevan, 2014). For that purpose, an interview has been conducted at a selected construction site with the respondents comprising of site management personnel such as the Safety Supervisor, Site Engineer, and Project Manager. Conducting interviews helps the researcher to obtain support from the data that was analyzed. Documents used such as NCR, No of Accident, and Number of Penalties are also used to support questionnaires and interview results to analyze whether the training is functional and effective in improving safety at the construction site.

3.4. Population and Sampling

Population in a study is a collection of objects that can be used as resources in the form of objects, people, or events that occur as an object or target of research. The population can be defined as a group of individual persons, objects, or items from which samples are taken for statistical measurement. The population can be an organism, person, object, event, or report (see **Table 1**) (Baldwin, 1995).

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The population is a generalized region consisting of objects/subjects that have certain qualities and characteristics set by the searcher to be studied and the withdrawn conclusions (Niswaty & Arhas, 2019). The population for this study is comprised of general workers who are working in Sg. Buloh.

The sample is a representative part or a single item from a larger whole or group, especially when presented for inspection or shown as evidence of quality. According to the central limit theorem, the sample size for each group or category should reach at least n=30. For this study, the minimum sample size table is used, which table uses confidence levels in sample counts. For this research on CIDB Green Card training, it was conducted at Club Training Centre at Jalan Sg. Buloh, which is located in Selangor. The selected participants are foreign general workers from Nadayu Construction Sdn. Bhd.

Table 1. Population and sample for cidb green card training (Source: Nadayu Construction Sdn.Bhd, 2018)

No.	CIDB Green Card Training	Population	Sample Size (N)
1	General Worker	62	55
Total		**62**	**55**

3.5. Research Subject

For this study, the research subject is general workers who are also participants who will be undergoing the training and site management personnel such as Project Manager, Engineer, Supervisor, and Site Safety Supervisor who are selected as informants for the interview. Workers from the CIDB training program are the main respondents for the questionnaire, while the management personnel are the informants, who will be giving the feedback after they have entered the training sessions.

3.6. Research Setting

For this study on CIDB Green Card training, it is conducted in Club Training Centre at Jalan Sg. Buloh, which is located in Selangor. The selected participants are foreign general workers at the Nadayu Construction Sdn. Bhd. (same sentence on top)

3.7. Research Instrument

The research instruments are questionnaires, interviews, and recorded documentation of the study. The research instrument is a data collection tool used to measure both natural and social phenomena observed.

3.8. Validity of the Research Instrument

A validity test is used to measure the validity of a questionnaire. The questionnaire is said to be valid if the questions in the questionnaire can uncover something to be measured by the questionnaire. The result of the research is valid if there is a similarity between the data collected with the actual/original data of the object under the same study. Valid means an instrument can be used to measure what needs to be measured. Content validity was used as an indicator to test the questionnaire.

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The prepared questionnaire was given to the superior and two other lecturers who are experts in their respective fields from the RAZAK School of University Technology Malaysia in Engineering and Advanced Technology to evaluate and improve the contents of the questionnaire items that have been constructed. This research also uses the triangulation technique to test the validity of data that has been obtained through a questionnaire. Triangulation is defined as a technique, which combines various data collection techniques and existing data sources.

Triangulation is divided into four types, which are triangulation of sources, methods, investigators, and triangulation theory. In this study, the researcher is using the triangulation of sources method. The triangulation method in this research is done by combining the questionnaire method, interview method, and documentation study during the research process, so they have complemented each other as needed.

3.9. Reliability of Questionnaires

A reliability test is performed to determine the consistency of an instrument (measuring instrument) in measuring what it is intended to measure across time. Instrument reliability is a way of ensuring that any tools used for measuring produce consistent results every time being measured. The high reliability of the instrument is shown by a number called the reliability coefficient. Alpha Cronbach's reliability coefficient is used to test the reliability of the instruments in this study. The set of questionnaires used for the pilot study has been used by the researcher to see the reliability of the questionnaire before the actual survey was conducted.

3.10. Research Questionnaires

One of the instruments used by the researcher is a questionnaire, which is divided into two parts:

(i) Section A contains 8 questions consisting of items related to the respondent's demographic detail.

(ii) Section B is made up of 40 items related to the basic knowledge on the safety of the workers towards safety practices while on the construction site.

Table 2 shows the elements of the question as well as the item number in this study.

Table 2. Criteria and number of items in the survey questionnaire.

No.	Criteria	No. of Question	No. of Item
1.	Demographic	8	1,2,3,4,5,6,7,8
2.	Reaction	14	1-40
3.	Language	6	1-6
4.	Background Participant	12	1-12
5.	Pre-Post Test	24	1-12(pre-test) 1-12 (post Test)
6.	Management Personnel	4	1,2,3,4
7.	Behavior of worker	10	1-10
8.	Opinion from Management Personnel	1	1

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To facilitate the analysis of data obtained, the five-point Likert scale was used in this study. The Likert scale is used to measure one's attitude, opinion, and perception of a person or group of people about a special phenomenon. A Likert Scale is a rating scale that requires the subject to indicate his or her degree of agreement or disagreement with a statement. This is because the Likert scale allows researchers to control the feedback bias.

The respondents specify their level of agreement or disagreement on a symmetric agree-disagree scale for a series of the statement while responding to a particular Likert questionnaire item and the range of the Likert scale captures the intensity of their feelings for a given item. Therefore, each of the items has five-choice options using the Likert scale, which are Strongly Disagree (SDA), Disagree (DA), Neutral (N), Agree (A), and Strongly Agree (SA) (see **Table 3**). Another study made by Juárez-Carrillo (2017) stated that discussion demonstration, video and printed material (brochures), and training conducted by the peer to peer results in safety knowledge and safety behavior becoming more effective in their native language. Training assessment and material during a class session should be provided in multiple languages so that they can understand the information better.

Table 3. Criteria five-point likert scale.

Scale	Strongly Disagree (SD)	Disagree (D)	Neutral (N)	Agree (A)	Strongly Agree (SA)
Score	1	2	3	4	5

The researcher will distribute the questionnaire herself to the respondent before the training session. The respondent is given ample time to answer the questionnaire in this case, the workers have been given 30 minutes to answer the questionnaire and the questionnaire was immediately collected by the researcher once the duration ends. After the training session, the same questionnaire will be distributed to see the improvement of their knowledge of safety that they have gained and the same duration (30 minutes) was allocated before collecting the questionnaire. By using this method, the researcher can gather all the questionnaire feedback from the respondents, as it not only saves time but also doesn't allow room for the respondents to submit blank, missing, or undelivered questionnaires.

3.11. Data Collection

Data collection can be done in various ways through various resources, in the early stage of this study the data collection can be obtained via journal, book, and related thesis of the study especially on the issues regarding safety training. The data collection method that is being used for this research are as follows:

(i) **Questionnaires.** In this study, questions have been distributed among respondents in the class before and after the training session. The completed questionnaire was submitted and analyzed to gather information for the findings to make conclusions and suggestions to complete this study.

(ii) **Interview.** The second stage is the interview process. In this study, the interview process is one of the methods used in collecting data directly from the subject of the study. By interviewing the management personnel, the researcher will be able to gather information from the supervisor, engineer, and project manager on how the respondent (workers) implement their knowledge on safety after the training session.

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The workers' behavior in recent work and terms of improvement on safety at the site after the training session will be assessed as well. The interview result session will be answered and support the results from questioners in terms of the outcome of effectiveness of the training program to improve safety at the construction site.

(iii) **Data analysis.** Statistical Package for Social Sciences (SPSS) Version 21.0 software package was used to analyze data from the questionnaire. Before we start analyzing the data to test hypotheses, some preliminary steps need to be completed. These help to ensure that data are reasonable and can be used for future analysis studies.

3.12. Pilot Study

The main purpose of the pilot study is to examine the feasibility of the intended approach the researchers use in the main study. A pilot study can be used to expose some logistic issues before starting the main study, in which the results of the pilot study can inform the possibility and identify the necessary modifications that needed to be made to the main study. There are also other reasons for conducting pilot studies, for example, but not limited to, checking words and statements from the used scale, refining scale items, developing scale items and research plans, and collecting early data are indeed examples of why there is a need to conduct a pilot study.

The pilot study done is to test the reliability of each item in the questionnaire and determine the degree of consistency and accuracy of the instrument. Instruments with a high degree of confidence have been given a permanent or almost identical result whenever they are used in different situations. Before the actual survey was conducted, the pilot study was first conducted to identify several factors:

(i) The extent to which the respondents can understand each statement in the item used.

(ii) The extent of the suitability in the overall use of the instrument to the respondents of the study, especially the use of the term and the structure of the sentences.

The Alpha Cronbach coefficient for the study instrument is measured according to the criteria as set out in **Table 4**.

Table 4. Alpha cronbach coefficient (Mahlangu & Kruger, 2015).

Coefficient range	Strength of Reliability
$0.90 \leq \alpha$	Excellent
$0.80 \leq \alpha < 0.90$	Good
$0.70 \leq \alpha < 0.80$	Acceptable
$0.60 \leq \alpha < 0.70$	Questionable
$0.50 \leq \alpha < 0.60$	Poor
$\alpha < 0.50$	Unacceptable

The Alpha Cronbach method practiced is a coefficient or reliability that illustrates how a set of items has a positive relationship with one another. High accuracy and reliability are shown when the alpha value approaches 1.0. Meanwhile, the lowest reliability is when alpha approximates or less than 0.50. Reliability between 0.70 and 0.80 is the best value for most basic research purposes. Therefore, this pilot study is aimed to obtain the accuracy, suitability, and clarity of the items formed in terms of direction, use of words, style of sentence arrangement, and other matters related to the questionnaire.

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The questionnaire in this pilot study was circulated after receiving consent from the supervisor and had obtained permission from the university. The researcher submitted the questionnaire to two lecturers from RAZAK School in Engineering and Advanced Technology to review and confirm the contents of the instrument that has been constructed. The discovery of the validity of the content can be done by using the verification panel to consider the extent to, which the instrument meets the standards. Recommendations from an expert in the field of measurement are necessary for adding or subtracting the scale used. As a result of the review, some improvements have been made that include:

(i) Improving the overall format structure.
(ii) Reduce the items listed in the questionnaire.

The instruments that have been confirmed and received further improvements will be tested on the level of reliability through pilot studies. Researchers will select 15 respondents from Nadayu Construction Sdn. Bhd site is located in Subang Bestari. The questionnaire will be distributed by the researcher herself to the selected respondent.

The selected respondents in this pilot study were from amongst those who attended the CIDB Training at CLAB Training Centre in Sg. Buloh. All selected respondents were not involved in the actual study. The data from the pilot study will be analyzed using the Alpha Cronbach test in IBM SPSS software version 21.0. The reliability index of the questionnaire will be evaluated according to the Alpha strength classification in **Table 4**.

3.13. Method of Data Analysis

Data analysis will be done once all data have been collected from the respondents. Data analysis aims to answer the proposed problem statement. The data is being analyzed to translate any information obtained into a form that can be understood. All gathered data that is collected from the questionnaire is raw data and material that needed to be analyzed to obtain useful knowledge and information.

A total of 55 questionnaires have been distributed to participants during the training. This distribution and collecting process has been done by the researcher by meeting the respondents involved during the CIDB training. The data collected for this study has been analyzed using the IBM Statistical Package for the Social Sciences (SSPS) Software version 21.0. The data obtained has been analyzed using descriptive statistical methods. For data about the respondent's demographics, researchers have used the frequency distribution analysis to see the percentage.

4. CONCLUSION

This paper discusses the detailed research methodology to conduct research in a planned manner. Using the questionnaire, it can make the data analysis easier and more effective as all the information obtained can be revised and the answer is correct because the respondent only needs to choose the answer as stated. The construction of presenting the questionnaires is very important to get the results that meet the objectives of the study. The interview also plays a role to use as a support result for questionnaires. This paper describes the research methods to ensure the validity and trustworthiness of the findings is discussed.

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5. AUTHORS' NOTE

The authors declare that there is no conflict of interest regarding the publication of this article. The authors confirmed that the paper was free of plagiarism.

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