Effectiveness of the Developed Sand Casting Instructional Video Package on Students’ Achievements in Technical Colleges in Bauchi and Gombe States, Nigeria

A. I. Haruna 1, E. F. Mele 2, Aminu Tijjani Umar 3

1 2 Department of Technology Education, Modibbo Adama University of Technology, Yola
3 School of Technical Education, Federal College of Education (Tech), Gombe

ABSTRACT

The study was on testing the effectiveness of the developed sand casting instructional video package on students’ achievement in technical colleges in Bauchi and Gombe states. Three research questions were raised and three null hypotheses were formulated and tested at 0.05 level of significance. Related literature was reviewed. Quasi-experimental pretest-posttest non-equivalent group design was used for the study. Sixty-seven (67) NTC II Mechanical Engineering crafts practice trades students in two intact classes from two co-educational colleges were used from the two States. One group of the intact class was taught using developed sand casting instructional video package and the other group taught using the conventional method. Sand Casting Achievement Test (SCAT) with a reliability coefficient of 0.89 used to measure students’ achievement before and after treatment and there manifested enough evidence in the study to prove that the developed instructional video package and SCAT are of high validity and reliability. Data obtained were analyzed using Mean and Standard Deviation was used to answer the research questions and t-test to test the hypothesis. Findings revealed that: the experimental group performed relatively the same with the control group before the treatment; students taught sand casting using developed instructional video package (Experimental Group) achieved better than those taught using the conventional method (control group); the post-test mean scores of the experimental group taught using the developed instructional video package was higher than their pre-test scores; the effect of developed instructional video package was significant on students’ achievement in the experimental group taught with a developed instructional video package. Based on the findings of this study, it was concluded that developed instructional video package was very effective in enhancing students’ achievement.

INTRODUCTION

Technical Vocational Education and Training (TVET) programmes are faced with the challenges of finding innovative ways to accommodate the growing interest in the programs (Aloraini, 2012). Technical colleges are not exceptional in this context for a common fact that, the traditional face to face method, demonstration method, lecture method, field trip etc has been used primarily in TVET schools and
colleges as the major method of teaching. The difficulties associated with conventional methods have contributed to low levels of academic achievement related to improper teaching and learning strategies used to teach technical courses at technical schools and colleges (Nwanekezi & Kalu, 2012; Oshinaike and Adekunmesi, 2012 & Rober, 2011). Udofia, Ekpo, Nsa, & Bilyaledino, (2012) pointed out that insufficient didactic techniques do not enhance students’ acquisition of skills and development of self-concepts as well as interest.

Technical Colleges are institutions usually vested with the responsibility for the training of skilled technical personnel for the technological and economic development of the country (the Federal Republic of Nigeria, 2012). To achieve these goals, technical colleges were established to run programs leading to the award of National Technical Certificate (NTC). They are also considered as the major institutions in Nigeria offering full vocational training to prepare students for entry into various occupations in industries or for self-employment.

Poor achievement in mechanical engineering craft practice students can be attributed to many factors such as unavailability of workshop facilities, lack of instructional materials, inadequate time allocation, large class size and poor instructional delivery approaches. According to Etukudo (2009) the fall in the standard of achievement in mechanical engineering craft practice. Specifically, sand casting is incontrovertibly attributed to the poor instructional delivery approach adopted by teachers in technical colleges. To support this assertion, Salau (2012) submitted that many researchers have adduced that poor achievement in public examinations is traceable to instructional delivery approaches adopted by teachers. The resultant effect is the low achievement in students’ outcome both in internal and external examinations.

This implies that the mastery of sand casting concept might not be fully achieved without the use of a good instructional delivery approach that utilizes instructional materials.

According to the Federal Republic of Nigeria (FGN, 2012), a cardinal factor that has been found to contribute to the poor achievement of students in the technical colleges in Nigeria is poor teaching. Commenting on the poor quality of teaching in the technical colleges in Nigeria Oranu (2012) observed that the teaching methods which are teacher-centred are the main teaching methods used by technical teachers to teach both theory and practical aspect of the curriculum. Currently, the use of a teacher-centred method which predominantly is focused on the theoretical way of transmitting knowledge from the teacher to passive students and encourages rote learning that makes students apathetic and repulsive to learning should be discouraged (Boyle, Duffy & Dunleavy, 2012).

Instructional materials are in various categories, such as sound or audio, visual or auditory. Thus, audio instructional materials refer to those devices that make sense of hearing only, such as radio, a recorded audiotape. Visual material, on the other hand, is a teaching material that appeals to the sense of sight just like Blackboard and outline, slides, and film. An audio-visual instructional material, however, is a combination of devices that appeal to both the senses of listening and watching such as the TV film and computer. Among the instructional materials used by the teacher in the classroom, the visuals outnumbered the combination of the audio and audio-visual (Paiko, 2014).

Teaching without adequate instructional materials make students have their imagination stretched too far due to the teacher’s excessive use of words to convey the meanings, techniques, or procedures, a practice that...
is boring and demoralizing especially in Technical Education aspect (Nafees, Farouq, and Tahirkhel (2012). It is established that traditional teaching strategy is deeply teacher-dominated as the teacher serves as the source of knowledge while learners turn out to be passive receivers (Kuzu, 2008). Previous researches have again shown that students are performing poorly in practical projects. The poor performance was blamed on poor quality technical teachers, overcrowded classroom, and lack of adequate and suitable technology equipment, facilities, materials and hand tools (Jegede, 2012 and Nwoji, 2013).

Consequently, the conventional teaching strategy may make students lose interest, perform poorly, promote negative attitude and encourage poor retention of learned materials and this will ultimately result in loss of employment opportunities in industries or make it impossible for graduates to be self-employment. Hitherto, the rising youth unemployment rate over the years in Nigeria may not be unconnected with the widespread use of the conventional approach in teaching technical courses. Over the years, the government has introduced several reforms in educational policy to improve the quality of technical education in Nigeria. However, the government’s efforts remain unfruitful as the quality continues to dwindle. The conventional method of instruction has failed, we need a change in instruction, but we can’t throw away the traditional instruction method, we just have to supplement it with another technique that is acceptable to the world. Developed sand casting instructional video package may be an improved way of instructional strategy that may effective, the study, therefore, finds it worthwhile to test the effect of the developed sand casting instructional video for teaching at NTC II technical college level in Bauchi and Gombe States.

Objectives of the Study
The main objective of the study is to test the effect of the developed sand casting instructional video package for teaching at NTC II Technical College level in Bauchi and Gombe States. Specifically, the study sought to:

i. Determine the difference in the achievement of the students at pre-test in sand casting before the treatment between the experimental and control group?

ii. Determine the difference in the achievement between the students taught developed sand casting using video instructional package and those taught using conventional method after the treatment?

iii. Determine the difference in achievement between the pre-test and post-test of the students taught using developed sand casting instructional video package.

Research Questions
i. What is the difference in the achievement of the students at pre-test in sand casting before the treatment between the experimental and control group?

ii. What is the difference in the achievement between the students taught developed sand casting using video instructional package and those taught using conventional method after the treatment?

iii. What is the difference in achievement between the pre-test and post-test of the students taught using developed sand casting instructional video package.

Hypotheses
The null hypotheses formulated for the study were tested at 0.05 level of significance

H0: There is no significant difference between the mean achievement of students in the experimental and control group before the treatment in a sand casting operation

Corresponding author: Haruna, A. I. 
aiharuna@mautech.edu.ng
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H02: There is no significant difference between the mean achievements of students taught with a developed instructional video package and those taught with a conventional method on sand casting operation

H03: There is no significant difference between pre-test and post-test mean achievement of students taught sand casting operation with the developed instructional package.

METHODOLOGY

The study adopts quasi-experimental design; specifically, the pretest-posttest non-equivalent group design. The major characteristic of this design is the use of two or more already existing or intact groups randomly assigned for the study (Fraenkel & Wallen, 2000).

A graphic representation of this design is as follows:

\[ \begin{align*}
G_1 & \quad P_1 \quad X \quad O_1 \\
G_2 & \quad P_2 \quad O_2 \\
\end{align*} \]

Where:

\[ \begin{align*}
G_1 & \quad \text{Experimental group} \\
G_2 & \quad \text{Control group} \\
P_1 & \quad \text{Pre-test of the experimental group} \\
P_2 & \quad \text{Pre-test of the control group} \\
O_1 & \quad \text{Post-test of the experimental group} \\
O_2 & \quad \text{Post-test of the control group} \\
X & \quad \text{Treatment} \\
\end{align*} \]

The area of the study was Bauchi and Gombe States. Bauchi State lies between longitude 9.84°E and latitudes 10.31°N with an elevation 616m. The target population for the study comprises all the NTC II level students of mechanical engineering craft practice trade in Government Science Technical Colleges in Bauchi and Gombe States. The reason for choosing NTC II is because the students have experienced in their present study and they are not new in the college system.

The sample for the study was using a two-stage random sampling technique. This involved the selection of two each Government Science Technical Colleges randomly from the list of eight and seven technical colleges in Gombe and Bauchi states respectively that are offering mechanical engineering craft practice at the NTC II level in the states and having current NBTE accreditation. Thereafter, one arm of Year II from each of the two colleges was used as a sample of the study. The choice of the Year II students was based on the fact that the NBTE (2007) syllabus for Mechanical Engineering Craft Practice prescribes that the aspect of Sand Casting operations which is the focus of this study is taught in the second year in technical colleges. Finally, of the two arms selected one represent the experimental group and the other one was assigned, control group. The experimental group had 36 students while the control group had 31 students respectively; hence the total sample size for the study was 67.

<table>
<thead>
<tr>
<th>Group</th>
<th>School</th>
<th>Location</th>
<th>Sample Size</th>
<th>Sampling Tech.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental</td>
<td>GDTC Bauchi</td>
<td>Bauchi State</td>
<td>19</td>
<td>Simple random</td>
</tr>
<tr>
<td>Group</td>
<td>GSTC Gombe</td>
<td>Gombe State</td>
<td>17</td>
<td></td>
</tr>
<tr>
<td>Control Group</td>
<td>GSTC Burumde</td>
<td>Gombe State</td>
<td>17</td>
<td>Simple random</td>
</tr>
<tr>
<td></td>
<td>GDTC K/Madaki</td>
<td>Bauchi State</td>
<td>14</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td>67</td>
<td></td>
</tr>
</tbody>
</table>

(Source: NBTE, 2007; School Records, 2017)
The draft copy of the instrument that was used to develop the video package from it, contained 60 multiple choice question on knowledge. The face and content validation was carried out by three experts from Vocational and Technology Education Department, ATBU Bauchi. The experts examined the structure of the items, determined the extent to which the items helped to achieve the objectives of the topic, determined the extent to which the table of specification is correct concerning the topic covered and also they were asked to reword, reviewed, restructure or delete where necessary.

The pilot testing was carried out by showing the developed sand casting instructional to the sample students after watching the video the research assistant administered the test items to a sample of 15 students in one intact mechanical engineering craft class of NTC II students at Government Science Technical College, Yola. This subject was not involved in the main study but was equivalent samples of the group for which the instrument was developed for and tested and the test covered the lessons on the topic chosen from the developed sand casting instructional video. Trial testing was done to determine the reliability of the instrument. The scripts were scored and the scores were recorded. To estimate the reliability coefficient of the instrument, the data collected from the SCAT was subjected to a reliability test and analyzed using Cronbach alpha reliability coefficient. Thus, the reliability test yielded a coefficient of 0.89.

The instruments used for testing the effect were developed instructional video package and Sand Casting Achievement Test (SCAT). The developed instructional package was used to teach sand casting (treatment) while the SCAT items were used to test the effect of the developed package. Specifically, some questions were drawn from Foundry Shop Safety Precautions, Sand Casting Tools and Equipment, Pattern and pattern making, Mold and core making, and Sand Casting Production of foundry technology content. SCAT was used for both Pre-test and Post-test. This consisted of 74 items of multiple-choice tests. Each objective question had 4 options A, B, C, D, with scores of 1 mark each with a total of 60 marks, This test was designed to measure students’ cognitive achievement in the sand casting operations and also determined the extent to which the experimental groups differed in remembering the contents taught and it was administered 2 weeks after the Pre-test. The Pre-test is the same as the Post-test, except for the fact that the items in the Post-test were re-organized and printed.

This study involved two groups of subjects which are the treatment group and the control group. The group taught with the developed instructional video named was experimental group 1 and the other group taught with the conventional method was named control group (group 2).

On the first day of the experiment, the test instrument SCAT was administered as Pre-test to all the students in the sample schools. After this, both the treatment and control groups were taught on sand casting operations for two weeks. The treatment group was taught using the Developed Sand Casting Instructional Video CD-ROM played from a laptop and projected on a screen using a projector for a better and clearer view while the control group was taught using the conventional method. A total of 5 lessons were used and each lesson period lasted for 40 minutes for each group.

At the end of the lessons, the Post-test was administered to the students. The researcher scored and recorded the scores personally.

The Students’ scores in the first administration of test items served as the Pre-test scores of the study. The topics treated consist of Foundry Shop Safety Precautions, Sand Casting Tools and Equipment, Pattern and pattern making,
Mold and core making and Sand Casting Production all were taught for two weeks after which the test items were rearranged and re-administered to the students as Post-test. The scores obtained from the second administration served as Post-test scores in the study. After 2 weeks, the items were re-arranged, printed on a paper, and re-administered.

SCAT data were analyzed using mean and standard deviation to interpret the results of the effect of developed sand casting instructional video package. This was similarly carried out using SPSS software package which computed group means of pretest and posttest, and thereafter the results were compared with each other to indicate the effectiveness of the developed instructional video for teaching sand casting to the students.

Finally, the study tested hypotheses using student t-test based on the popular level of significance of 5 per cent (0.05). This was conducted by comparing the probability value (P-value) of t-test to the level of significance. If the group mean of the experimental group was found to be higher, then the developed instructional video was to be adjudged as effective; if however the group mean of the experimental group was found to be lower, then the developed instructional video was to be adjudged as ineffective.

The t-test was used to test the null hypothesis at the 0.05 level of significance. If p-value was found to be less than 0.05, then there was a significant difference, otherwise, there was no significant difference.

RESULTS

Research Question one
What is the difference in the achievement of the students at pre-test in sand casting before the treatment between the experimental and control group?

Table 2 contains the pretest results. The result shows that the performance of students during the pre-test on Sand Casting Achievement Test (SCAT) of the experimental group mean was 15.28 with a standard deviation 2.42 whereas control group performance was 15.13 groups mean with a standard deviation 1.73. The experimental group performed almost similar to the control group in the pre-test.

Table 2: Mean and Standard Deviation of the pre-test scores for the experimental and control group.

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>X</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental</td>
<td>36</td>
<td>15.28</td>
<td>2.42</td>
</tr>
<tr>
<td>Control</td>
<td>31</td>
<td>15.13</td>
<td>1.73</td>
</tr>
</tbody>
</table>

Key
N - Number of Students
X - Mean
SD - Standard Deviation

Research Question Two
What is the difference in the achievement between the students taught developed sand casting using video instructional package and those taught using conventional method after the treatment?

Table 3 contains the post-test results. In the table, the groups mean scores of students’ achievement in (SCAT) by the experimental group were 28.36, with a standard deviation 5.04 whereas the control group was 19.25, with a standard deviation 1.81. Therefore the
experimental group performed higher than the control group.

Table 3: Mean and Standard Deviation of the Post-test scores for students taught with a developed instructional video package and those taught with conventional method control.

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>X</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental</td>
<td>36</td>
<td>28.36</td>
<td>5.04</td>
</tr>
<tr>
<td>Control</td>
<td>31</td>
<td>19.25</td>
<td>1.81</td>
</tr>
</tbody>
</table>

Research Question Three
What is the difference in achievement between the pre-test and post-test of the students taught using developed sand casting instructional video package?

The result on the difference in achievement between the pre-test and post-test of the students taught using sand casting instructional video package is presented in table 4. The scores of students at pre-test in the experimental group have the group mean of 15.28 with a standard deviation of 2.42 whereas Post-test scores had a group mean of 28.36 with a standard deviation of 5.04. The Post-test score of the students is higher than the Pre-test scores.

Table 4: Mean and Standard Deviation of the Pre-test and Post-test scores for students in the experimental group

<table>
<thead>
<tr>
<th>Experimental Group</th>
<th>N</th>
<th>X</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-Test</td>
<td>36</td>
<td>15.28</td>
<td>2.42</td>
</tr>
<tr>
<td>Post-Test</td>
<td>36</td>
<td>28.36</td>
<td>5.04</td>
</tr>
</tbody>
</table>

Hypothesis One
H₀₁: There is no significant difference between the mean achievement of students in the experimental and control group before the treatment in a sand casting operation.

Result of the test of this hypothesis is presented in table 5. The group mean achievement of students in the experimental group 15.13 with a standard deviation of 1.73 in the control group. Therefore, the table also reveals that there was no significant difference between the mean achievement of students in the experimental and control group before the treatment, since the p-value is greater than the confidence level (P>0.05). For that reason, the null hypothesis was accepted.

Table 5: T-test result of Pre-test for the experimental and control group.

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>X</th>
<th>SD</th>
<th>Df</th>
<th>T</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental</td>
<td>36</td>
<td>15.28</td>
<td>2.42</td>
<td>65</td>
<td>0.28</td>
<td>0.78</td>
</tr>
<tr>
<td>Control</td>
<td>31</td>
<td>15.13</td>
<td>1.73</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Key
N - Number of Students
X - Mean
SD - Standard Deviation
df – degree of freedom
t- Value of t-cal.
p-Value of p
Hypothesis Two

$H_{02}$: There is no significant difference between the mean achievements of students taught with a developed instructional video package and those taught with a conventional method on sand casting.

Result of the test of this hypothesis is presented in table 6. The groups mean achievement of students taught with developed instructional package (Experimental group) was 28.97 and standard deviation 4.39 whereas; those taught with the conventional method (Control group) had the mean achievement of 19.26 with a standard deviation of 1.81. Therefore, the table also reveals that the difference of means was statistically different ($p<0.05$). For that reason, the null hypothesis was rejected; this indicated that there was a significant difference between the performance of students in the experimental and control group.

Table 6: T-test result of Post-test for the experimental and control group.

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>X</th>
<th>SD</th>
<th>Df</th>
<th>T</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental</td>
<td>36</td>
<td>28.97</td>
<td>4.39</td>
<td>65</td>
<td>9.53</td>
<td>0.00**</td>
</tr>
<tr>
<td>Control</td>
<td>31</td>
<td>19.26</td>
<td>1.81</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Hypothesis Three

$H_{03}$: There is no significant difference between Pre-test and Post-test mean achievement of students taught sand casting operation with the developed instructional package.

Result of the test of this hypothesis is presented in table 7. The groups mean achievement of the students taught with the developed instructional package in the Pre-test was 15.33 with a standard deviation of 2.66. Whereas the Post-test group mean was 28.97 and a standard deviation of 4.39. Therefore, the table also reveals that the difference in mean was statistically significant ($p<0.05$). For that reason, the null hypothesis was rejected; this indicated that there was a significant difference between the performances of the experimental students in the Post-test and Pretest on the sand casting achievement test.

Table 7: T-test result of the Pre-test and Post-test for experimental group students

<table>
<thead>
<tr>
<th>Exp. Grp.</th>
<th>N</th>
<th>X</th>
<th>SD</th>
<th>Df</th>
<th>T</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre – test</td>
<td>36</td>
<td>15.33</td>
<td>2.66</td>
<td>75</td>
<td>14.04</td>
<td>0.00**</td>
</tr>
<tr>
<td>Post – test</td>
<td>36</td>
<td>28.97</td>
<td>4.39</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

SUMMARY OF THE MAJOR FINDINGS

i. The students' achievement was not statistically different before the treatment among the experimental and control group.

ii. The effect of instructional video was significantly different on students achievement in the experimental group taught using instructional video;

iii. The effect of instructional video package was significant in the post-test when compared with the pre-test for students taught using instructional video.

DISCUSSION OF RESULTS

The findings revealed that the experimental group performed relatively the same with the control group at the pre-test before the treatment. The relatively same performance obtained from both group can be attributed to the similar characteristics they have such as
age limit, day technical colleges and co-
education. The finding is in agreement
with the finding of Anita, (2014). But, the
finding disagreed with the study of
Dangana, (2011). The findings of this
study also revealed that the developed
instructional video delivery approach
enabled students to better retain what
was learnt over some time than the
conventional instructional delivery
approach. This means that the type of
instructional delivery approach used in
teaching students the sand casting
techniques resulted in a significant
increase in the retention of knowledge.

The study also revealed that the
students’ performance was not
statistically different before the
treatment among the experimental and
control group.

The finding also revealed that the effect
of instructional video was significant on
students’ achievement in the
experimental group taught using
instructional video. The null hypothesis
was rejected. The researchers describe
the emergence of this result to the
inability of the conventional method to
fulfil the needs of the students and the
absence of real specimen to attract
students in teaching practical sand
casting. The difference obtained may be
as a result of the nature of the instruction
used in teaching the experimental group
(instructional video package) which yields
significant effect on students. The above
exposed to the conventional teaching
method.

The findings also revealed that the
effect of instructional video was
significant in the post-test when
compared with a pre-test in the group
taught using instructional video. The null hypothesis was rejected. This shows that
there was a significant difference
between pre-test and post-test
performance of students taught using
video instruction. The implication
confirmed that the performance of
students in post-test differ significantly
when compared to the pre-test. This is in

support by Chinna & Dada (2013), who
observed that there was a significant
difference between the performance of
students who received similar treatment
but pretested before treatment. The
finding revealed that the experimental
group students after the treatment
significantly better, than before the
treatment. It disagrees with that of
Ayodele (2009), who examines location as
a factor that influences students’ failure
in basic science. The finding explained
that there was no significant difference
between the performance of students in
the pretest and posttest in the
experimental group.

CONCLUSION

The use of developed
instructional video package as an
instructional strategy in teaching practical
sand casting is effective as the real object
because the developed sand casting
instructional package produce a
significant effect on students’
achievement in sand casting. Moreover,
the developed sand casting instructional
video package can be replayed or
downloaded from YouTube depending on
students’ need.

RECOMMENDATIONS

Based on the findings of this study
the following recommendations were
made;

i. Teachers should learn how to
develop valid and effective
instructional video package,
especially practical oriented
courses/subjects in technical
colleges

ii. Teachers in the technical colleges
should adopt teaching practical
courses using instructional video
since it indicates a significant effect
on the students’ achievement and
also saves time and energy over
the use of the conventional
method

iii. Seminars and workshops should be
organized so that all teachers can
be abreast with current challenges in using the multimedia package for teaching.

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