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APPLICATION OF CONSTRUCTIONISM TO RESEARCH-RELATED STATISTICAL COMPUTING TRAINING WORKSHOP AT RIVERS STATE UNIVERSITY PORT HARCOURT, NIGERIA

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Abstract

The study investigated the applicability of the Constructionist/Learning-While-Doing (C/LWD) instructional model to a professional development training programme in the Department of Business Education, Rivers State University, Port Harcourt, Nigeria. The study adopted the one-group pretest-posttest design. A sample of 52 participants took part in the study. An instrument titled the Statistical Computing and PowerPoint Scale (SCPS) was used to assess the knowledge of the participants before and after the training activity. The instrument was adapted and modified using Lough (2014). The response variables, such as knowledge of statistical computing (data coding, descriptive statistics, parametric statistics, and non-parametric statistics), reliability test computation, and PowerPoint presentation, were measured on a 10-point scale. The participants were trained in the use of Statistical Product and Service Solutions (SPSS) in statistical computing. The use of PowerPoint presentations in seminar delivery was also learned using the C/LWD model. The mean and standard deviation were used to answer the research questions, whereas the hypotheses were tested at a .05 level of significance. The finding, among others, established that the participants significantly improved their knowledge of data coding, descriptive statistics, parametric statistics, and non-parametric statistics over time using the C/LWD instructional model. A similar finding was established in terms of knowledge of the use of PowerPoint presentations and reliability test computations using the SPSS software package. This study recommended, among others, that researchers in education and related disciplines should study Statistical Computing and PowerPoint Presentations using C/LWD in a professional development training programme.

Keywords: Constructionism, Statistical Computing, Research Training, Workshop, Knowledge

Introduction

An outgrowth of constructivism is constructionism. It is a learning theory that Seymour Papert developed (Harel & Papert 1991), and it expands upon Jean Piaget's constructivist theory (Piaget, 1929, 1977). Seymour Papert created constructionism as a theory of instruction based on the theory of knowing formulated by Swiss psychologist Jean Piaget (1896-1980). The foundation of constructionism is the idea that students can learn by building tangible objects through the completion of projects or artefacts that are connected to their knowledge base. Between 1958 and 1963, Seymour Papert collaborated with Jean Piaget in Geneva. According to the constructionism idea, learning is most effective when students are working to create something significant, like a machine, a poem, a tale, a computer program, or a song. According to constructionism, children learn more effectively when they are involved in creating valuable products or some other type of external artefact that they can reflect on and discuss with others. Constructionism advocates learning through project-based activities (Papert & Harel, 1991). As a result, there are two categories of constructionism: Learners simultaneously develop knowledge or mental models in their thoughts as a byproduct of the construction of things in the outside world. A self-reinforcing cycle results from their use of this novel information, which allows them to physically construct even more complex objects (Harel & Papert, 1991; Kafai & Resnick, 1996). Constructionism shares principles of learning by doing with Dewey's (1897) constructivist element of experiential learning thanks to its emphasis on knowledge quest and practical application rooted in hands-on learning experiences. Constructionism stimulates students' imaginations while improving their understanding of the subject matter. This was demonstrated when Papert (1993, 1994) challenged students to learn mathematics while teaching them how to create computer programs to teach specific mathematical ideas. It was discovered that computer-aided learning and Piaget's (1977) mental mapping methods of building and supplementing knowledge structures in the learner's mind's eye shared certain parallels by actively engaging the students with computer-aided learning. Constructionism is helpful at enhancing learning results (Harel & Papert, 1991; Kafai, et al., 2008).

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Constructionism is concerned with the learning that occurs as a by-product of the learner's engagement in the building of sharable artefacts or products while Constructivism holds that the learner generates knowledge delivered by the instructor (Harel & Papert, 1991; Papert, 1993, 1994). However, both ideas are subsets of the instructional theories of cognitive learning. The use of a constructionist-based pedagogical paradigm like C/LWD is meant to give students a way to take ownership of their learning and put it to use. It is meant to help the student gain new skills rather than replace the learning of fundamental knowledge and skills. Unquestionably essential to students' success are the abilities for professional development, lifelong learning, and citizenship in the globalized world of the twenty-first century (Bray, 2010; Wagner, 2012). The essential elements of these two interconnected learning theories, according to Mays (2015), are the empowerment of students to deepen their understanding through intentional learning activities and exploration, reflection, collaboration, and inventive design. This is mostly accomplished by involving students in the conception and implementation of a project that is intended to produce a particular outcome. The project involves statistical computing in this case.

Therefore, projects constitute the foundation of constructionist instructional approaches. Project-Based Learning (PBL), as opposed to a simple "science lesson" or "math lesson," focuses first on identifying an issue that has to be solved. Then, a project is created to address this issue. Participants gain a stronger grasp of the problem-solving process and associated ideas from numerous allied academic areas as a byproduct of this endeavour, realistically and engagingly (Lough 2014). Incorporating real content and evaluation, clear educational objectives, teacher-facilitated instruction, collaborative learning, and reflection are all part of the PBL environment. It is essential that students use Vygotsky's (1978) social aspects to critique and learn from one another's work when engaging in collaborative learning. PBL activities that involve group collaboration and problem-solving encourage students to actively expand their knowledge. PBL's exploratory style and students' genuine involvement in project completion help students develop their problem-solving abilities and gain a deeper comprehension of the subject matter (Han & Bhattacharya, 2001; Kafai, et al., 2008; Kafai et al., 2009; Krauss & Boss, 2013; Baytak et al., 2011). Project-based learning, learning by doing, design-based learning, Math-by-design, open education, child-centred education, and informal learning are a few examples of constructionist instructional methodologies. But since Piaget and Papert concur that knowledge is actively built by the learner, education entails allowing students to partake in creative activities that stimulate this positive process. The students become the main focus of the learning process as they are active in the construction of learning content. Through active learning engagement, discovery, creative design, and reflection, the students are assisted in increasing their knowledge (Kuh, et al., 2010; Bergmann & Sams 2012; Mays, 2015). The students gain social skills, mutual respect, and teamwork as a result of peer critique and peer mentoring, which are based on Vygotsky's (1978) social constructivism. They also develop communication skills by sharing their knowledge artefacts with other students, which promotes both knowledge retention and skill mastery (Kafai, 2008; Kafai, 2009; Gerver & Robinson, 2010; Lough, 2014; Stager, 2001, 2005).

Constructionism is also the foundation of the instructional model known as Learning-While-Doing (LWD). The LWD is a form of Projected-Based Learning (PBL) strategy. The PBL strategy uses an integrated approach to project development. This paradigm is a proactive approach to education in which participants take on dual roles of teaching and learning. While working on the project, learners are encouraged to use a variety of styles and techniques, engage in exploration, and take calculated risks. Collaboration is a key component of the LWD strategy as students work with professionals, discussion of inquiry-based learning is encouraged, and students complete real-world projects that are grounded in reality (Tempel, 2007; Lough 2014; Han & Bhattacharya, 2001). Additionally, Waddell (2010) views LWD as a project-based "active learning" episode. Instead of focusing on the acquisition of technical knowledge, the projects are typically chosen to help the students grow their interpersonal and critical-thinking abilities. The Constructionist/Learning-While-Doing (C/LWD) model serves as the foundation for the Schlumberger Excellence in Education Development (SEED) educational initiatives.

The C/LWD involves using systems thinking to solve complicated problems. There are two types of intelligence: individual member intelligence, team intelligence developed through interactions among the entire team during collaborative learning, and science and technology "know-how" acquired through SEED tool kits. In this interactive approach, teachers are expected to provide more guidance than direction so that students will be more engaged in their learning. According to Aristotle, "we learn through doing for the things we have to learn before we can do them independently." The LWD paradigm may be summed up as an active learning method that involves both physical activity and mental activity. People of all ages and abilities share the classroom with other learners. The LWD paradigm is a learner-centred, project-based, and collaborative learning technique. Additionally, it guarantees that everyone is a teacher and a learner. Project-based learning focuses first on identifying a problem that has to be solved, and then a project is formed to tackle this problem, as opposed to progressing as a "science lesson" or "mathematics lesson." Participants gain a stronger grasp of the problem-

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solving process and associated ideas from numerous allied academic areas as a byproduct of this project genuinely and interestingly (Tempel, 2007; Lough, 2014). Project-based learning, problem-solving, collaborative learning, systems thinking, and theme-based approach are the main methodologies incorporated in the LWD paradigm. In addition, some current learning approaches rooted in constructionism and constructivism include The flipped classroom (Bergmann & Sams 2012; Roehl et al., 2013; Mok, 2014), case-based learning (Hung, 2013), service learning, (Garcia & Longo, 2013), place-based education (Buxton, & Provenzo, 2011; Zimmerman & Land, 2014), Farm-based education, and outdoor and nature-based education (Beames et al., 2012). The core tenets of both theories focus on the education of the whole person and the learner's internal job of constructing meaning through intellectual stimulation, interaction and guided discovery (Mays 2015).

In the Emohua Local Government Area of Rivers State, Nigeria, Wonu and Arokoyu (2016a) investigated the efficacy of the Learning-While-Doing (LWD) instructional strategy for improving the learning accomplishment of senior secondary students in solid geometry. The research used a quasi-experimental approach. The study included 60 Senior Secondary School I (SSS1) students in total. The Solid Geometry Achievement Test (SGAT) was used for data collection. Students in this cohort collaborated in teams of approximately five students each. The instruction followed the LWD facilitating guidelines. The facilitator gave the participants a brief overview of the methods used for the duration of the experiment in a big group. Additionally, techniques for systems thinking and complicated problem-solving in real life were introduced to them. Previous prototype projects for store impressions and materials were presented to the participants. They were also exposed to the LWD team activities for stages 0-3, which involve identifying real-world problems, coming up with ideas for solutions, developing solution concepts, and developing projects. In small groups, the participants also practiced the project creation process. When coming up with solutions, they were warned not to discard wild ideas. The learners were directed to start working on their projects in groups. The attendees were informed of the details of the projects that were to be presented. Each group of students was permitted to work together, create a controlled amount of noise while working on their projects, and keep a notebook record of the project's progress. When it was required to elicit critical thinking from the learners, the teacher just stood around and asked probing questions. During this stage of the project development, the student groups were permitted to collaborate even outside school hours. After the project development episode, the students exhibited their completed prototype projects in big groups, and each group took part in providing feedback on the many concepts that were on display. The participants were urged to review and improve their projects after making mistakes. The results showed, among other things, that students who were taught using the LWD model obtained more SGAT scores than students who were taught using the Problem-based Learning (PbL) model.

In a related study, Wonu and Arokoyu (2016b) investigated the efficacy of the Design-Based Learning (DBL) paradigm in raising senior secondary students' solid geometry achievement in a related study. It was decided to use the quasi-experimental design. The study included 59 Senior Secondary School I (SSSI) pupils as a sample. The test for measuring achievement in solid geometry (SGAT) was utilized to gather data. The DBL approach was used to deliver instruction to the experimental group of students. The students collaborated in small groups while exchanging knowledge and ideas. The study's objectives were produced by eight (8) learning cycle phases, or strategic elements of the plan (Create design, Evaluate outcome, Generate reasoning, Test idea, Analyze Results, Generalize Results, Connect to Big Idea). The teacher acted as a facilitator, posing questions to encourage groups of participants to use critical thinking abilities while the students worked on model projects utilizing pertinent instructional resources. Creating a Design was the first step in the cycle, and Connect to Big Idea was the last. The results showed that the DBL model advanced students' learning achievement in solid geometry more effectively than the Problem-based Learning (PbL) model. The learning gains of the students in the experimental group were higher over time than those of the students in the other group.

Several studies have explored the efficacy of instructional strategies based on constructionism in advancing the learning outcomes of participants in various fields. Yarnall and Kafai (1996) explored the design of computer games and involved the collaboration of students of varying ages. The interactions between learners and the learning outcomes of the students were examined with the more experienced learners participating as consultants. High commitment and motivation were found to exist among the participants. Beisser and Gillespie (2003) combined constructionism and social constructivism to engage some undergraduate students in learning. The students were made to participate in individual projects; they shared their projects and analyzed each other's work using technological autobiography and the outcome was encouraging. The need to create awareness of civic engagement and informed citizenship was explored by Howe and Covell (2009). The learners designed their charter of school conduct following the format of The UN Declaration of Rights of the Child. Among other findings were that students were found to interact effectively, and they were found to logically relate their projects to interactions in their personal lives, with school and the outside world. Willey and Burke (2011) designed a similar study, which involved students working collaboratively in groups as a component of the large class, to

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create a code of conduct as a conduit for teaching business ethics to college students. The findings established, among others, that the participants were able to learn that conducting business is centred on people and the ability to work collaboratively. Arokoyu and Wonu, (2019) explored the effectiveness of the Constructionist instructional model in advancing the performance of students in Solid Geometry. The findings established, among others that instructions based on Constructionism enhanced the performance of students in Solid Geometry. The above literature review showed that Constructionist-based instructional models are efficacious in advancing the learning outcomes of students in different contexts adopted. A study aimed at determining the efficacy of the C/LWD instructional model in enhancing the learning outcomes of scholars engaged in a training workshop involving Statistical Computing and PowerPoint Presentation at Rivers State University is worthwhile and timely.

Problem specification

The use of statistical packages such as SPSS, Minitab, Gretl, R, and Scientific Python, among others, in research articles and project data analyses, has been enforced in some universities in Nigeria. Observation shows that many researchers are not knowledgeable in the utilization of these statistical software packages in data analysis. This category of researchers prefers positional or theoretical papers to empirical articles and finds it difficult to communicate research effectively. Some postgraduate students in this category either find it difficult to complete their projects in record time or abandon the programme. Some researchers in education and related disciplines have published studies to advance the knowledge of statistical computing among scholars in Science and Education (Wonu et al., 2021; Wonu & Ndimele, 2021), but most of these studies are practical guides to the use of statistical tools in data analysis. The C/LWD pedagogical model has not been applied to engage scholars in the utilisation of software packages in statistical computing for effective collaboration and enhanced understanding of the learned contents. To plug the knowledge gap, this study investigates the efficacy of the C/LWD instructional model in advancing the statistical computing knowledge of scholars involved in a professional development training workshop in the Department of Business Education, Rivers State University, Port Harcourt.

Purpose of the study

The study aims to investigate the applicability of the C/LWD model in professional development training programmes on statistical computing in the Department of Business Education, Rivers State University, Port Harcourt. Specifically, the objectives of the study were:

1. determine the statistical computing knowledge of scholars before and after professional training programme using the C/LWD instructional model
2. find out the difference in the PowerPoint presentation knowledge of scholars before and after the professional training programme using the C/LWD instructional model
3. determine the difference in research instrument reliability-computation knowledge of scholars before and after professional training programme using the C/LWD instructional model

Research questions

The following research questions guided the study:

1. How might we describe the statistical computing knowledge of scholars before and after professional training programmes using the C/LWD instructional model?
2. What is the difference in the PowerPoint presentation knowledge of scholars before and after professional training programmes using the C/LWD instructional model?
3. What is the difference in the research instrument reliability-computation knowledge of scholars before and after professional training programmes using the C/LWD instructional model?

Hypotheses

The following hypotheses guided the study:

1. There is no significant difference in the statistical computing knowledge of scholars before and after professional training programmes using the C/LWD instructional model.
2. There is no significant difference in the PowerPoint presentation knowledge of scholars before and after the professional training programme using the C/LWD instructional model.
3. There is no significant difference in the research instrument reliability-computation knowledge of scholars before and after the professional training programme using the C/LWD instructional model.

Materials and Methods

The study adopted the one-group pretest-posttest design. This design was appropriate because the researchers obtained the knowledge gained using pre-workshop and post-workshop survey data. The researchers are cognizant of the threats to internal validity associated with this design including history, maturation, testing, instrumentation and regression to the mean. A sample of 52 participants took part in the study. This sample involved the postgraduate students participating in a 4-day research-training workshop in the Department of Business

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Education at Rivers State University, Port Harcourt, Nigeria. An instrument titled Statistical Computing and PowerPoint Scale (SCPS) was used to assess the knowledge of the participants in statistical computing and PowerPoint before and after the training activity. The instrument was adapted and modified from SEED collaborative workshop manual (Lough, 2014). The instrument had two sections, section A measured the demographic variables of the respondents whereas section B quantified the response variables such as knowledge in statistical computing (data coding, descriptive statistics, parametric statistics & non-parametric statistics), reliability test computation and PowerPoint presentation on a 10-point scale. The highest score was 10 and the least score was one (1) per item.

A total of 52 copies of the instrument were administered to the participants before the commencement of the training. They rated their knowledge regarding the various aspects of the module to be studied, viz: data coding, descriptive statistics, parametric statistics, nonparametric statistics, PowerPoint presentation and instrument reliability computations). Teams of about five scholars each were formed among the learners to collaborate. The lesson followed C/LWD's recommendations. The experiment's protocols were briefly explained to the participants by the facilitator in a large group. They were also taught strategies for systems thinking and challenging real-world problem-solving. The attendees were shown examples of previous statistical computing prototype projects for storing impressions and data. They were also exposed to the C/LWD team activities for stages 0-3, which entail identifying real-world research problems, coming up with concepts for solutions (variable identification), developing those concepts (interacting with the independent and dependent variables, developing questionnaires, gathering data, etc.), and developing projects (carrying out statistical computing project). The participants also practiced the project development process in small groups. They were told not to throw forth crazy ideas when coming up with solutions. The participants were instructed to begin working on their group projects. The specifics of the projects that were to be presented were disclosed to the guests. Each participant group was permitted to collaborate, make moderate noise while working on their projects, and keep a notebook log of the project's development. The trainer prodded the participants when it was necessary to encourage critical thinking. The participant groups were allowed to work together even after school hours at this phase of the project's development. The participants displayed their finished prototype statistical computing ideas in big groups after the three-day project development episode, and each group participated in offering input on the numerous concepts that were on display. After making mistakes, the participants were urged to review and revise their projects. The participants were given the same test again after the training to gauge their knowledge level following the training workshop. For data analysis, only 52 copies of the questionnaire that the respondents filled out were used. Mean and standard deviation were used to answer the research questions whereas the hypotheses were tested using a dependent sample t-test at a .05 level of significance.

Results

Table 1: Summary of descriptive statistics and paired sample test on the statistical computing knowledge of before and after professional training programme using the Constructionist/Learning-While-Doing instructional model (n=52).

	Data coding		Descriptive statistics		Parametric statistics		Non-parametric Statistics	
Test-phase	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
Pre-workshop survey	5.23	2.36	5.29	2.62	4.88	2.44	4.48	2.64
Post-workshop survey	8.10	2.53	8.21	2.50	8.27	2.35	8.23	2.49
Knowledge gain	2.87	3.07	2.92	2.98	3.38	2.82	3.75	3.21
t-test:	t=-6.73, p=.00		t=-7.08, p=.00		t=-8.65, p=.00		t=-8.42, p=.00	

The result of Table 1 shows the summary of descriptive statistics and paired sample t-test on the statistical computing knowledge before and after the professional training programme using the constructionist/Learning-while-Doing instructional model. It shows that the pre-survey mean score of the participants on data coding was 5.23±2.36, whereas their mean post-survey mean score was 8.10±2.53 and their mean knowledge gain in data coding was 2.87±3.07. The dependent sample t-test showed that the mean variations between the pre-workshop survey and the post-workshop survey over knowledge in data coding were significant (t=5.73, df=51, p=.00). The pre-survey mean score of the participants in descriptive statistics was 5.29±2.62, whereas their mean post-test mean score was 8.21±2.50 and their mean knowledge gain in descriptive statistics was 2.92±2.98. There the pre-workshop survey and post-workshop survey varied significantly over descriptive statistics (t=7.08, df=51, p=.00).

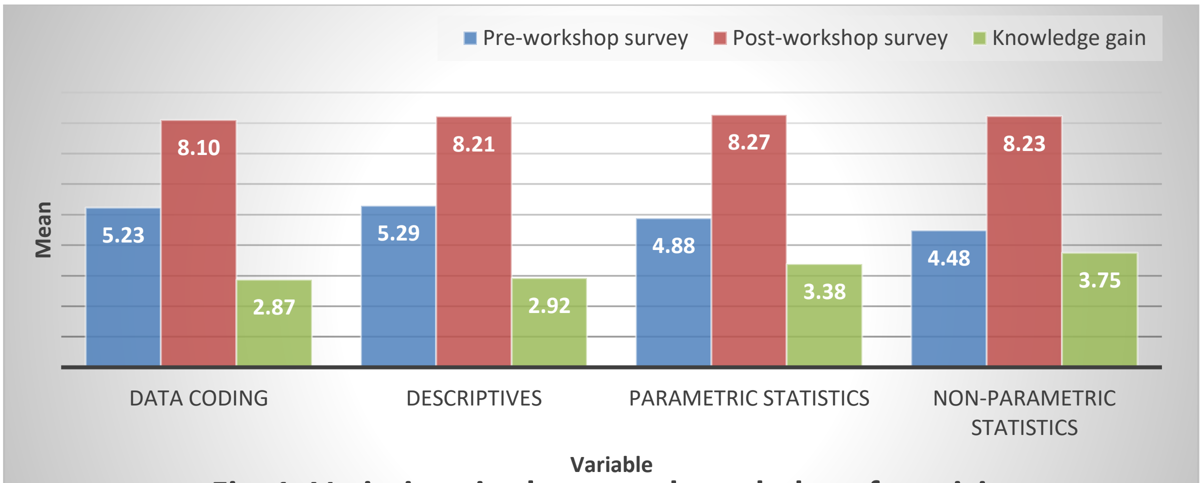

Fig. 1: Variations in the mean knowledge of participants before and after training using C/LWD model

The pre-survey mean score of the participants in parametric statistics was 4.88±2.44, whereas their mean post-test mean score was 8.27±2.35 and their mean knowledge gain in parametric statistics was 3.38±2.82. The pre-workshop survey and post-workshop survey varied significantly over parametric statistics (t=8.65, df=51, p=.00). The null hypothesis three was rejected at a .05 level of significance. The pre-survey mean score of the participants on non-parametric statistics was 4.48±2.64, whereas their mean post-test mean score was 8.23±2.49 and their mean knowledge gain in non-parametric statistics was 3.75±3.21. The pre-workshop survey and post-workshop survey varied significantly over non-parametric statistics (t=8.42, df=51, p=.00).

Table 2: Summary of descriptive statistics and paired sample test on the PowerPoint presentation as well as reliability test computation knowledge of before and after professional training programme using the Constructionist/Learning-While-Doing instructional model (n=52).

	PowerPoint presentation		**Scale-reliability computation**	
Test-phase	**Mean**	**SD**	**Mean**	**SD**
Pre-workshop survey	5.58	2.26	4.37	2.56
Post-workshop survey	8.44	2.07	8.37	2.35
Knowledge gain	2.87	2.74	4.00	3.16
t-test:	t=-7.53, p=.00		t=-9.12, p=.00	

The result from Table 2 shows the summary of descriptive statistics and paired sample test on the PowerPoint presentation as well as reliability test computation knowledge of before and after professional training programme using the Constructionist/Learning-While-Doing instructional model**.** The pre-survey mean score of the participants on the PowerPoint presentation was 5.58±2.26, whereas their mean post-test mean score was 8.44±2.07 and their mean knowledge gain in the PowerPoint presentation was 2.87±2.74. The pre-workshop survey and post-workshop survey varied significantly over the PowerPoint presentation (t=7.53, df=51, p=.00). The null hypothesis was rejected at a .05 level of significan**ce.** The pre-survey mean score of the participants on scale-reliability computation was 4.37±2.56, whereas their mean post-test mean score was 8.37±2.35 and their mean knowledge gain in scale-reliability computation was 4.00±3.16. The pre-workshop survey and post-workshop survey varied significantly over scale-reliability computation (t=7.53, df=51, p=.00). The null hypothesis was rejected at a .05 level of significant

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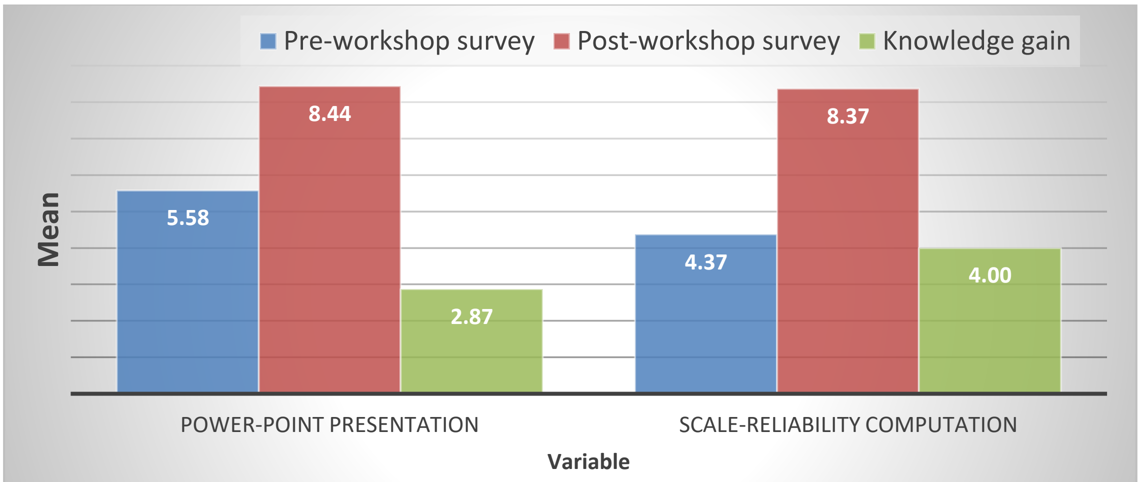

Fig. 2: Variations in the mean knowledge of participants before and after training using C/LWD model

Discussion of findings

The result from Table 1 showed that the participants increased their knowledge of data coding over time with a learning gain mean score of 2.87 which was significant at a .05 level of significance (t=6.73, df=51, p=.00). It is important to note that the participants had a pre-test mean score of 52.3% which indicates that they already possessed some data coding knowledge. The training, as a capacity-strengthening training workshop, ensured that the participants constructed their learning experiences while doing the activities collaboratively with others. This resulted in a post-test mean score of 81% and a knowledge gain of 28.7%. A similar result was obtained in terms of knowledge in descriptive statistics the participants had a mean learning gain of 2.92. Concerning the 10-point scale used, this also implies that the participants gained about 29.2% in descriptive statistics due to the training. This was also significant at a .05 level of significance (t=7.08, df=51, p=.00). The participants improved in their knowledge of parametric and nonparametric statistics that had mean knowledge gains of 3.38 (t=8.65, df=51, p=.00) and 3.75 (t=8.42, df=51, p=.00) which were respectively significant at 0.05 level of significance. The knowledge gains of 33.8% and 37.5% in parametric and nonparametric statistics respectively were not large enough because the participants already had some knowledge of the parametric and nonparametric statistics. The capacity-strengthening training workshop facilitated using the C/LWD model made the learning process more interesting than usual. It enabled scholars of varying ages and research skills to interact and share knowledge and experiences while solving real-life research-related problems. This lends credence to the rejection of hypothesis one at a .05 level of significance. The overall finding as shown in Figure 1 showed that participants had their highest mean knowledge gain in non-parametric statistics (M=3.75), followed by parametric statistics (M=3.38) and the least was in data coding (M=2.87). These findings consistent with the present study established that the C/LWD model was effective in advancing the performance of participants who were engaged in learning solid geometry learning. (Wonu & Arokoyu, 2016b; Arokoyu & Wonu 2019).

The result from Table 2 showed that the participants advanced in their knowledge of the use of PowerPoint presentations by a mean learning gain score of 2.87 and this was significant at a .05 level of significance (t=7.53, df=51 p=.00). The learning gain of the participants in PowerPoint presentations, 28.7%, was also encouraging.
The result also showed that the knowledge of the participants over reliability test computations using the SPSS software package advanced with a mean score of 4.00 this was significant at 05 levels of significance (t=9.12, df=51 p=.00). The overall result showed that the participants had their highest knowledge gain in reliability test when compared with other variables measured with regards to the use C/LWD model in training. The participants had the highest knowledge gain in reliability(40%) computation using SPSS because they were found to be excited and keen to learn how the software package could be used to compute Cronbach Alpha, Strict parallel, Split half and parallel form methods among other methods. They had a higher expectation of using the knowledge acquired to approach their research-related problems. Wonu and Arokoyu, (2016a) established that a Constructionist-based learning model such as Design-based learning was effective in advancing the performance of participants who were engaged in learning solid geometry.

Conclusion

This study has established that the C/LWD instructional model significantly advanced the knowledge of the participants in statistical computing, in terms of data coding, descriptive statistics, parametric statistics and non-parametric statistics. The knowledge of participants regarding the use of PowerPoint in presentations and the reliability test computations using the SPSS software package also improved over time. The present findings imply that the C/LWD instructional model is capable of enhancing the learning outcomes of participants since it is a form of Project-based Learning strategy.

Recommendations

Based on the findings of the study, the following recommendations were made:

1. Researchers in education and related disciplines should study Statistical Computing and PowerPoint Presentations using C/LWD in a professional development training programme.
2. Scholars of varying experience and ages should collaborate effectively in similar training workshops to crossbreed knowledge for improved understanding among participants, as this is one of the tenets of the C/LWD model.
3. Researchers should study the use SPSS software package for the computation of the reliability of instruments/scales to optimize time and improve the accuracy of the results.

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