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Efficacy of an Online Pedagogy on TVET Practical Skills Training Delivery: A Quasi-Experimental Study

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Abstract: To commit to the 'everywhere' access to TVET practical skills (at and away from the training institution), there is need for empirical evidence that supports the idea of delivering practical skills training through an online pedagogy. As such, the purpose of this study was to analyse and compare delivery of TVET practical skills training of face-to-face and online pedagogies in order to determine the efficacy of an online pedagogy on TVET practical skills training. A quasi-experimental design was used for the study so as to identify a comparison group (face-to-face pedagogy) from which baseline data was captured and compared with outcomes of the treatment group (online pedagogy). The population sample (N) for this quasi-experimental study consisted of Instructors (n = 20), and Trainees (n = 69). Observation checklists and questionnaires were the instruments used for data collection of the study. Descriptive statistics were used to define and explain the characteristics of the data (mean and frequency) of the data and then inferential statistics (Independent-Samples Mann-Whitney U Test) was used to examine the significance of the identified difference(s) between the means. The findings of the study demonstrated that the processes of delivering a practical skill training online was as effective as delivery of the same face-to-face. The study recommends development of an online training framework and investment in online pedagogy enablers.

Keywords: TVET, Practical Skills, Online Pedagogy, Face-to-Face Pedagogy, Training

1. Introduction

Technologies and their accelerated advance in the 21st century have created both an opportunity and a dilemma for the 21st century trainer and the education system as a whole. The prospect of reorienting our perspective of teaching and learning processes towards an era of the *'active student'* that takes charge of their own learning, is such a wonderful opportunity. As part of the future evolution of technology into a world of calm and continuous experiencing of life, it's now plausible to predict that technology shall transition from its current state as a "tool we use to do something" to a more complex context in which "we extend our abilities" to earlier unimagined horizons. This seemingly prophetic notion has not only already come true, but it's a basis for predicting what will happen in the foreseeable future. Technology is here to stay and will affect and influence every aspect of our lives in various ways. In education for instance, technology has the potential to supply the tools that are necessary for enhancing the process of teaching and learning, as well as opening up new chances and pathways. In particular, it has the potential to improve the degree to which the educational process can be personalized and adapted to the specific requirements of the learner [19].

In the Uganda Vision 2040, the government of Uganda committed that "ICTs shall be mainstreamed in education to benefit from ICT-enabled learning and to prepare future generations of ICT-savvy professionals, and to assure ICT effective usage [18]". As a result, government education agencies are now obligated with the task of realigning the teaching and learning processes at all levels of learning to this government commitment. However, the use of ICTs to reconstruct the teaching and learning practice in Education has not been discussed frequently by the academe in Uganda. The little work that has been done thus far has all been in the area of general education, leaving the TVET sub-sector solely

reliant on the traditional pedagogies of the last decade to train the 21st century TVET trainee.

1.1. Purpose of the Study

The purpose of this quasi-experimental study was to compare an online pedagogy to a face-to-face pedagogy so as to determine the effectiveness of an online pedagogy as a method for delivering TVET practical skills training. By analysing and comparing data from delivery of practical skills training through the online pedagogy (experimental group) to those of the face-to-face pedagogy (control group), this quasi-experimental study determined the efficacy of an online pedagogy as a method for delivering practical skills in TVET.

1.2. Study Hypothesis

The null hypotheses for this quasi-experimental study was '*$H_{0:}$ There is no significant difference in the TVET practical skills training delivered face-to-face and that delivered online'*.

1.3. Study Conceptual Underpinnings

According to Wikipedia, the term '*pedagogy'* refers to the theory and practice of teaching and how it affects and is influenced by students' social, political, and psychological growth [30]. Pedagogy also refers to the philosophy and practice of teaching, including feedback and assessment, as well as teaching methods and styles [27]. Pedagogy in education can take a low-tech or high-tech approach and can either be teacher- or learner-centered [5]. High-tech and low-tech approaches, refer to how much technology a teacher utilizes to support subject instruction [5]. Among the four distinct categories that discuss the impact technology has on education, is the: 1- Face-to-face instruction, in which students and instructors interact in person and in which class time is the only time when content and discussions can be accessed; and 2- Online instruction, in which teaching takes place online with the majority of the course material and all of the class discussions being accessed through the internet [23].

The term '*practical skills'* is defined as the practical aspects of something involving real situations and events, rather than just ideas and theories and/or a session in which you make things or do experiments rather than simply writing answers to questions [24]. Closely related to the term practical skills in use and practice in TVET, are the terms technical skills and practical work. *Technical skills* are a subset of hard skills, which are the knowledge or abilities needed to perform specific tasks such as working with a piece of technology or equipment or to use a certain technique [3]. They are the individual's affinity or ability to complete tasks related to a specific science or technology and as such they cover a broad array of subjects and areas such as Math, Engineering, Science or Computer-Technology. and as such, technically skilled individuals are often an essential part of the economy because they are responsible for the creation of innovation [17] and [4]. On the other hand, it's noted that practical work refers to any teaching and learning activity that, at some point throughout the activity, requires the students to either observe or manipulate the items and materials that they are studying [16]. Because the setting does not play a significant role in defining the nature of the work being done, the term "practical work" is preferred to the more traditional "laboratory work." It is possible that the examination or manipulation of things may take place in a school laboratory (workshop), but it is also possible that it will take place in an environment other than a school setting, such as the student's home or out in the field [16].

The now universally acceptable definition of the term '*Technical and Vocational Education and Training (TVET)'* is that by UNESCO. It is defined as a comprehensive term referring to those aspects of the educational process involving, in addition to general education, the study of technologies and related sciences, and the acquisition of practical skills, attitudes, understanding and knowledge relating to occupations in various sectors of economic and social life [28]. Availability, Accessibility and Acceptability to TVET have been some of the main challenges of the decade in most developing countries. Its opined that: first, it is important to ensure that everyone has access to high-quality education by removing all obstacles, whether they are financial, physical, institutional, or systemic; second, it is equally important to ensure that everyone can benefit from that education by eradicating all forms of discrimination and by implementing flexible modes of instruction, especially for the most disadvantaged and marginalised students who might not otherwise be reached by conventional modes; and third, it is also important to emphasize that simply having access to education is not enough [25].

2. Literature Review

Benjamin Bloom's learning taxonomy concerned with intellectual skills development offers a concise entry point towards effective delivery of training. The six key elements of the taxonomy include: 1) *Creating*: the process of planning, producing or arranging elements in order or into new patterns or structures that are cohesive or functional; 2) *Evaluating*: making decisions based on standards and criteria by inspecting and criticizing; 3) *Analysing*: the process of separating a piece of information into its component parts and figuring out how those parts connect to one another and to a larger structure or goal by distinguishing, organising, and assigning; 4) *Applying*: Performing or making use of a technique by carrying it out or putting it into practice; 5) *Understanding*: Making sense of oral, written, and visual communications by interpreting, exemplifying, categorising, sumarising, inferring, contrasting, and clarifying; and 6) *Remembering*: the process of recalling, locating, identifying, and retrieving pertinent information from long-term memory [21].

Building on Bloom's works, educational psychologist Robert Gagne's taxonomy of events of instruction, became the basis for cognitivist instructional design. The nine teaching experiences proposed by Gagne and cited in Harasim include:

1) Draw attention by using the appropriate medium; 2) Describe the aim by providing specific objectives for the overall course objectives; 3) stimulate past knowledge by going through the information and ideas that were previously covered and make connections between them and the content that will be covered in the current module; 4) Present the subject matter available for learning through readings, demonstrations, presentations, multimedia, images, audio files, animations, etc.; 5) Give guidance for learning through dialogues that encourage students to actively reflect on new material in order to assess their topic knowledge and comprehension; 6) Encourage performance-based learning through assignments, discussions, and group research projects; 7) Give feedback to enable students receive rapid, detailed, and constructive comments; 8) Evaluate performance using a test, research project, essay, or presentation as the evaluation tool; and 9) Support retention and transfer through guided practice or projects that could connect learning towards other real-life scenarios [11].

When teaching learners, a new skill, either in person (face-to-face) or online, the DEDICT method is a great step–by–step principle to make your training engaging and impactful [6]. DEDICT includes: *Demonstrating* the task at normal speed (real time) to enable learners get a clear idea of what it is they are trying to achieve; *Explaining* what you did step-by-step by use of talking, animations, frozen images and diagrams; *Demonstrating* again, but this time slowly with less in–depth explanation than the previous step; *Imitating* the skill is key to learning a new skill especially when the learner is encouraged to follow along, do an activity, and share their results; *Coach* the learner by giving feedback, further advice, scenarios where the skill would apply, or different scenarios where there may be an alternative way of executing the skill; and, *Test* the learners by giving them a practical challenge, quiz, assessment or activity [6].

Skills learning can be seen as a hierarchical pyramid that starts with knowing at the base of the pyramid, then knowing how, showing how, and then doing at the apex of the pyramid [1]. A four-step model in teaching practical skills proposed and it involves: 1) A realistic demonstration in which the trainer does the exercise normally while making no comments - this enables learners to see how a skill is being mastered; 2) Trainer speak through - the trainer goes over the steps again while explaining each one, responding to queries from the trainees, and making any necessary clarifications. 3) Learner talk through - the student guides the instructor, explaining each move and step while the instructor does the skill. 4) Learner does - the student does the skill under careful observation by the instructor, outlining each step as they [1]. Whereas the proposed model was primarily related to the structured approach to acquiring medical skills, such as Advanced Trauma Life Support, it also provides a solid framework for the teaching of practical skills and, consequently, for the measuring of those abilities, in a variety of TVET sectors.

For some time now, practical skills have been taught using multimedia especially in the field of medical training. The works of Kalet et al, encourage the use of computer-assisted materials to teach skills such as the physical exam (in the medical area) and indicate that careful attention to the design of interactive elements has the potential to significantly improve educational efficacy [13]. Study, either voluntarily or obligatorily, using multimedia applications such as video clips of certain skills, in combination with a structured programme that includes the possibility for individual exercise with personal feedback from peers or teachers, seems to provide a good opportunity for learning fundamental practical skills [29].

Various psychological researchers have pointed to: distributing practice session; part-task training; adaptive and guided training; immediate feedback; practicing well; and positive transfer of skills, as important pillars in training and practice that leads to the most rapid development of a variety of skills. It's been opined that '*Distributing practice sessions'* over a long time, rather than massing them together, leads to more efficient learning during each session and the freedom to set your own standard of success [8, 14]. Whereas some researchers have observed that '*Part-task training'* makes the learning of very complicated skills easier by practicing each component of the skill separately, then putting them all together at the end [15], others have cautioned that when components of a complex skill are intimately coordinated, it may not be a good idea to practice them separately [2]. The two closely related techniques that can aid skill development are '*Adaptive and guided training'*. In adaptive training the student begins with very easy versions of the skill and then attempts gradually more difficult versions whereas guided training provides supports – like "training wheels" – that prevent the learner from making disruptive or dangerous mistakes as skill develops [2].

'Immediate feedback' about which responses are right and wrong, plus the opportunity to correct errors, is vital for efficient skill development [9]. For instance, in the clinical setting, feedback is encouraged to give students information about their performance for possible improvement and as direction for them to review their accomplishment of goals [22]. In order to tailor feedback on performance to enhance processes like perception and planning that occur in the learner's mind, instructional designers are informed that they need to be aware of what approaches each learner prefers or at the very least provide feedback that considers the various learning styles of each learner [10]. *'Practicing well beyond initial mastery'* is the surest way to maintain a skill because highly practiced skills are characteristically automatised as a consequence of extensive practice in contexts similar to those under which the skills will ultimately have to be performed [12]. If tasks require similar responses, then '*Positive transfer'* occurs when a skill learned on one kind of task sometimes aids performance of a second [2].

The three principles for successful online pedagogy are pointed out as: 1. Allow the students to do the work (student-led conversations, discovery and discussion of online resources, peer-to-peer learning, grading of personal homework projects, and case study analysis); 2. Rely heavily

on interaction (collaborative research papers, research proposals for team projects), and 3. Strive for presence (social presence, cognitive presence, and teaching presence) [20]. Online pedagogy usually incorporates consultation and collaboration with a variety of support people, in contrast to traditional classroom pedagogy, which derives from a "Lone Ranger" approach to course preparation [26]. Collaborations include those between graphic designers, web programmers, instructional designers, e-producers, and librarians, many of whom help teachers with design and implementation or online students with subject-specific research [26].

3. Study Design and Methodology

A quasi-experimental (QE) design served as the study's compass and thus enabled comparison of outcomes (delivery of practical skills training) of the experimental group (which is online pedagogy) with the control group (which was face-to-face pedagogy), to determine the efficacy of the online pedagogy, while controlling for any other factors that could affect that result [7]. The study was conducted at St Joseph's Technical Institute - Kisubi (institution X) and Nakawa Vocational Training College (institution Y) located in Wakiso and Kampala Districts of Uganda respectively. A total number of sixty-nine (69) trainees, twenty (20) instructors and eight (8) assessors participated in the study. The trainees were first years' offering the National Certificate in Building Construction - NCBC (Programme A) and the National Certificate in Woodwork Technology – NCWT (Programme B). For each programme, two practical task trainings were delivered through both face-to-face and online.

To promote homogeneity between study groups, and ensure equipment and tools are enough for trainees to work on the practical tasks, only trainees that would be comfortably accommodated in the respective institution workshop were selected to participate in the study. Thus, following administration of the pre-test questionnaire (Appendix I), stratified sampling was used to select trainees who participated in the study and purposive sampling to select only instructors from institution X and Y on the basis of their typicality and specific purpose in the study. The methods (and respective instrument) of data collection for this study were observation (Training observation checklist) and survey (pre-test and post-test Questionnaires) methods.

To ensure validity and reliability of the data collected by the instruments: the instruments focused on collecting data that accurately address the objectives of the study; the observations were made by instructors who are well versed with the practical tasks being performed; a pilot study to test the reliability and validity of the 4 Linkert scale questionnaires was conducted at Kyambogo University; and the Cronbach alpha test was used to check the internal consistency (reliability) of the questionnaires which were found to be reliable (Cronbach's alpha: 0.726 respectively). In addition, the control and experimental groups were in separate institutions for the same practical task whereas both training sessions (Face-to-face and online) of the same practical task, took place simultaneously (at the same time); the control and experimental group of the first task switched to the experimental and control groups of the second task respectively (Table 1); and for uniformity of extent and difficulty of content, the practical task taught in the face-to-face (control) group was the one recorded and digitally enhanced with the use of ICTs, and livestreamed for training the online (experimental) group.

Table 1. *Schedule for face-to-face and online training of practical tasks.*

	Programme A		**Programme B**	
Practical	Steel	Broken	Beam	Equilateral
Task	Bending	Bond	Framework	Arch
Institution X	Face-to-face	Online	Online	Face-to-face
Institution Y	Online	Face-to-face	Face-to-face	Online

A group of twenty (20) instructors observed both the face-to-face and online training delivery of two practical tasks in programme A (Steel Bending and Broken Bond), and another two practical tasks in programme B (Beam Formwork and Equilateral arch center). Since each practical session that was delivered face-to-face was also being live streamed for the online group to train simultaneously, the instructors were split into two groups of ten (10) each to observe and score both pedagogies (Face-to-face and Online). Each observer scored their respective training session (face-to-face or online) based on ten (10) parameters as summarised in observation checklist shown in Appendix II. The scoring of each observed parameter was made along a five-point ranked Likert scale that ranked from Strongly Disagree, Disagree, Neutral, Agree and Strongly Agree. To simplify the presentation of the findings, the rankings were condensed to just three points that included Disagree (merging strongly disagree and disagree), Agree (merging strongly agree and agree) and Neutral.

4. Findings of the Study

Demographically, the sample population of trainees (t! = 69) varied in institution of study, programme of study, gender, academic background, competency in use of ICT and experience in online learning. 56.5% of trainees in the study were from programme A and 43.5% on programme B; 26.1% were female and 73.9% male; 24.6% had Uganda Advanced Certificate of Education, 71% had Uganda Certificate of Education, and 4.3% were from Community Polytechnic/Technical School; 79.7% were competent in use of ICT and 20.3% were not competent in use of ICTs; and 26.1% had prior experience of online training and 73.9% had no prior experience of online training.

The sample population of instructors (t! = 20) also varied in programme taught or assessed, gender, academic background, competency in use of ICT and experience in online learning. An equal number (50%) were drawn from each of the programmes (A and B); 30% were female and 70% male; 10% had post graduate qualifications, 40% were degree holders and 50% were diploma holders; all were competent in the use of ICTs; and 10% had prior experience of online training whereas 90% had no prior experience of online training.

A total of eighty (80) observations of the training process were made for both programmes [10 observations per practical task session x 2 tasks per programme x 2 pedagogies (face-to-face and online) x 2 programmes (A and B)]. The mean scores of the observations made were computed and are presented in

Table 2. The results in the table show that the mean score of parameters 1, 2, 3, 5, 8 and 9 are consistently bordering around or over 4.0 (a rank for 'agree' on the Likert scale) for both face-to-face and online data. On the other hand, Parameter 4, 6, 7 and 10 showed a disparity between the face-to-face and online means. Parameter 6, 7 and 10 had the lowest mean scores (2.78, 3.25 and 2.40 respectively) for the face-to-face data set, whereas parameter 4 and 7 had the lowest mean scores (2.53 and 2.73 respectively) for the online data set. Conversely, parameters 1, 2, 3, 5, 8 and 9 showed the highest mean scores (4.58, 4.43, 4.38, 4.28, 4.40 and 4.40 respectively) for the face-to-face data, whereas parameter 1, 2, 3, 5, 6, 8, 9 and 10 had the highest mean scores (4.38, 4.20, 4.28, 3.98, 4.47, 4.45, 4.22 and 4.40 respectively) for the online data set. The means of the observed data set for the face-to-face training process are in the agreement range for parameters 1, 2, 3, 4, 5, 7, 8 and 9 whereas for parameters 6 and 10 the data set is in the disagreement range. The means of the online assessment process show parameters 1, 2, 3, 5, 6, 8, 9 and 10 in the agreement range; whereas parameters 4 and 7 are in the disagreement range.

Table 2. *Mean of observed scores of the online and face-to-face training sessions across the ten observed parameters.*

Observed Parameter	Number of Observations	Face-to-face Mean score	Online Mean score
Parameter 1	80	4.58	4.38
Parameter 2	80	4.43	4.20
Parameter 3	80	4.38	4.28
Parameter 4	80	3.75	2.53
Parameter 5	80	4.28	3.98
Parameter 6	80	2.78	4.47
Parameter 7	80	3.25	2.73
Parameter 8	80	4.40	4.45
Parameter 9	80	4.40	4.22
Parameter 10	80	2.40	4.40

To graphically present the difference in mean scores of the parameters, the mean scores of observed responses for the online and face-to-face training sessions across the ten observed parameters were plotted in a line chart. The biggest gaps between the line chart plots (Figure 1) of the face-to-face and online mean scores occurred at parameter 4, 6 and 10.

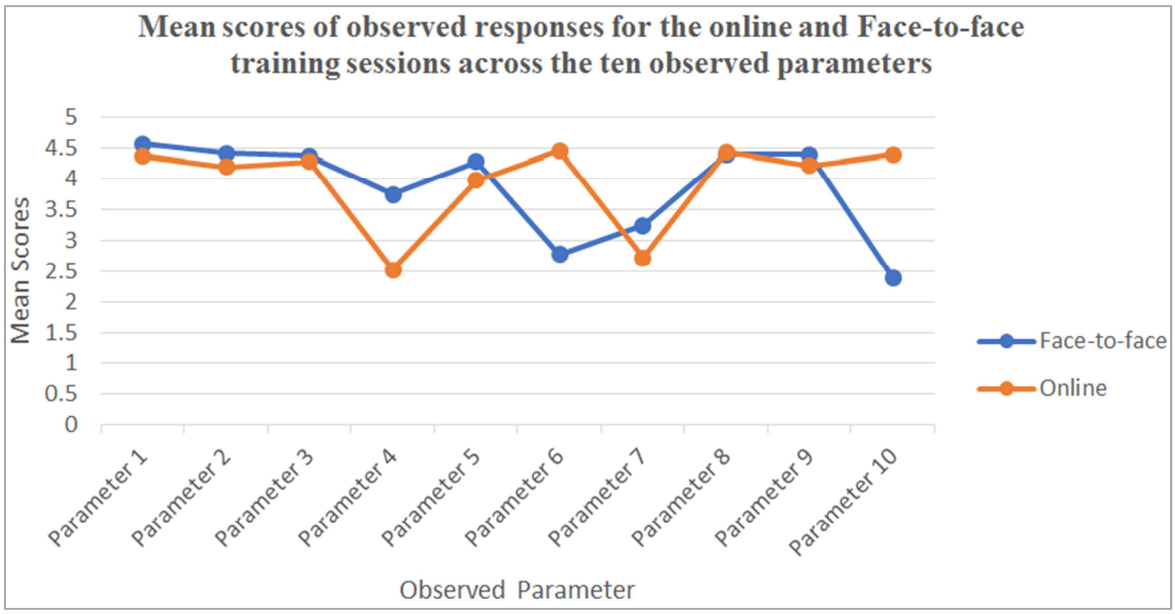

Figure 1. *Line chart of the mean scores of observed responses for the face-to-face and online training sessions across the ten (10) observed parameters.*

The first hypothesis for the study stated that "*There is no significant difference in TVET practical skills training conducted through face-to-face and that conducted online*". To test the hypothesis, the normality of the scores was first determined before deciding on which inferential statistical test to run on the data set. The normality of the mean scores was run in SPSS and due to the number of samples in the study, the Shapiro-Wilk test of Normality was used to test the normality of the mean scores of the practical skills training process as shown by the results in Table 3.

Table 3. *Normality test for the amalgamated means of all the tasks combined.*

	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistic	**df**	**Sig.**	**Statistic**	**df**	**Sig.**
Mean	.152	80	.000	.963	80	.020

Table 3 shows that the significant value 0.020 of the amalgamated means is less than 0.05 which indicates that the means are not normally distributed. This is confirmed by the Detrended Normal Q-Q Plot of the amalgamated means (Figure 2) in which a sizable number of means are far above and below the horizontal line which represents how much higher and lower they are respectively, than what would be expected if the data were normally distributed.

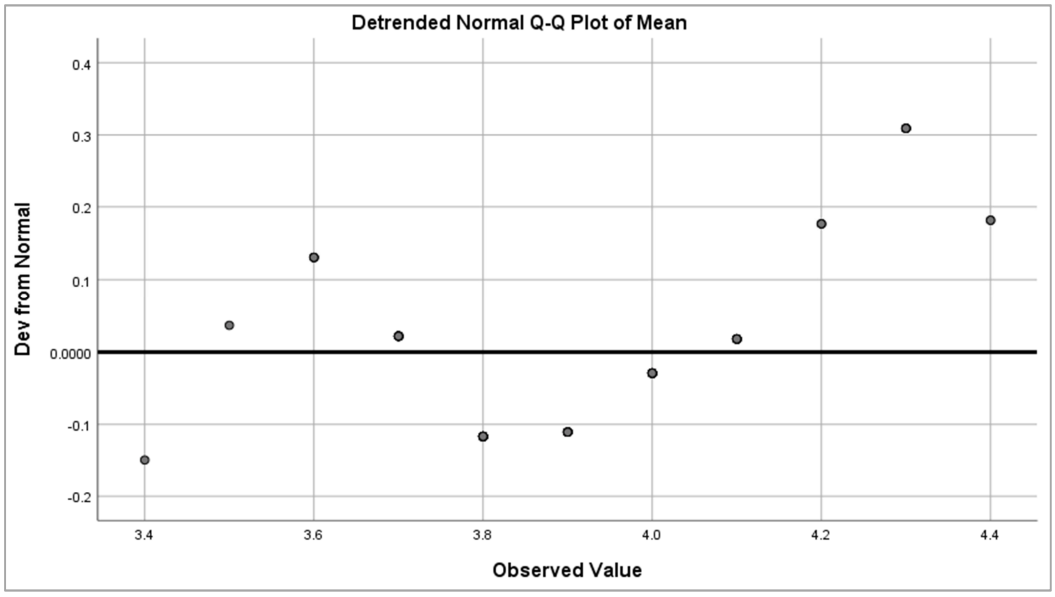

Figure 2. *Detrended Normal Q-Q Plot for the amalgamated means of all the tasks combined.*

Considering that the amalgamated means of all the tasks that were to be used in the analysis are not normally distributed as shown above, then a Nonparametric Test, the Independent-Samples Mann-Whitney U Test, was used to test the means. The results of the test are summarised in Table 4 and Figure 3.

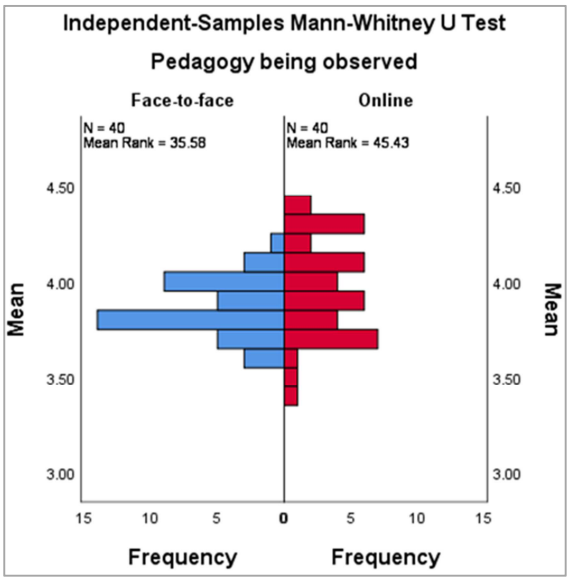

Figure 3. *The Independent-Samples Mann-Whitney U Test Comparison of means.*

Table 4. *The Independent-Samples Mann-Whitney U Test Summary.*

Total N	80
Mann-Whitney U	997.000
Wilcoxon W	1817.000
Test Statistic	997.000
Standard Error	102.692
Standardised Test Statistic	1.918
Asymptotic Sig. (2-sided test)	.055

As summarised in the hypothesis test summary in Table 5, Since the significant value p = 0.055 is greater than the study significance level $\alpha = 0.05$, then the null hypothesis is retained, and conclusion made that the distribution of trainees' average performances is the same across the face-to-face and online categories of pedagogy being observed in the study. Based on the results, there was no statistically significant difference in the TVET practical skills training delivered face-to-face and that delivered online.

Table 5. *Hypothesis Test Summary.*

Null Hypothesis	**Test**	**Sig.**	**Decision**
The distribution of mean is the same across categories of Pedagogy being observed.	Independent-Samples Mann-Whitney U Test	.055	Retain the null hypothesis.

5. Discussion of Findings

The results of the study showed that the distribution of the mean scores was the same across both training categories (face-to-face and online pedagogies) being observed and thus the null hypothesis was retained. The findings of the study demonstrated that the process of delivering a practical skill training online (experimental group) was as effective as the process of delivering the same practical skill training face-to-face (control group).

The findings agree with the foundations of the community of Inquiry theory that is formed on three separate "presences" of instruction, social interaction, and cognitive presence; and the observations of Picciano [21] that with the advent of discussion boards, blogs, wikis, and video conferencing, this theory (community of Inquiry) has emerged as one of the most well-liked instructional models for online and hybrid courses. Keeping in league with the theory's central focus of creating online and hybrid learning environments that function as communities where teachers and learners interact and exchange knowledge, the study content about the practical tasks was presented by instructors at the start of each training session to the group training face-to-face and it was recorded on video and livestreamed to the group that was being trained on the task online. This online engagement of the mind that incorporated original video and audio content of the instructor teaching, enabled the trainees that were training online to follow the content being presented that they later used when working on the assigned tasks. The lack of significant difference in TVET practical skills training conducted through face-to-face and that conducted online was also evidence enough of existence of instruction and cognitive presence for the online group during the study.

The study results showed that both pedagogies (face-to-face and online) clearly presented the material to be learned in an adaptive way that enabled trainees to begin with very easy versions of the practical task and then moved gradually to more difficult versions of the task; elicited performance and enhanced retention and transfer by providing opportunities for projects that might relate what was learnt to other real-life activities; and enabled trainees to participate and properly follow the training content and material being presented during the training session. These findings of the study are well aligned with the findings of other studies, which claim that: adaptive and guided training are two closely related techniques that can aid skill development by enabling a student to begin with very easy versions of the skill and then gradually move to more difficult versions [2]; and the characterization of skill acquisition as the development of a hierarchy of habits [12]. The results are also in agreement with one of the nine teaching experiences proposed by Robert Gagne's taxonomy of events of instruction cited in Harasim [11], that emphasized supporting retention and transfer through guided practice or projects that could connect learning towards other real-life scenarios.

With findings showing that trainees effectively trained for the respective practical tasks online, thanks to the livestreaming of the training via the ICTs, the study results are in tow with Siemens's connectivism theory which contends that because of the extensive data communications networks, there are significant changes in the way knowledge and information travel, develop, and change [21]. As held by the theory, the study findings supported the claims that learning has shifted from private, individualistic activities to group, communal, and even crowd activities as a result of the development of the Internet. conversely, it's also important to note, that whereas online training was able to be made available to groups further away from the physical location where the training was taking place thanks to the internet, the results of the study showed that the online training sessions were affected by service(s) interruption (by lack of access to electricity, internet connectivity, devices or media, learning platforms).

Although there was no significant statistical difference in TVET practical skills training delivered through face-to-face and that delivered online, a few means of the two pedagogies (face-to-face and online) differed in some of the parameters which signified the respective strength and weakness of each pedagogy. The results showed that delivery of a practical skills training online had two major strengths when compared to the face-to-face pedagogy, and these were its ability to foster and integrate collaboration and access within the training process. In terms of collaboration, the results showed that online delivery of practical skills training was a collaborative process that included a trainer (s), technician (s), ICT staff among others during its delivery. Whereas this finding means added overall costs of training, it is also congruent with previous literature that points to online pedagogy usually incorporating consultation and collaboration with a variety of support people to help teachers with design and implementation as opposed to the "Lone Ranger" approach of the face-to-face pedagogy [26].

The results also collaborated findings on the importance of ensuring that everyone has access to high-quality education by removing all obstacles, whether they are financial, physical, institutional, or systemic [25]. To this extent, it was evidenced from the results that online delivery of training enabled trainees' flexible access to the training since they had the option of playing back the training session over and over again to reinforce their learning as they performed the task at hand.

On the other hand, the results showed that training of practical skills online had three major drawbacks. The first was its inability to provide immediate feedback to the trainees since they were separated in time and space with the instructor. This finding contrasted with various literature that emphasized the significance of feedback in training delivery. The finding contradicts with Robert Gagne's emphasis on giving of feedback to enable students receive rapid, detailed, and constructive comments [11]; Observations on coaching the learner by giving feedback, further advice and scenarios where the skill would apply [6]; insistence on Immediate feedback about which responses are right and wrong so as to give the trainee an opportunity to correct errors [9]; and the advice to instructional designers on providing for feedback

that takes into account the various learning styles of each learner [22, 10].

The second drawback of training practical skills online was the finding that it was greatly affected by service(s) interruption that included electricity outages, internet connectivity and slow download speeds. As such, considering that teaching only takes place online when the majority of the course material and all of the class discussions can be accessed through the internet [23], then this finding points to a serious drawback to online pedagogy for practical skills training.

The third drawback was that the results cannot be used to support or negate views on knowledge being created in a group through conversation in three phases, which include: 1- idea generation known as brainstorming, that involves the collection of a variety of different concepts; 2- "idea structuring," in which ideas are contrasted, examined, and categorized via the use of argumentation and discussion; and 3- Intellectual convergence in which intellectual synthesis and consensus takes place, including the act of agreeing to disagree with one another [11]. This is because whereas the data showed cooperation in the training processes (instructors, assessors, technicians, camera crew, and ICT staff working together); the fact that trainees were confined and thus accessed online training in one location, meant that it was not possible to definitively establish existence and thus extent of trainees' cooperation in idea generation or brainstorming and idea structuring. In the same vein, considering that the study was not designed to have a group task for the trainee's cooperative effort to be established, the results of the study cannot support views on intellectual convergence [11].

6. Conclusion

This quasi-experimental study has offered insights into the efficacy of an online pedagogy on TVET practical skills training delivery by comparing, analyzing and drawing conclusions on both face-to-face and online pedagogies. The results of this study have provided statistical support and thus demonstrated that the processes of delivering practical skills online were as effective as those done in the face-to-face. The results of this study suggested that online training delivery sessions can clearly present the practical task material to be learned in an adaptive and guided style that enables trainees to begin with very easy versions of the practical task and then move gradually to more difficult versions of the task, enhance retention and transfer of learned skills by providing opportunities for additional guided practice or projects that might relate learning to other real-life activities, and elicit trainee performance.

The findings of the study have also amplified the potential for collaboration that may include, those between graphic designers, web programmers, instructional designers, e-producers, and librarians, many of whom help teachers with design and implementation or online students with subject-specific research. Such collaborations are key not just in regards to practical skills training and assessment, but to educational and training as a whole because they highlight a feeling of being a part of the learning community; and encourage learning communities where different players in the teaching and learning process interact and exchange knowledge.

The main implication of the results of this study is that, now, the delivery of practical skills training can no longer be confined to formal training, in workshops and laboratories, but can now be accessed everywhere including to trainees in the nonformal and informal training setup. Practical skills can now be for everyone through the internet. Teachers, instructors and lecturers now have the basis upon which to deliver practical skills online. Primary and secondary schools, Universities, colleges, TVET institutions and private teaching and learning content developers; can now include practical skills among the content that can be delivered online be it for home schooling or distance learning purposes.

7. Recommendations

1. TVET providers and institutions should be equipped with enablers of online training delivery that may include internet connectivity with good speeds; stable electricity source that also has a backup system in case of an outage; and ICT equipment (Digital video cameras, video editing equipment, sound equipment, projectors, computers and Wi-Fi routers among others).
2. TVET providers should develop and accumulate practical skills training content that is to be used in the online pedagogy starting with recording their face-to-face training sessions that may be then edited and enhanced for online delivery later.
3. Conduct further studies on delivery of practical skills online that should address some of the limitations of this study and have participants from more than just two training institutions.

8. Limitations of the Study

The need for trainees to work on practical tasks meant that the study had to take place in the workshops where the equipment and tools were located. This dictated that the sample population had to be numbers that could be accommodated comfortably in the respective workshops. The resulting small sample size and the fact that only two programmes were selected for the study, was a limitation to the study.

Also, because of the limited number of female trainees enrolled in TVET programmes across the country, the programmes selected for the study had very few female trainees.

Declarations

Availability of Data and Materials

The authors confirm that the sources of data supporting the findings of this review are available within the article.

Competing Interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Authors' Contributions

Ronald Mutebi conceived the idea, study topic, developed the theory, collected and analyzed the data, and compiled the study draft.

Prof. Bonaventure W. Kerre (PhD) and Dr. Joseph Mubichakani (PhD) supervised and guided the study, and proof read the draft.

All authors discussed the results and contributed to the final manuscript.

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Appendix

Appendix I: Demographic and Background Information

Participant Identification code

Please tick in the box of the most appropriate option

1. Category of participant
   - A Trainee □
   - B Instructor □
   - C Assessor □
2. Name of Institution
   - A St Joseph's Technical Institute, Kisubi □
   - B Nakawa Vocational Training College □
3. Programme of study/Teaching/Assessing
   - A National Certificate in Building Construction □
   - B National Certificate in Woodwork Technology □
4. Gender
   - A Female □
   - B Male □
5. Academic Background
   - A Uganda Advanced Certificate of Education – UACE (S6) □
   - B Uganda Certificate of Education – UCE (S4) □
   - C Community Polytechnic/ Technical School □
   - D Diploma holder □
   - E Degree holder □
   - F Post Graduate □
6. Competency in use of ICTs
   - A Competent □
   - B Not Competent □
7. Experience in online learning
   - A Have Experience □
   - B No Experience □

Dear trainee/Instructor/Assessor: Thank you for sparing time to help with this study.

Appendix II: Delivery of Practical Skills Training Observation Checklist

(To be filled by instructors during the course of the training session)

1. Practical task being observed
2. Pedagogy being observed (online/Face-to-face)

Section 1. Background Information

Please tick in the box of the most appropriate option

3. Institution being observed
   A St Joseph's Technical Institute, Kisubi □
   B Nakawa Vocational Training College □
4. Programme being observed
   A National Certificate in Building Construction □
   B National Certificate in Woodwork Technology □

Section 2. Practical Skills Training observation.

Please tick in the box of the most appropriate option.

Table 6. *Training Observation Checklist.*

	Parameter being observed	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1	Training session is clearly presenting the material to be learned (to include graphics, presentations by instructors, practical demonstrations, etc).					
2	The training is adaptive to enable trainees to begin with very easy versions of the practical task and then move gradually to more difficult versions of the task.					
3	The training elicits performance (training is activity-based learning such as group work, discussions, practice tasks, etc).					
4	The training provides immediate feedback (immediate, specific, and constructive feedback is provided to trainees for the opportunity to correct errors as they train on the task).					
5	The training enhances retention and transfer by providing opportunities for additional guided practice or projects that might relate learning to other real-life activities.					
6	The training delivery is a collaborative process including more than one trainer, Technician, ICT staff, librarians, etc.					
7	The training session is not affected by service(s) interruption (by lack of access to electricity, internet connectivity, devices or media, learning platforms).					
8	Trainees are properly following the training content and material being presented during the training session.					
9	Trainees are participating in the training session activities (such as full attendance, asking questions, and free expression to the instructor).					

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