Construction Worker's Perceptions of the Effectiveness of Health and Safety Training Practices of Construction Firms in Abuja, Nigeria

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Abstract
The effectiveness of safety training practices is an important part of safety management on a construction site. Construction workers' ability to identify and assess risks and hazards is acquired through training and experience and is among the key factors that determine their behaviour and thus their safety. Yet researchers have questioned the effectiveness of health and safety training practices in construction. This research explored construction workers' perceptions of the effectiveness of safety training practices of construction firms based on two objective outcomes namely: reaction on safety training design and delivery; and learning in safety training. The study involved the conduct of a survey using self-administered questionnaires with both closed and open-ended questions to obtain data. The self-administered questionnaire was presented to 150 medium and large construction firms which were purposively sampled from 245 construction firms registered with Corporate Affairs Commission (CAC). Descriptive statistics specifically, frequency tables, mean and standard deviation were used to gain an overview of the effectiveness of safety training practices of construction firms, while independent sample t-test was used to test for significance in the difference between mean scores of respondents. The results of the study revealed that construction workers in civil engineering firms are more satisfied with their firm's safety training practices than their counterparts in building construction firms in terms of safety training design and delivery components that corresponds to workers' safety needs; and learning strategies that aid worker learning of safety knowledge, skills and attitudes in safety training. It was therefore recommended that construction firms and practicing professionals should pay special attention to the key components of safety training design and delivery that yield better safety outcomes in terms learning of safety knowledge, skills, and attitudes by workers. The contribution of this study is that it reports the views of construction workers about the effectiveness of health and safety training practices of construction firms in developing countries.

Keywords: *Construction safety, Safety training, Safety management, Training method, Training delivery, Training reaction, Worker learning.*

Introduction
Every year, more than 60,000 fatalities are reported from construction projects around the world (Lingard 2013). In the United States, the Bureau of Labor Statistics reported 908 fatal injuries and more than 200,000 nonfatal injuries in 2014 (BLS, 2015). Despite significant advances in safety management research and practice, unacceptable injury rates in construction continue to be a worldwide pattern. Apart from emotional and physical distress, the annual cost of these injuries exceed 48 billion dollars in terms of litigations in the United States (Ahmed, Azhar & Forbes, 2006) and adversely impact profit margins

and project success (Zou & Sunindijo, 2015).

Given the high proportion of fatal and non-fatal accidents occurring in the construction industry, construction companies constantly seek different and novel strategies to reduce the number of work-related accidents. The construction safety literature shows that researchers mostly focus on safety performance on construction sites and on ways to minimize the number and severity of accidents. Among others, human factors have received much recent attention. For example, Hinze (2006) and Haslam *et al.* (2005) found that more than 70% of construction injuries involve unsafe worker actions. Tixier *et al.* (2014) explain that such unsafe worker actions are not deliberate safety violations; but are rather outcomes resulting from poor hazard recognition and safety risk perception. In another study, Huang and Hinze (2003) investigated construction worker falls and found that falls represent a high proportion of construction accidents that result in fatalities. Esmaeil *et al.* (2012) developed a framework to investigate the effectiveness of fall protection systems in roofing projects.

As evidenced by these few examples and many others, in general, the literature highlights the importance of the development of effective strategies in preventing work accidents in the construction industry. One such strategy that is mentioned often in the literature is formal, well organized and effective safety training. Effective safety training may lower accident rates, but there are several challenges associated with safety training that need to be overcome by construction firms. Among these challenges is the extent to which workers' learning experiences are affected in safety training sessions and the extent to which workers learn safe practices in training sessions. Furthermore, the prevalent use of ineffective, unengaging, and poorly designed training programmes is a major factor that significantly impede training efforts. In fact, Li *et al.* (2012) argue that a positive correlation does not exist between traditional safety training and safety performance. Not surprisingly, workers lack essential safety knowledge despite having received substantial safety training (Haslam *et al.*, 2005).

For effective training, employers must adopt training practices that will yield maximum benefits. However, there is a dearth of research in construction that explores perceptions of construction workers about the effectiveness of safety training practices of construction firms in terms of design and delivery and about worker learning in safety training. The aim of this study is to explore safety training practices of construction firms based on the perceptions of construction workers on two (2) objective outcomes of safety training namely: reaction of workmen on safety training design and delivery; and worker learning in safety training.

Construction Safety Training

Safety training is one of the most widely adopted interventions to improve workplace safety. Each year, organizations invest millions of dollars to train their workforce on safety issues including hazards recognition, hazard management, and safe work practices. For example, safety training is provided to promote the proper use of personal protective equipment (PPE) and to encourage the implementation of effective injury prevention strategies. Not surprisingly, hundreds of research articles emphasize the importance of safety training, and many others have established causal relationships between safety training and safety performance (Cohen *et al.* 1998; Lingard2002; Ruttenberg, 2013).

In view of these potential benefits, safety regulations require that employers provide their workers with safety and hazard recognition training (Occupational Safety and Health Administration, 2010). Despite these efforts, however, research has revealed that workers still lack essential safety skill and knowledge. In fact, examination of accident reports has

identified deficits in safety knowledge as a principal contributing factor in a disproportionate number of injuries (Haslam *et al.*, 2005). According to Haslam *et al.* (2005), more than 70% of accidents in construction projects are associated with poor safety knowledge. These deficits in safety knowledge and skills have traditionally been attributed to industry barriers for effective training. For example, the transient nature of the workforce discourages some employers from adopting innovative, sophisticated, and resource-intensive training programs (Goldenhar *et al.*, 2001). Other common barriers to effective training include schedule constraints in time-sensitive projects, unavailability of funds and resources, lack of interest among workers, and the uncertainty and difficulty of quantifying training benefits (Wang *et al.*, 2008).

Apart from these barriers, several training programmes fail because of common design flaws including unorganized material, ineffective trainers, and an insensitivity to effective instructional methods (Bunch, 2007). Most training programmes are delivered based on the naïve assumption that knowledge transfer can easily occur when conventional classroom instructional techniques are adopted. However, Haslam *et al.* (2005) argues that these passive instructional methods do not sufficiently engage workers, and that they can instill negative attitudes among workers towards safety issues. Similarly, Wilkins (2011) suggests that pedagogical and classroom instructional methods must be replaced with andragogical approaches that encourage participation and are more suitable for adult learners. More recently, Burke *et al.* (2011) argued that engaging safety training methods that facilitate dialogue, feedback, and action can result in higher learning gains.

Learning as an Objective Outcome of Safety Training

Some examples of research work that involves "learning" in safety training include the following. Han *et al.* (2008) state that low skill levels, inadequate technical knowledge, and a steep learning curve are the factors that affect the safety performance of construction workers in a negative manner. Porteous (1997) states that safety knowledge, skills and abilities could be improved by well-generated learning theories. The Occupational Safety and Health Administration specifically requires that safety proficiency be evaluated and documented by the use of a written assessment and a skill demonstration to evaluate the knowledge and individual skills developed in the course of training (OSHA, 2012). Kirkpatrick (1998) suggests that the effectiveness of learning could be tested by observing the differences between a control group that does not receive training and a trained group. Furnham (2005) argues that individuals learn best when they encounter an obstacle or an intellectual challenge that is of interest to them. According to Furnham (2005), the best way to help people learn is to explain the abstract of the situation and provide varied examples over an effective learning period. Furnham (2005) also states that people learn by modeling others' skills. In addition, Furnham's (2005) study also indicates that safety learning might be achieved by computer-aided tools since it has the benefit of being self-paced.

Business Legal Reports (2007) asserts that three basic learning styles exist, including visual learning, auditory learning, and hands-on learning. Workers learn things in different ways and at their own pace. For example, visual learners learn best by seeing, while auditory learners like to listen, and hands-on learners learn best through practical instruction. The BLR (2007) report suggests using more visual aids in safety training sessions. Dudley (2010) defines two teaching styles commonly used by trainers, namely andragogical and pedagogical styles. In the andragogical style, the learner is self-directed and is responsible for his/her own learning. Contrastingly, in the pedagogical style, the trainer takes the full responsibility in how the material is

learned and the trainer evaluates learning. In the andragogical style, learners are internally motivated, display self-esteem, recognition, and confidence, while in the pedagogical style, learners are externally motivated by competition for performance and the negative consequences of failure.
It is to be noted that safety training is negatively affected by factors such as economic downturns, limited training budgets, and unpredictable product and technical innovations (Furnham, 2005). Additionally, the efficiency of safety training programs depends on organizational, feedback, content, process, and worker-related issues.

Organizational issues consist of the firm's structure, middle management's commitment to safety, and the effectiveness of safety trainers in improving the quality of training sessions. Bontis *et al.* (2002), Sicilia and Lytras (2005), and Pham and Swierczek (2006) assert that a supportive firm structure results in knowledge transfer and motivates workers to learn quickly and capture the necessary information in an effective manner in safety training sessions. According to Jaselskis *et al.* (1996), and O'Toole (2002), middle management's commitment to safety training results in experiencing lower injury rates and helps with improving a company's safety culture. Concerning the qualifications of a trainer, occupation safety and health administration standards mandate that a trainer is considered to be qualified if he/she has previously completed a training program on the subject to be instructed. Furthermore, these trainers are expected to possess relevant academic credentials and teaching experience (OSHA, 2013).

Feedback issues play an important role in improved safety performance. Indeed, according to Furnham (2005), safety performance is enhanced by accurate and timely feedback because feedback reinforces safety learning. Also, Loosemore (1998) conducted research about the psychological mechanisms that cause poor safety performance in construction companies and found that feedback should be continuous to achieve actual safety performance that is aligned with planned performance. Therefore, feedback issues deserve special attention in conducting safety training.

Issues related to the content of training sessions consist of goal setting before conducting safety training and developing the safety training content with respect to worker needs and interests. A well-designed content that addresses worker needs and interests results in higher efficiency during training sessions as workers start with different levels of knowledge (Tam & Fung, 2012). Therefore, designing safety training content requires an in-depth analysis of the materials, methods and processes that are perceived by workers to be of importance to safety.

Issues related to the training process may have significant impact on the effectiveness of safety training. The use of visual aids in the training session deserves special attention. Miller *et al.* (2012) emphasize that the use of 4D and 5D visualization tools helps to increase the knowledge gained in training sessions. Also, observing worker practices after training sessions could indicate how much workers learned in the training session.

Worker-related issues include encouraging worker awareness about safety issues, promoting pride in work completed without accidents, and motivating workers through frequent and effective training meetings. Workers who are part of an effectively trained team take pride in their firm if projects are completed with a great safety record (Bontis *et al.* 2002). Han *et al.* (2008) studied critical factors and possible solutions to motivate foreign construction workers and found that one of the measures to be taken to motivate foreign construction workers was training for better communication. In a more recent study, Wanberg *et al.* (2013) asserts that the promotion of safety and quality can be achieved through strategies such as

assigning resources to preplanning, motivating leadership at workplace, and motivating workers to take pride in their work. The literature appears to support the idea that a good safety record can be achieved if workers are motivated through effective training.

There are several methods that can be used to train workers in construction safety. Kraiger (2003) highlighted four methods, namely computer-based training which is flexible, cheap and allows easy-access; team training which aims to practice with other teammates' tasks, roles and responsibilities in order to increase understanding; cross-cultural training which helps with enhancing sensitivity and flexibility towards cultural differences; and corporate training which consists of distance learning and specialized courses. McMahan *et al.* (2010) encourage the use of virtual environments as a strategy in worker training because they found that virtual environment applications improve worker training in pre-inspections of haul trucks and operational procedures of conveyer systems. In another study, Chen *et al.* (2013) proposed a virtual system that consists of a BIM/2D model developed to enhance safety awareness by the careful consideration of hazard types and safety issues along with the testing of users' ability to resolve problems, hence offering a "learning by doing" technique to better recognize site hazards and gain awareness about the severity of accidents.

Reaction of trainees on key components of training as an objective outcome of safety training

Emotional reaction refers to the attitudes of participants at the end of safety training. An employee who has considerably gained safety skill and knowledge from the training will be willing to apply it on the job environment, thus bring positive reaction (Kirkpatrick, 1976). This could be a barometer for measuring employee's general attitude, expectations and motivation. Although subjective, reaction also provides feedback on training style and content (Mohammed & Norsiah, 2013). Measurement is useful in fostering management support for the training programme.

Post training questionnaire can be used to measure emotional reaction (Kirkpatrick, 1998). According to Bates (2004), questionnaire should be directed towards measuring the training attitudes as regards content, process (presentation style), definition of course objectives, attainment of course objectives and overall course value. The focus of the type of measurement is to investigate the attitudes toward the training material provided during safety training and obtain feedback from the trainees (workers). The post training questionnaire methods have also received several criticisms in terms of their accuracy and bias, also regarding forms ad type of questions included in the questionnaire can largely influence the answer provided in the questionnaire (Bates, 2004). Attempt at improving both pre and post training questionnaires have been made with accuracy and bias issue in mind (Kirkpatrick, 2006). The issue of quantification of measuring believes cannot be totally devoid of bias (Kirkpatrick, 2006).

At reaction level, employee (workers) reactions are understood to show their perceived and subjective evaluation of the relevance and quality of the safety training programme. According to Kirkpatrick (2006), training program should at least first be evaluated at this level to help improve the conceptualization and design of the safety training programme for use in future. Employee (worker) reaction at this level measured satisfaction derived from evaluation categories of training such as safety training program objectives, course materials and relevance, facilitator knowledge, facilitator delivery, program evaluation and training facility.

Methodology

This study adopted a quantitative research approach. As defined by Hughes (2006), quantitative research is concerned with the

collection and analysis of data in numeric form. The study involved the conduct of a survey using self-administered questionnaires with both closed and open-ended questions which were used to explore the safety training practices of construction firms based on the perceptions of construction workers. The self-administered questionnaire was designed to have two sections (sections A and B). Section A of the questionnaire was designed to get respondent's demographic information, while section B of the questionnaire was designed to seek views of workmen employed by medium and large construction firms in Abuja (FCT) based on two questions. Question 1 was designed to gauge reactions of workmen on the key components of safety training design and delivery of construction firms. It asked "what is the level of your agreement with the following statements on key components of safety training design and delivery based on the safety training practices of your firm?" Question 2 sought to explore information on the strategies used by construction firms to achieve worker learning in safety training. It asked "how does your firm achieve worker learning in safety training?" For question 1, sixteen key components of health and safety training design and delivery were identified from the literature and respondents were asked to indicate their level of agreement with each component on a scale rating of 1-5, where 1= strongly disagree, 2= disagree, 3= neither disagree nor agree, 4= agree and 5= strongly agree. Similarly, question 2 was assessed through fifteen strategies that facilitate worker learning in safety training identified from detailed literature review. Respondents were then requested to indicate the extent to which construction firms employ each strategy to ensure learning in safety training on a rating scale of 1-5, where 1= never, 2= seldom, 3= sometimes, 4= often and 5= always. The self-administered questionnaire was distributed to 150 medium and large construction firms which were purposively sampled from the 245 medium and large construction firms registered with Corporate Affairs Commission (CAC) in Abuja, Nigeria. The sample size was computed based on Watson (2001) formula for getting a representative sample size from a large population. Out of the 150 questionnaires distributed, 130 were returned and found useful for analysis, thereby giving a good response rate of 86.7%. The study employed the use of descriptive statistics specifically, frequency tables, mean and standard deviation were used to analyse the collected data in order to achieve the aim of the study. Furthermore, the independent samples t-test was performed in order to see if the differences between the groups are statistically significant at $\alpha = 0.05$. All these statistical analyses were undertaken using the statistical package for social science (SPSS) for Windows version

Results and Discussion

Results of Demographic Features

The results revealed that most of the respondents (86%) have had between 1 and 15 years of experience at the construction firm and remaining (14%) have years of experience between 20 years and above. In the light of this, the respondents are discovered to be suitable to provide accurate answers to the questions in the research questionnaire.

It was also revealed that majority of the respondents (52.6%) have been involved in building construction works while the remaining (47.4%) are involved in civil engineering works. It thus, can be concluded that the majority of respondents that took part in this study were involved in building construction works. In terms of health and safety training practice, respondents were requested to indicate whether or not their firm practice health and safety training. Results revealed that majority (87.6%) of the respondents indicated yes, while the remaining (12.4%) indicated no. This result shows that the majority of construction firms that participated in this study consider health and safety training as a strategy for improving safety on construction sites and therefore, are qualified enough to provide accurate data for the study. In addition,

respondents were requested to indicate the frequency/rate at which safety training is provided by their respective firms. Results revealed that (17.5%) of construction firms provide safety training on daily basis, (40.4%) weekly, and (42.1%) monthly. This implies that the construction firms that took part in this study provide safety training at least once a month.

Reactions of workmen on key components of health and safety training design and delivery of construction firms

From the review of literature in this study, 16 key components of health and safety training design and delivery were identified and ranked by workmen in order of agreement using a five-point scale (1=strongly disagree to 5=strongly agree). Table 1 and Table 2 summarise the reactions of workmen on these key components of health and safety training design and delivery in building construction and civil engineering firms.

Table 1: Reactions of workmen on key components of health & safety training design & delivery in Building Construction firms

S/N	Components of health & safety training design & delivery	Respondent's Choices					Mean	SD	Rank
		1	2	3	4	5			
i	I was appropriately challenged by the material	0	0	0	52	8	4.13	0.34	1
ii	I experienced minimal distractions during the training session	0	7	45	8	0	3.02	0.50	2
iii	I was pleased with the room set-up	0	7	45	8	0	3.02	0.50	2
iv	My learning was enhanced by the experiences shared by the facilitator	0	7	46	7	0	3.00	0.49	4
v	My learning was enhanced by the knowledge of the facilitator	0	7	46	7	0	3.00	0.49	4
vi	I felt that the course materials will be essential for my success	0	33	27	0	0	2.45	0.50	6
vii	I will be able to immediately apply what I learned	0	39	21	0	0	2.35	0.48	7
viii	I found the course materials easy to navigate	0	46	7	7	0	2.35	0.69	7
ix	I understood the learning objectives	0	42	17	1	0	2.32	0.50	9
x	I was able to relate each of the learning objectives to the learning I achieved	0	44	15	1	0	2.28	0.49	10
xi	It was easy for me to get actively involved during the session	17	38	15	0	0	2.13	0.60	11
xii	I was given ample opportunity to demonstrate my skills		53	7	0	0	2.12	0.32	12
xiii	I was given ample opportunity to demonstrate my knowledge	7	46	7	0	0	2.00	0.49	13
xiv	I was given ample opportunity to get answers to my questions	14	39	0	7	0	2.00	0.84	13
xv	I was well engaged during the session	7	46	7	0	0	2.00	0.49	13
xvi	I was given ample opportunity to practice the skills I am asked to learn	14	46	0	0	0	1.77	0.43	16

The mean score used to rank the key components of health and safety training design and delivery of construction firms in Table 1 revealed that out of the 16 key components of health and safety training design and delivery, workmen in building construction firms agreed with only 1 component, disagreed with 11 key components, and neither agree nor disagree with the other 4 components. The only component that workmen agreed to is: *"I was appropriately challenged by the material"* (with a mean score of 4.13). The 11 components of health and safety training design and delivery that workmen showed disagreement with range between *I felt that the course materials will be essential for my success* (2.45) and *I was*

given ample opportunity to practice the skills I am asked to learn (1.77). The other 4 components that workmen showed neither agreement nor disagreement with range between *I experienced minimal distractions during the training session* (3.02) and *my learning was enhanced by the knowledge of the facilitator* (3.00).

Respondent's assessments on the key components of health and safety training design and delivery (Table 1) showed that workmen are mostly dissatisfied with the way building construction firms design and deliver health and safety training.

Table 2 shows respondents' assessments in civil engineering firms on the key components of health and safety training design and delivery. The mean score used to rank the key components revealed that workmen disagreed with only 1 component out of the 16 components of health and safety training design and delivery identified. According to the results in Table 2, respondents disagreed with the statement *"I was appropriately challenged by the material"* with a mean score of 2.30. Also, workmen showed agreement with the remaining 15 key components. These key components range between *I found the course materials easy to navigate (4.22)* and *my learning was enhanced by the knowledge of the facilitator (3.59)*. Results in Table 2 indicated that workmen are mostly satisfied with the way civil engineering firms design and deliver health and safety training. Indeed, trainees who are satisfied with the health and safety training practices of their firms tend to be more motivated to learn safe practices than those who are dissatisfied.

Additionally, Independent Samples Test was carried out to compare the mean scores of the respondent's assessments on the key components of health and safety training design and delivery between building construction and civil engineering firms in order to ascertain if significant differences exist. Results in Table 3 show that ($p<0.001$) which is less than p-value= 0.05 and thus it can be concluded that there was a statistically significant difference in mean scores between building construction and civil engineering firms as regards key components of health and safety training design and delivery.

Table 2: Reactions of workmen on key components of health & safety training design & delivery in Civil Engineering firms

S/N	Components of health & safety training design & delivery	Respondent's Choices					Mean	SD	Rank
		1	2	3	4	5			
i	I found the course materials easy to navigate	0	0	4	34	16	4.22	0.57	1
ii	I understood the learning objectives	0	0	0	44	10	4.19	0.39	2
iii	I was given ample opportunity to get answers to my questions	0	0	0	45	9	4.17	0.38	3
iv	My learning was enhanced by the experiences shared by the facilitator	0	0	0	48	6	4.11	0.32	4
v	I was able to relate each of the learning objectives to the learning I achieved	0	0	0	48	6	4.11	0.32	4
vi	I will be able to immediately apply what I learned	0	0	4	41	9	4.09	0.49	6
vii	I was well engaged during the session	0	0	19	25	10	3.83	0.72	7
viii	I was given ample opportunity to demonstrate my skills	0	0	10	44		3.81	0.87	8
ix	I was pleased with the room set-up	0	4	14	24	12	3.81	0.87	8
x	I was given ample opportunity to practice the skills I am asked to learn	0	6	0	48	0	3.78	0.63	10
xi	I was given ample opportunity to demonstrate my knowledge	0		26	18	10	3.70	0.77	11
xii	I felt that the course materials will be essential for my success	0	9		45	0	3.67	0.75	12
xiii	It was easy for me to get actively involved during the session	0	6	9	39	0	3.61	0.69	13
xiv	I experienced minimal distractions during the training session	0	4	20	24	6	3.59	0.79	14
xv	My learning was enhanced by the knowledge of the facilitator	0	6	10	38	0	3.59	0.79	14
xvi	I was appropriately challenged by the material	6	26	22	0	0	2.30	0.66	16

Table 3: Results of independent samples t-test of key components of training design & delivery between building construction & civil engineering firms

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	T	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Type of construction firm	Equal variances assumed	1.979	.170	-6.842	30	.000	-1.29000	.18854	-1.67505	-.90495
	Equal variances not assumed			-6.842	28.051	.000	-1.29000	.18854	-1.67617	-.90383

***Results of* strategies employed by construction firms to ensure/achieve worker learning in safety training**

From the review of literature in this study, 15 worker learning strategies in health and safety training were identified and ranked by workmen based on level of implementation using a five-point scale (from 1=never to 5=always). Tables 4 and 5 show the respondent's assessments in building construction and civil engineering firms respectively.

Results in Table 4 revealed the mean score used to rank the strategies mostly practiced in building construction firms to achieve learning in safety training. According to the respondents, only 2 out of the 15 learning strategies are implemented in building construction firms. Respondents indicated that *the safety related behaviours of workers are observed* is the most critical issue in achieving learning in safety training with a mean score of 3.62.

The second learning strategy cited by respondents in safety training involves *encouraging experienced workers to share their safety knowledge with the inexperienced workers* (3.62). This means that building construction firms mostly perform health and safety training in an environment where experience sharing does occur.

Table 4: Workmen assessments of worker learning strategies in Building Construction firms

S/N	Strategies for achieving worker learning in safety training	Respondent's Choices					Mean	SD	Rank
		1	2	3	4	5			
i	The safety-related behaviors of workers are observed	0	0	0	55	5	4.08	0.28	1
ii	Experienced workers share their safety knowledge with inexperienced workers	0	2	5	40	13	4.07	0.66	2
iii	Organizational structure encourages safety training	0	29	16	15	0	2.77	0.83	3
iv	Qualified safety trainers are employed	0	29	31	0	0	2.52	0.50	4
v	Middle management participates in health and safety training	0	30	30	0	0	2.50	0.50	5
vi	Safety goals are set before safety training	0	31	29	0	0	2.48	0.50	6
vii	Content of safety training is designed to satisfy worker needs/interests	7	37	0	16	0	2.42	1.01	7
viii	Feedback on health and safety issue provided to workers	0	38	22	0	0	2.37	0.49	8
ix	Workers are motivated to follow safety rules	7	29	24	0	0	2.28	0.67	9
x	Workers are aware of the critical safety issues	0	53	7	0	0	2.12	0.32	10
xi	Questions and answers are encouraged in safety training	0	53	7	0	0	2.12	0.32	10
xii	Visual aids are used in safety training sessions	15	38	7	0	0	1.87	0.60	12
xiii	Management encourage pride in work completed without accidents	38	22	0	0	0	1.37	0.49	13
xiv	Workers who have completed safety training are rewarded	45	8	7	0	0	1.37	0.69	13
xv	Exams are administered to workers during or after safety training	53	7	0	0	0	1.12	0.32	15

Table 5: Workmen assessments of worker learning strategies in Civil Engineering firms

S/N	Strategies for achieving worker learning in safety training	Respondent's Choices					Mean	SD	Rank
		1	2	3	4	5			
i	Organizational structure encourages safety training	0	1	3	26	24	4.35	0.68	1
ii	Qualified safety trainers are employed	0	0	0	41	13	4.24	0.43	2
iii	Content of safety training is designed to satisfy worker needs/interests	0	0	16	10	28	4.22	0.88	3
iv	Safety goals are set before safety training	0	0	16	10	28	4.22	0.88	3
v	Experienced workers share their safety knowledge with inexperienced workers	0	0	6	32	16	4.19	0.62	5
vi	Workers are motivated to follow safety rules	0	3	6	33	12	4.00	0.75	6
vii	Questions and answers are encouraged in safety training	0	3	6	33	12	4.00	0.75	6
viii	The safety-related behaviors of workers are observed	0	0	4	50	0	3.93	0.26	8
ix	Workers are aware of the critical safety issues	0	33	7	14	0	2.65	0.87	9
x	Middle management participates in health and safety training	0	32	21	1	0	2.43	0.54	10
xi	Feedback on health and safety issue provided to workers	0	40	14		0	2.26	0.44	11
xii	Workers who have completed safety training are rewarded	16	13	23	2	0	2.20	0.92	12
xiii	Management encourage pride in work completed without accidents	0	46	7	1	0	2.17	0.42	13
xiv	Visual aids are used in safety training sessions	0	45	9		0	2.17	0.38	13
xv	Exams are administered to workers during or after safety training	19	18	12	5	0	2.06	0.98	15

Results in Table 5 revealed the mean score used to rank the strategies mostly practiced in civil engineering firms to achieve learning in safety training. According to the respondents, 8 out of the 15 learning strategies in safety training have been implemented in civil engineering firms. Respondents indicated that *organisational structure encourages safety training* (4.35), *qualified safety trainers are employed* (4.24), *safety goals are set before safety training* (4.22), *content of safety training is designed to satisfy workers' needs/interests* (4.22), *experienced workers are encouraged to share their safety knowledge with the inexperienced workers* (4.19), *questions and answers are encouraged in safety training* (4.00), *workers are motivated to follow safety rules* (4.00), *and the safety related behaviours of workers are observed* (3.93). According to the respondents, the other 7 learning strategies in safety training which are yet to be implemented in civil engineering firms range between *workers are aware of the critical safety issues* (2.65) and *exams are administered to workers during or after safety training* (2.06).

Furthermore, Independent Samples Test was carried out to compare the mean scores of the respondent's assessments on the worker learning strategies' implementation between building construction and civil engineering firms in order to see if significant differences exist. Results in Table 6 show that ($p<0.01$) which is to less than p-value= 0.05 and thus it can be concluded that there was a statistically significant difference in mean scores of the worker learning strategies between building construction and civil engineering firms.

Table 6: Results of independent samples test of learning strategies in safety training between building construction & civil engineering firms

	Levene's Test for Equality of Variances	t-test for Equality of Means

									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Type of construction firm	Equal variances assumed	4.845	.036	-2.724	28	.011	-.90867	.33361	-1.59204	-.22530
	Equal variances not assumed			-2.724	27.411	.011	-.90867	.33361	-1.59270	-.22463

Discussion of Results

Reaction of workmen on key components of health and safety training design and delivery

The descriptive results in section 3.1.2 revealed that workmen in civil engineering firms are more satisfied than their counterparts in building construction firms with the key components of health and safety training design and delivery of their construction firm. The results therefore, imply that construction firms that majorly carry out civil engineering works are more likely than their counterparts that carry out building construction works to design and deliver health and safety training practices that suit the safety needs of workmen. The result of the study carried out by Wilkins (2011) is evident to the findings discussed above because it revealed that construction workers in The US showed dissatisfaction with the ways in which health and safety training is designed and delivered. Wilkins highlighted the needs for safety training to cover content relevant to the lives of the trainees, for presentation by a trainer knowledgeable about the subject, and for supplementing training with tangible materials that are understandable.

Strategies employed by construction firms to ensure/achieve worker learning in safety training

The descriptive results in section 3.1.3 revealed that building construction firms achieve worker learning in safety training through 2 strategies which are: the safety related behaviours of workers are observed and experienced workers are encouraged to share their safety knowledge with inexperienced workers. The findings of this study are supported by the findings of David and Sevilay (2015) that revealed that companies that perform building works monitor workers' safety related behaviours more closely than companies that are involved in civil engineering works, because building works involve a large number of activities with a multitude of trades compared to civil works that are generally composed of fewer trades. Also, Rowlinson (2004) mentions that building works are more labor intensive and repetitive than civil works, hence providing the opportunity to observe safety related behaviours of workers more consistently.

The findings of this study also revealed that civil engineering firms employ 8 strategies to achieve worker learning in safety training which are: *organisational structure encourages safety training, qualified safety trainers are employed, safety goals are set before safety training, content of safety training is designed to satisfy workers' needs/interests, experienced workers are encouraged to share their safety knowledge with the inexperienced workers, questions and answers are encouraged in safety training, workers are motivated to follow safety rules, and the safety related behaviours of workers are observed*. The results therefore

imply that workers in civil engineering firms are more likely than their counterparts in building construction firms to learn/acquire safety knowledge, skills and attitudes in safety training. The findings of this study are supported by Demirkesen and Arditi's (2015) study that states that companies that perform mostly civil works design the content of training sessions more in line with workers' needs and interests, because civil works may include many diverse types of construction such as highways, bridges, railroads, dams, etc., each requiring a tailor made training program.

Conclusion

This study explored safety training practices of construction firms based on the perceptions of construction workers on two (2) objective outcomes of safety training namely: reaction of workmen on safety training design and delivery; and worker learning in safety training. For each objective outcome, questions were asked to find out the actual practices of construction firms on each of the two objective outcomes of safety training used. The findings of the study revealed that workmen in building construction and civil engineering firms have contrasting opinions on the key components of health and safety training design and delivery. In building construction firms, workmen are dissatisfied with the majority (15) out of the 16 key components of health and safety training. Conversely, workmen in civil engineering firms are satisfied with the majority (15) out of the 16 key components of health and safety training design and delivery.

It was also established that building construction firms achieve worker learning in safety training through two strategies. The two strategies are; observing workers' safety-related behaviours and encouraging experienced workers to share their safety knowledge with the inexperienced workers. On the other hand, civil engineering firms use eight (8) strategies to achieving worker learning in safety training. The 8 strategies are; setting up organizational structure that supports safety training, employing qualified safety trainers, setting goals ahead of safety training, designing safety training content to satisfy worker needs/interests, encouraging questions and answers in safety training sessions, allowing experienced workers to transfer safety knowledge to less experienced workers, motivating workers to follow safety rules and observing workers' safety-related behaviours.

Based on the findings of the study, the study thus, concludes that construction workers in civil engineering firms are more satisfied with their firm's safety training practices than their counterparts in building construction firms in terms of safety training design and delivery components that corresponds to workers' safety needs; and learning strategies that aid worker learning of safety knowledge, skills and attitudes in safety training. This therefore, means that civil engineering firms consider effective health and safety training as a company strategy for better safety outcomes more than building construction firms.

Recommendation

In view of the conclusion from the research findings, it was therefore recommended that construction firms and practicing professionals should pay special attention to the key components of safety training design and delivery that yield better safety outcomes in terms learning of safety knowledge, skills, and attitudes by workers.

It should be noted that this study explored the effectiveness of health and safety training practices of construction firms based on two objective outcomes namely: reactions of workmen on health and safety training design and delivery and worker learning in safety training. Further studies can be conducted by identifying additional objective outcomes of health and safety training such as hazard recognition, return on investment and safety risk perception. It would also be interesting to directly measure in future research how much

safety knowledge workers actually learn and implement in training sessions.

References

Ahmed, S. M., Azhar, S., and Forbes, L. H. (2006). Costs of injuries/illnesses and fatalities in construction and their impact on the construction economy. *CIB W99, International Conference on Global Unity for Safety and Health in Construction, Beijing*.

Bates, R. A. (2004), A critical analysis of evaluation practice: the Kirkpatrick model and the principle of beneficence', Evaluation and Program Planning, 27, 341–7.

BLR, (2007). 50 tips for more effective safety training. Special Report, Business. Legal Reports. Inc., Nashville, T.N., Bontis, N., Crossan, M.M., Hulland, J., (2002). Managing an organizational learning system by aligning stocks and flows. *Journal of Management. Studies.* 39 (4), 437–469.

BLS (Bureau of Labor Statistics). (2015). National census of fatal occupational injuries in 2014. ⟨http://www.bls.gov/news.release/cfoi .nr0.htm⟩ (Nov. 15, 2016).

Bunch, K. J. (2007). Training failure as a consequence of organizational culture. *Human Resource Development Review. 6(2), 142–163.*

Burke, L.A., Hutchins, H.M., (2008). A study of best practices in training transfer and proposed model of transfer. *Human Resource Development. 19 (2), 107–128.* http://dx.doi. *org/10.1002/hrdq.*

Chen, A., Golparvar-Fard, M., Kleiner, B., (2013). Design and development of SAVES: a construction safety training augmented virtuality environment for hazard recognition and severity identification. *Proc., International Conference on Computing in Civil Engineering.* ASCE, Los Angeles, CA, pp. 841–848.

Cohen, A., Colligan, M. J., Sinclair, R., Newman, J., and Schuler, R. (1998). Assessing occupational safety and health training: A literature review. *National Institute for Occupational Safety and Health, Cincinnati*.

Dudley, L., 2010. Andragogy vs. pedagogy in training. http://managementhelp.*org/blogs/training-and-development/2010/03/30/andragogy-vs-pedagogyin-training/* (Mar. 30, 2010).

Esmaeil, B., Hallowell, M., Roucheray, M., (2012). Developing a framework for measuring the effectiveness of common fall prevention/protection practices. *Proceedings of International Conference on Sustainable Design, Engineering, and Construction. (ASCE), Fort Worth, TX, pp. 719–726.*

Furnham, A., (2005). The Psychology Behavior at Work: The Individual in the Organization. Second Edition. *Taylor & Francis Group, New York, NY.*

Goldenhar, L. M., Moran, S. K., and Colligan, M. (2001). Health and safety training in a sample of open-shop construction companies. *Journal of Safety Resource.* 32(2), 237–252.

Han, H.S., Park, H.S., Jin, J.E., Kim, H., Seong, K.Y., (2008). Critical issues and possible solutions for motivating foreign construction workers. *Journal of Management Engineering*. 24, 217–226.

Haslam, R. A., et al. (2005). Contributing factors in construction accidents. *Applied Ergonomics*, 36(4), 401–415.

Hinze, J. (2005). Concealing the Occurrence of Construction Injuries. In: The W99 Triennial Conference, Rethinking and Revitalizing Construction Safety, Health, Environment and Quality (edited by Haupt, T. C. and Smallwood, J.). *Construction Research Education and Training Enterprises, Port Elizabeth, 714-727.*

Huang, X., Hinze, J., (2003). Analysis of construction worker fall accidents. *Journal of Construction Engineering and Management 129 (3), 262–271.*

Jaselskis, E., Anderson, S., Russell, J., (1996). Strategies for achieving

excellence in construction safety performance. *Journal of Construction Engineering and Management 122 (1), 61–70.*

Kirkpatrick, D. L. (1976). Evaluation of training. In R. L. Craig (Ed.), Training and development handbook: A guide to human resource development. New York: McGraw Hill. Kirkpatrick, D. L. (1959). Techniques for evaluating training programs. Journal of American Society for Training and Development, 11, 1–13.

Kirkpatrick, D. L. and Kirkpatrick, J. D. (1998), Evaluating Training Programs: The Four Levels, 3rd edition (*San Francisco, CA: Berrett-Koehler*).

Kirkpatrick, D. L. and Kirkpatrick, J. D. (2006), Evaluating Training Programs: The Four Levels, 3rd edition (San Francisco, CA: Berrett-Koehler).

Kraiger, K., (2003). Perspectives on training and development. In: Borman, W.C., Ilgen, D.R., Klimoski, R.J. (Eds.), *Handbook of Psychology. John Wiley & Sons, Inc., Hoboken, NJ*, pp. 171–192.

Li, H., Chan, G. and Skitmore, M. (2012). Visualizing safety assessment by integrating the use of game technology. Automation in Construction, 22, 498–505.

Lingard, H. (2002). The effect of first aid training on Australian construction workers' occupational health and safety motivation and risk control behavior. *Journal of Safety Resources, 33(2), 209–230.*

Lingard, H. (2013). Occupational health and safety in the construction industry. *Construction Management and Economics, 31(6), 505–514.*

Loosemore, M., (1998). Psychology of accident prevention in the construction industry. *Journal of Construction Engineering and Management, 14 (3), 50–56.*

McMahan, R., Schafrik, S., Bowman, D., Karmis, M., (2010). Virtual environments for surface mining powered haulage training. Extracting the science: a century of mining research. In: Brune, J. (Ed.). The Society for Mining, Metallurgy and Exploration, pp. 520–528.

Miller, G., Dawood, N., Kassem, M., (2012). Building an emergent learning environment for construction health and safety by merging serious games and 4D planning. Proceedings, *International Conference on Computing in Civil Engineering. (ASCE), Clearwater Beach, FL, pp. 129–136.*

Mohammed, S.A., and Norsiah, B.M., (2013). Evaluation of the effectiveness of training and development: The Kirkpatrick model. Asian Journal of Business and Management Science.

OSHA (Occupational Safety and Health Administration). (2010). *OSHA training standards policy statement. Washington, DC.*

OSHA (Occupational Safety and Health Administration). (2013). Top 10 most frequently cited standards. *⟨https://www.osha.gov/Top_Ten_Standards.html⟩* (Oct. 15, 2015).

O'Toole, M., (2002). The relationship between employees' perceptions of safety and organizational culture. *Journal of Safety Resources 332, 231–243.*

Pham, N.T., Swierczek, F.W., (2006). Facilitators of organizational learning in design. *The Learning, Organization. 132*, pp. 186–201.

Porteous, M., (1997). Occupational Psychology. Prentice Hall, London, UK. OSHA, (2012). Occupational safety and health administration regulations. http://www.osha.gov/pls/oshaweb/owasr h.search_fo m?p_doc_type=*STANDARDS&p_toc_level=1&p_keyvalue=1910* (Apr. 26, 2011).

Rowlinson, S., (2004). Construction Safety Management Systems. *Taylor and Francis Inc., New York, NY.*

Ruttenberg, R. (2013). The economic and social benefits of OSHA-10 training in the building and construction

trades. *Center for Construction Research and Training (CPWR), Silver Spring, MD*.

Sicilia, M., Lytras, M., (2005). The semantic learning organization. *Learning Organisation 12 (5), 402–410*.

Tam, V., Fung, I., (2012). Behavior, attitude, and perception toward safety culture from mandatory safety training course. *Journal of professional Issues in Engineering and Education Practice 138 (3), 207–213*.

Tixier, A. J., Hallowell, M. R., Albert, A., van Boven, L., and Kleiner, B. M. (2014). Psychological antecedents of risk-taking behavior in construction. *Journal of Construction Engineering Management, 10.1061/(ASCE)CO.1943-7862.0000894, 04014052.*

Wanberg, J., Harper, C., Hallowell, M., Rajendran, S., (2013). Relationship between construction safety and quality performance. *J. Constr. Eng. Manag.* 139 (10), 04013003.

Wang, Y., Goodrum, P. M., Haas, C. T., and Glover, R. W. (2008). Craft training issues in American industrial and commercial construction. *Journal of Construction Engineering Management, 10.1061/(ASCE)0733-9364(2008)134:10(795), 795–803*.

Watson, J. (2001). *How to Determine Sample Size:* Tip sheet #60, University Park, P.A: *University Cooperative Extension, Pennsylvania State University*.

Wilkins, J. R. (2011). Construction workers' perceptions of health and safety training programmes. *Construction Management and Economics, 29(10), 1017–1026.*

Zou, P., and Sunindijo, R. Y. (2015). Strategic safety management in construction and engineering, *Wiley, Hoboken, NJ*.