

# Educational Technology Undergraduates' Performance in a Distance Learning Course Using Three Courseware Formats

Oluwole Caleb Falode  and Ibrahim Abba Mohammed 

Volume 24, Number 4, November 2023

URI: <https://id.erudit.org/iderudit/1108545ar>  
DOI: <https://doi.org/10.19173/irrodl.v24i4.7219>

[See table of contents](#)

Publisher(s)

Athabasca University Press (AU Press)

ISSN

1492-3831 (digital)

[Explore this journal](#)

Cite this article

Falode, O. & Mohammed, I. (2023). Educational Technology Undergraduates' Performance in a Distance Learning Course Using Three Courseware Formats. *International Review of Research in Open and Distributed Learning*, 24(4), 1–19. <https://doi.org/10.19173/irrodl.v24i4.7219>

Article abstract

Most educators' inability to provide learning contents that suit different learning styles has caused a lot of problems in terms of performance. Thus, to cater to students' preferences in terms of access to learning contents, the distance learning regulatory body in Nigeria emphasized that course materials should be developed in mixed-media formats. This study was carried out to compare the effects of printed, video, and Moodle-based courseware on educational technology students' achievement, retention, and satisfaction in a distance learning course. A quasi-experimental design was employed for the study involving 108 participants from three experimental groups. The learning content and instruments, subjected to validation and reliability tests, where values of 0.78 and 0.86 were obtained using the Pearson product moment correlation and Cronbach's alpha for achievement and satisfaction inventory, respectively, were administered within a four-week period. Data collected were analyzed using descriptive and inferential statistics. Findings indicated that the printed, video, and Moodle-based courseware formats improved students' achievement with mean gain scores of 47.92, 40.89, and 43.03, respectively. A significant difference was observed in the achievement ( $F(2,104) = 8.67, p < 0.05$ ), retention ( $F(2,104) = 29.406, p < 0.05$ ), and satisfaction scores ( $F(2,104) = 5.662, p < 0.05$ ) of the three groups. Open and distance learning administrators in Nigeria are recommended to produce and deploy printed, video, and Moodle-based formats of courseware to meet different students' learning preferences.

© Oluwole Caleb Falode and Ibrahim Abba Mohammed, 2023



This document is protected by copyright law. Use of the services of Érudit (including reproduction) is subject to its terms and conditions, which can be viewed online.

<https://apropos.erudit.org/en/users/policy-on-use/>

Érudit

This article is disseminated and preserved by Érudit.

Érudit is a non-profit inter-university consortium of the Université de Montréal, Université Laval, and the Université du Québec à Montréal. Its mission is to promote and disseminate research.

<https://www.erudit.org/en/>

November – 2023

# Educational Technology Undergraduates' Performance in a Distance Learning Course Using Three Courseware Formats

Oluwole Caleb Falode<sup>1</sup> and Ibrahim Abba Mohammed<sup>2</sup>

<sup>1</sup>Department of Educational Technology, Federal University of Technology, Minna Niger State, Nigeria; <sup>2</sup>Department of Science Education, Federal University Kashere, Gombe State, Nigeria

## Abstract

Most educators' inability to provide learning contents that suit different learning styles has caused a lot of problems in terms of performance. Thus, to cater to students' preferences in terms of access to learning contents, the distance learning regulatory body in Nigeria emphasized that course materials should be developed in mixed-media formats. This study was carried out to compare the effects of printed, video, and Moodle-based courseware on educational technology students' achievement, retention, and satisfaction in a distance learning course. A quasi-experimental design was employed for the study involving 108 participants from three experimental groups. The learning content and instruments, subjected to validation and reliability tests, where values of 0.78 and 0.86 were obtained using the Pearson product moment correlation and Cronbach's alpha for achievement and satisfaction inventory, respectively, were administered within a four-week period. Data collected were analyzed using descriptive and inferential statistics. Findings indicated that the printed, video, and Moodle-based courseware formats improved students' achievement with mean gain scores of 47.92, 40.89, and 43.03, respectively. A significant difference was observed in the achievement ( $F_{(2,104)} = 8.67, p < 0.05$ ), retention ( $F_{(2,104)} = 29.406, p < 0.05$ ), and satisfaction scores ( $F_{(2,104)} = 5.662, p < 0.05$ ) of the three groups. Open and distance learning administrators in Nigeria are recommended to produce and deploy printed, video, and Moodle-based formats of courseware to meet different students' learning preferences.

*Keywords:* courseware, distance learning, mixed media, performance, educational technology

## **Educational Technology Undergraduates' Performance in a Distance Learning Course Using Three Courseware Formats**

Technology has brought innovative changes into the education sector in all fields, hence, different student-centered techniques continue to permeate modern classrooms, leading to major breakthroughs (Campillo-Ferrer & Miralles-Martínez, 2021). Technology makes it possible for schools to plan, organize, and implement new instructional approaches and deliver content face to face or from a distance. One of the new pedagogical approaches used to deliver course contents and educational activities is distance learning (Colomo-Magana et al., 2021; Li, 2018).

Distance learning is a form of technology-based education whereby students are separated physically from teachers but are connected through electronic media. The learning interactivity provided by computer technologies to deliver lessons either synchronously or asynchronously in distance learning is higher than that found in the conventional method of teaching (Al-Balas et al., 2020; Al-Mawee & Gharaibeh, 2021). The rapid expansion of the need to provide access to education for everyone regardless of location, distance, and time has led to the proliferation of technology-supported approaches capable of leveraging interactive courseware aimed at meeting individual requirements and learning styles of students. This explains why the duo of teaching and learning continually advances from a class-based, textbook-oriented strategy to a more flexible, anywhere, anytime system supported by technology (Lau & Thomas, 2018).

The term *courseware* combines the words *course* and *ware*; courseware is understood to be computerized learning materials developed by instructional designers involved in open and distance learning (ODL). Courseware is developed for learners to acquire knowledge in a particular subject area; it uses a conversational tone to carry learners along, or it links up with learners through electronic means. Thus, for teaching and learning to be effective in ODL settings, courseware should have a mixed-media format; that is, it should be downloadable as PDF, learning management system (LMS), audio (MP3), and video (DVD, VCD) formats in order to enhance learning (Falode, 2019). To this end, printed, video-based, and Moodle-based formats of courseware were developed and studied in this research.

### **Printed Courseware in ODL**

Printed courseware has been the main orthodox tool for instructional purposes in most distance learning settings. Print materials guide teachers through the instructional process and allow students to learn and practice procedures. In ODL, print materials have become the regulatory compass used to organize learning in order to provide extra resources for students at both home and school. Given their interactive nature, these resources allow students to study at their own pace (Weng & Cox, 2018).

Studies on how print courseware enhances achievement are not straightforward in terms of their conclusions. For example, Hautea-Arendain (2019) studied the comparative effectiveness of print and nonprint reading materials in improving reading comprehension and discovered that students exposed to reading comprehension print materials performed better than those taught using nonprint materials. In a similar study, Sidabutar et al. (2022) compared the effectiveness of digital and printed English-language

texts and discovered that while both formats improved students' achievement, digital text outperformed print text. Utami and Saefudin (2017) looked at the comparative effect of adopting e-learning and printed materials on independent learning and creativity and discovered no significant difference in students' independence or creativity whether they were exposed to e-learning or printed formats. Conversely, when Whelan (2020) compared the effectiveness of digital and print media on students' performance in a fourth-grade class, he reported a significant difference in the scores of the two groups that favored digital media. Finally, Ziegler (2019) studied the effects on comprehension when students read digital text versus printed text and discovered that students performed better when exposed to print materials over digital.

While print appears to be a good format to present educational contents, using printed materials alone in distance learning may not appeal to learners' various human senses, compared with video-based courseware, for example, hence limiting the capacity of printed materials to cater to different learning styles.

## **Video-Enhanced Learning in ODL**

Video courseware serves as an audio–visual learning medium that offers a real-world examples of learning contents with detailed contextual reality. Videos used for educational purposes help to break down difficult concepts. Thus, videos are effective tools for fostering self-paced learning (Colasante & Douglas, 2016; Khoo et al., 2020). Educational videos are increasingly used to replace face-to-face lectures due to their ability to appeal to both auditory and visual senses, as well as their pervasive availability (Foster et al., 2022). With this type of courseware, students are also offered ample time and opportunity to watch the educational videos as many times as they feel necessary and at their preferred pace, place, and time (Coyne et al., 2018). Furthermore, videos enable learners to understand and digest complex contents, and they also provide an avenue for learners to see concepts from different viewpoints. In line with global best practices, students need the best mixed-media formats to cater to their needs.

Studies on video courseware usage have come to various conclusions. Donkor (2010) compared the effectiveness of print versus video courseware and found the two platforms to be equivalent in their effectiveness. Dikshit et al. (2013) studied the effectiveness of print, interactive multimedia, and online resources and discovered that the use of interactive multimedia CD-ROMs was more effective than print and online materials. Foster et al. (2021) reported that students had better achievement and retention when exposed to video courseware in a flipped classroom setting. Bawa et al. (2021) researched the effectiveness of a video-based instructional package on biology students' achievement and reported that video improved students' achievement.

In light of these studies, more research is required to complement the limitations ingrained in video courseware. Research should include extending the video courseware to an online learning medium with additional interactive features to allow students to interact textually and visually. One such online learning medium that supports different interactive features is Moodle.

## Moodle-Based Online Learning in Education

Moodle is used to create online courseware that provides opportunities for interaction and communication between students and teachers (Gudkova et al., 2021). As a popular LMS, Moodle allows students to be more flexible and self-scheduled in their learning, which promotes their independence and increases achievement (Mlotshwa et al., 2020). Likewise, Moodle provides students with various learning materials and tools, including videos and e-text, that arouse interest and understanding of complex information (Chen et al., 2022). Interactive courseware tools provided by Moodle such as email, forum posts, virtual meeting rooms, and chat rooms enhance communication between students and teachers.

Studies on online-based learning are still emerging, thereby giving rise to different LMSs. Most studies have divergent conclusions, depending on the media and circumstances deployed. For example, some studies (Dooley et al., 2018; Green et al., 2018; Morton et al., 2016; Riddle & Gier, 2019) revealed online learning to be highly satisfying and that students achieved better results than from conventional learning. Other studies showed no difference in terms of students' satisfaction (Pickering & Swinnerton, 2019). Falode et al. (2019) looked at the effectiveness of Moodle and WizIQ toward enhancing students' achievement in educational technology concepts, and their findings revealed no significant difference in the effectiveness of the two platforms. In the same vein, when compared with the lecture method, Moodle was found to enhance the learning achievement of undergraduate agricultural science students in North-Central Nigeria (Sobowale et al., 2019). Similarly, Agustina et al. (2020) studied whether Moodle improved students' achievement in reading and writing and discovered it improved students' writing skills more than their reading skills. Bupo (2019) investigated the effect of teaching financial accounting using Moodle and reported that the students achieved and retained the information more after exposure to Moodle. Tukura et al. (2020) examined the effectiveness of e-learning on basic science and technology students' achievement and retention; they found that the students performed better in their achievement and retention after exposure to an online e-learning instruction. Chen et al. (2022) researched the effectiveness of Moodle-based e-learning on e-collaborative learning, perceived satisfaction, and study achievement among nursing students and discovered a significant difference in achievement in favor of Moodle. Going further, Arifin (2020) studied the effect of blended learning with Moodle on students' writing achievement, and findings revealed that blended learning with Moodle was more effective than the conventional approach. Thus, the self-paced, mixed-media formats provided in distance education settings, with different learning preferences catered to, appear to enhance students' achievement, retention, and satisfaction.

*Achievement* is educationally translated into students' performance after having been instructed. That is, it is a scale that reveals students' degree of performance and accomplishment of a specific task at the end of the instructional engagement (Kayii & Dambo, 2019). *Retention*, on the other hand, is an individual's ability to store what has been learned and to recall what has been stored thereafter. Generally, satisfaction is the feeling of difference between prior expectations and perceived achievement. In terms of learning using online-based e-learning technology, the most important factor to have a positive effect on learning satisfaction is the learner's actual performance (Nagy, 2018). Specifically, *online learning satisfaction* refers to learners' evaluation of, opinions about, feelings about, and experiences toward the quality of online learning service provided by online learning providers. It is a cumulative psychological response to online learning contents and the learning environment formed after a rational and emotional comparison between the actual perceived online learning effect and students' perception (Yu, 2022). Ideally, in any form of

online ODL education, students' satisfaction is one of the most important indicators for evaluating the quality of a learning environment. Supporting this idea, AbdulRahman et al. (2015) stated that students' satisfaction, in terms of their expectations being realized, is one of the most critical factors for evaluating the success of any online-based education and resultant performance.

In light of the foregoing discussion, several studies were conducted to ascertain the satisfaction of students in online-based learning. Choe et al. (2019) ascertained students' satisfaction and learning outcomes in asynchronous online lecture videos and discovered that combining different media in a multimedia learning format is highly satisfying; students were highly satisfied with various videos used because they catered to different learning styles. Also, Nagy (2018) evaluated online video usage and learning satisfaction using the technology acceptance model and discovered that online learning has many significant effects on learning and the satisfaction of learners. Additionally, some studies (Dooley et al., 2018; Green et al., 2018; Riddle & Gier, 2019) reported that online learning was highly satisfying, and learners also achieved better learning outcomes through online learning than conventional learning. However, in contrast with the aforementioned studies, Pickering and Swinnerton (2019) found no difference in terms of online satisfaction. Hence, more studies need to be conducted to close these gaps.

## **Statement of the Problem**

Despite the technological advancements that have unanimously simplified learning and allowed for catering toward different learning styles, most ODL instructional designers in Nigeria have not leveraged the opportunities offered by technology to enhance learning. Whenever students' profiles are gathered during enrollment, many learners state their preferences regarding the courseware formats, but ODL instructors in Nigeria do not give special attention to those learning preferences by providing different mixed-media formats, and this affects students' performance. Many studies were carried out to improve students' performance using different technology-supported courseware formats, but very few studies have been conducted in Nigeria or by educational technology experts. Also, most studies have not deployed mixed-media formats. To ameliorate this problem, the effectiveness of using more than one type of courseware during engagement must be examined, in line with the acceptable standards of using various mixed-media formats. This study was therefore carried out to determine whether students' learning outcomes would be enhanced when optional media formats were deployed to teach educational technology students a distance learning course.

## **Purpose of the Study**

The study sought to do the following:

1. Determine the effects of printed, video, and Moodle-based courseware on students' academic achievement in an undergraduate educational technology distance learning course.

2. Ascertain the effects of printed, video, and Moodle-based courseware on students' learning retention in an undergraduate educational technology distance learning course.
3. Find out the differences in students' satisfaction with printed, video, and Moodle-based courseware in an undergraduate educational technology distance learning course.

## Research Questions

The following research questions were answered in the study:

1. What are the effects of printed, video, and Moodle-based courseware on students' academic achievement in an undergraduate educational technology distance learning course?
2. What are the effects of printed, video, and Moodle-based courseware on students' learning retention in an undergraduate educational technology distance learning course?
3. What are the differences in students' satisfaction levels when they are exposed to printed, video, and Moodle-based courseware in an undergraduate distance learning course?

## Research Hypotheses

The following null hypotheses were tested:

HO<sub>1</sub>: There is no significant difference in the achievement scores of students exposed to printed, video, and Moodle-based courseware in an undergraduate educational technology distance learning course.

HO<sub>2</sub>: There is no significant difference in the retention scores of students exposed to printed, video, and Moodle-based courseware in an undergraduate educational technology distance learning course.

HO<sub>3</sub>: There is no significant difference in students' satisfaction when they are exposed to printed, video, and Moodle-based courseware in an undergraduate educational technology distance learning course.

## Methodology

The study adopted a pretest, posttest, non-randomized, quasi-experimental design. The research design layout is presented in Table 1.

**Table 1**

*Research Design Layout*

| Group                   | Pretest        | Treatment      | Posttest       | Retention      | Satisfaction   |
|-------------------------|----------------|----------------|----------------|----------------|----------------|
| Print courseware        | O <sub>1</sub> | X <sub>1</sub> | O <sub>2</sub> | O <sub>3</sub> | O <sub>4</sub> |
| Video courseware        | O <sub>1</sub> | X <sub>2</sub> | O <sub>2</sub> | O <sub>3</sub> | O <sub>4</sub> |
| Moodle-based courseware | O <sub>1</sub> | X <sub>3</sub> | O <sub>2</sub> | O <sub>3</sub> | O <sub>4</sub> |

*Note.* O<sub>1</sub> = pretest for experimental groups 1, 2, and 3; X<sub>1</sub>, X<sub>2</sub>, and X<sub>3</sub> = treatment for experimental groups 1, 2, and 3; O<sub>2</sub> = posttest for experimental groups 1, 2, and 3; O<sub>3</sub> = retention for experimental groups 1, 2, and 3; O<sub>4</sub> = satisfaction for experimental groups 1, 2, and 3.

The study population consisted of all undergraduate educational technology students at the Federal University of Technology Minna, Nigeria, during the 2021–2022 academic session. The target population comprised all 170 second-year educational technology students. A total of 108 students who were offered a distance learning course (EDT 215: Distance Education) from five teaching options (Biology Education, Chemistry Education, Physics Education, Mathematics Education, and Geography Education) drawn from intact classes were purposively used as the sample. Simple random sampling was used to select three teaching options from the five. Thereafter, the selected options were randomly assigned to the three experimental groups. Students in the three groups received either printed, video, or Moodle-based courseware.

Two instruments were used in the study: treatment instruments and test instruments. The treatment instruments were the printed, video, and Moodle-based courseware. The distance learning course contents treated in the courseware were arranged in six study units, covering the concepts of distance learning, modes of tutoring, procedure for courseware development, mode of assessment in distance learning, team approach in courseware development, and learner support service in distance learning. The test instruments were the achievement test and the satisfaction inventory. The achievement test was made up of 50 multiple-choice questions drawn from the course contents. The satisfaction inventory consisted of 15 items rated on a five-point Likert scale. The total points obtained by each participant in the inventory were converted to an interval scale (percentage).

The treatment instruments were validated by two educational technology experts, two computer science experts, two media production specialists, two instructional designers, one graphic artist, and one language editor, and their observations were infused before the pilot study. A single-shot pilot test was administered with 20 randomly selected students using a split-half method, where a coefficient value of 0.78 was obtained using the Pearson product moment correlation. The satisfaction inventory was administered to the same students in a single-shot test, and a figure of 0.86 was obtained using Cronbach's alpha.

All the three experimental groups were subjected to four-week treatment period. The students in experimental group 1 were given the printed courseware, those in the experimental group 2 were given the video version of the courseware, and students in experimental group 3 learned the course through Moodle. To test achievement, students took a pretest, posttest, and retention test; the retention test was



administered two weeks after the posttest. The satisfaction inventory was administered during the posttest to determine which of the courseware formats the students were more satisfied with. Descriptive statistics were used to answer the research questions while inferential statistics involving ANCOVA, ANOVA, and Šidák and Scheffé post hoc tests were used to test the null hypotheses at a .05 level of significance.

## Results

### Research Question 1

What are the effects of printed, video and Moodle-based courseware on students' achievement scores in undergraduate educational technology distance learning course?

Table 2 shows the mean and standard deviation of the pretest and posttest scores of students exposed to printed, video, and Moodle-based courseware formats.

**Table 2**

*Pretest and Posttest Scores of Students Exposed to Print, Video, and Moodle-Based Courseware Formats*

| Group  | <i>N</i> | Pretest<br><i>M (SD)</i> | Posttest<br><i>M (SD)</i> | <i>M</i> gain |
|--------|----------|--------------------------|---------------------------|---------------|
| Print  | 35       | 23.17 (5.27)             | 71.09 (5.62)              | 47.92         |
| Video  | 36       | 22.50 (7.06)             | 65.39 (6.64)              | 40.89         |
| Moodle | 37       | 23.11 (5.50)             | 66.14 (6.50)              | 43.03         |

Students exposed to printed courseware had a mean of 23.17 and a standard deviation of 5.27 at pretest, and a mean score of 71.09 and a standard deviation of 5.62 at posttest. The mean difference between the pretest and posttest scores of the students exposed to print courseware was 47.92. The students exposed to video courseware had a mean of 22.50 and a standard deviation of 7.06 in the pretest, and a mean score of 65.39 and a standard deviation of 6.64 in the posttest. The mean difference between the pretest and posttest scores of the students exposed to video courseware was 40.89. Similarly, the students exposed to Moodle-based courseware had a mean of 23.11 and a standard deviation of 5.50 in the pretest, and a mean score of 66.14 and a standard deviation of 6.50 in the posttest. The mean difference between the pretest and posttest scores of the students exposed to Moodle-based courseware was 43.03. Thus, the trio of printed, video, and Moodle-based courseware formats improved students' achievement. However, the students exposed to printed courseware achieved better, with the highest mean gain of 47.92.

### Research Question 2

What are the effects of printed, video, and Moodle-based courseware on students' academic retention scores in undergraduate educational technology distance learning course?

Table 3 shows the mean and standard deviation of the posttest and retention scores of students exposed to printed, video, and Moodle-based courseware formats.

**Table 3**

*Posttest and Retention Scores of Students Exposed to Print, Video, and Moodle-Based Courseware Formats*

| Group  | <i>N</i> | Posttest<br><i>M (SD)</i> | Retention<br><i>M (SD)</i> | <i>M</i> difference |
|--------|----------|---------------------------|----------------------------|---------------------|
| Print  | 35       | 71.09 (5.62)              | 66.34 (5.15)               | 4.75                |
| Video  | 36       | 65.39 (6.64)              | 63.58 (6.46)               | 0.19                |
| Moodle | 37       | 66.14 (6.50)              | 59.95 (5.38)               | 6.19                |

The students exposed to printed courseware had a mean of 71.09 and a standard deviation of 5.62 at posttest, and a mean score of 66.34 and a standard deviation of 5.15 at the retention test. The mean difference between the retention and posttest scores of the students exposed to printed courseware was 4.75. The students exposed to video courseware had a mean of 65.39 and a standard deviation of 6.64 in the posttest, and a mean score of 63.58 and a standard deviation of 6.46 in the retention test. The mean difference between the retention and posttest scores of the students exposed to video courseware was 0.19. Similarly, the students exposed to Moodle-based courseware had a mean of 66.14 and a standard deviation of 6.50 in the posttest, and a mean score of 59.95 and a standard deviation of 5.38 in the retention test. The mean difference between students' posttest and retention scores for Moodle-based courseware was 6.19. Thus, the use of printed, video, and Moodle-based courseware formats all improved students' learning retention. However, students exposed to video-based courseware had better learning retention, with the lowest mean difference of 0.19.

### Research Question 3

What are the differences in the satisfaction levels of students in learning undergraduate educational technology distance learning course through printed, video, and Moodle-based courseware?

Table 4 shows the mean and standard deviation of students' satisfaction after being exposed to printed, video, and Moodle-based courseware formats.

**Table 4**

*Students' Satisfaction with Print, Video, and Moodle-Based Courseware Formats*

| Group  | <i>N</i> | <i>M</i> | <i>SD</i> |
|--------|----------|----------|-----------|
| Print  | 35       | 70.74    | 4.28      |
| Video  | 36       | 71.11    | 4.55      |
| Moodle | 37       | 67.95    | 4.36      |

Students exposed to printed courseware had a mean satisfaction score of 70.74 and a standard deviation of 4.28. The students exposed to video courseware had a mean satisfaction score of 71.11 and a standard deviation of 4.55. Similarly, the students exposed to Moodle-based courseware had a mean satisfaction score of 67.95 and a standard deviation of 4.36. This shows that the students were highly satisfied with the various courseware formats used. However, the students exposed to video-based courseware were the most satisfied, with the highest mean satisfaction score of 71.11.

### Testing of Null Hypotheses

#### ***Hypothesis 1***

There was no significant difference in the mean achievement scores of students exposed to printed, video, and Moodle-based courseware in undergraduate educational technology distance learning course.

Table 5a shows the ANCOVA results of students exposed to printed, video, and Moodle-based courseware formats.

**Table 5a**

*Students' Achievement After Exposure to Print, Video, and Moodle-Based Courseware Formats: ANCOVA Results*

| Source              | <i>SS</i>   | <i>df</i> | <i>MS</i>  | <i>F</i> | <i>p</i> |
|---------------------|-------------|-----------|------------|----------|----------|
| Corrected model     | 702.246     | 3         | 234.082    | 5.911    | .001     |
| Intercept           | 32,394.901  | 1         | 32,394.901 | 817.985  | .000     |
| Pretest (covariate) | 22.878      | 1         | 22.878     | 0.578    | .449     |
| Achievement         | 687.036     | 2         | 343.518    | 8.674*   | .000     |
| Error               | 4,118.745   | 104       | 39.603     |          |          |
| Total               | 496,761.000 | 108       |            |          |          |

Corrected total                      4,820.991                      107

\*  $p \leq .05$ .

In the table,  $F_{(2,104)} = 8.67$  and  $p < .05$ . This means that the null hypothesis was rejected, indicating a significant difference in the mean achievement score of students exposed to printed, video, and Moodle-based courseware formats. To determine where the significant difference lies, the Šidàk post hoc test was conducted, as presented in Table 5b.

**Table 5b**

*Students' Achievement Using Printed, Video, and Moodle-Based Courseware Formats: Šidàk Post Hoc Test Results*

| (I) Group | (J) Group | M difference |       |      | 95% CI |       |
|-----------|-----------|--------------|-------|------|--------|-------|
|           |           | (I-J)        | SE    | p    | Lower  | Upper |
| Print     | Video     | 5.70*        | 1.491 | .001 | 2.08   | 9.31  |
|           | Moodle    | 4.95*        | 1.481 | .003 | 1.36   | 8.54  |
| Video     | Print     | -5.70*       | 1.491 | .001 | -9.31  | -2.08 |
|           | Moodle    | -0.75        | 1.470 | .942 | -4.31  | 2.82  |
| Moodle    | Print     | -4.95*       | 1.481 | .003 | -8.54  | -1.36 |
|           | Video     | 0.75         | 1.470 | .942 | -2.82  | 4.31  |

\*  $p \leq .05$ .

There was a significant difference in achievement between students exposed to printed and students exposed to video courseware formats. There was also a significant difference in achievement between students exposed to video and students exposed to printed courseware formats.

### **Hypothesis 2**

There is no significant difference in the mean retention scores of students exposed to printed, video, and Moodle-based courseware in undergraduate educational technology distance learning course.

Table 6a shows the ANCOVA result of students' retention when exposed to printed, video, and Moodle-based courseware formats.

**Table 6a**

*Students' Retention Scores When Exposed to Print, Video, and Moodle-Based Courseware Formats: ANCOVA Results*

| Source          | SS        | df | MS        | F       | p    |
|-----------------|-----------|----|-----------|---------|------|
| Corrected model | 3,561.967 | 3  | 1,187.322 | 210.991 | .000 |
| Intercept       | 51.588    | 1  | 51.588    | 9.167   | .003 |

|                      |             |     |           |         |      |
|----------------------|-------------|-----|-----------|---------|------|
| Posttest (covariate) | 2,819.282   | 1   | 2,819.282 | 500.995 | .000 |
| Retention            | 330.953     | 2   | 165.477   | 29.406* | .000 |
| Error                | 585.246     | 104 | 5.627     |         |      |
| Total                | 435,955.000 | 108 |           |         |      |
| Corrected total      | 4,147.213   | 107 |           |         |      |

\*  $p \leq .05$ .

In the table,  $F_{(2,104)} = 29.40$ , and  $p < .05$ . This means the null hypothesis was rejected, indicating a significant difference in the retention scores of students exposed to printed, video, and Moodle-based courseware formats. To determine where the significant difference lies in the retention scores of the students across the various groups, the Šidàk post hoc test was conducted, as shown in Table 6b.

**Table 6b**

*Students' Retention When Exposed to Print, Video, and Moodle-Based Courseware Formats: Šidàk Post Hoc Test Results*

| (I) Group | (J) Group | Mean difference |       |      | 95% CI |       |
|-----------|-----------|-----------------|-------|------|--------|-------|
|           |           | (I-J)           | SE    | p    | Lower  | Upper |
| Print     | Video     | 2.76            | 1.352 | .125 | -0.52  | 6.04  |
|           | Moodle    | 6.40*           | 1.343 | .000 | 3.14   | 9.65  |
| Video     | Print     | -2.76           | 1.352 | .125 | -6.04  | 0.52  |
|           | Moodle    | 3.64*           | 1.333 | .022 | 0.40   | 6.87  |
| Moodle    | Print     | -6.40*          | 1.343 | .000 | -9.65  | -3.14 |
|           | Video     | -3.64*          | 1.333 | .022 | -6.87  | -0.40 |

\*  $p \leq .05$ .

A significant difference was observed in the retention score of students exposed to printed and Moodle-based courseware formats. Also, a significant difference was observed between the retention score of students exposed to video and Moodle-based courseware formats.

### Hypothesis 3

There is no significant difference in the mean responses of students' satisfaction level when exposed to undergraduate educational technology distance learning course through printed, video, and Moodle-based courseware.

Table 7a shows the ANOVA result of the satisfaction of students exposed to printed, video, and Moodle-based courseware formats.

**Table 7a**

*Satisfaction of Students Exposed to Print, Video, and Moodle-Based Courseware Formats: ANOVA Results*

| Source         | SS        | df  | MS      | F      | p    |
|----------------|-----------|-----|---------|--------|------|
| Between groups | 218.941   | 2   | 109.470 | 5.662* | .001 |
| Within groups  | 2,030.133 | 105 | 19.335  |        |      |
| Total          | 2,249.074 | 107 |         |        |      |

\*  $p \leq .05$ .

In the table,  $F_{(2, 105)} = 5.662$ , and  $p < .05$ . This means the null hypothesis was rejected, indicating a significant difference in the satisfaction of students exposed to printed, video, and Moodle-based courseware. The students were highly satisfied while using the various courseware formats. To determine where the significant difference lies, the Scheffé post hoc test was conducted, as presented in Table 7b.

**Table 7b**

*Students' Satisfaction with Print, Video, and Moodle-Based Courseware Formats: Scheffé Post Hoc Test Results*

| (I) Group | (J) Group | M difference |       |      | 95% CI |       |
|-----------|-----------|--------------|-------|------|--------|-------|
|           |           | (I-J)        | SE    | p    | Lower  | Upper |
| Print     | Video     | -0.368       | 1.044 | .979 | -2.90  | 2.16  |
|           | Moodle    | 2.797*       | 1.037 | .024 | 0.28   | 5.31  |
| Video     | Print     | 0.368        | 1.044 | .979 | -2.16  | 2.90  |
|           | Moodle    | 3.165*       | 1.029 | .008 | 0.67   | 5.66  |
| Moodle    | Print     | -2.797*      | 1.037 | .024 | -5.31  | -0.28 |
|           | Video     | -3.165*      | 1.029 | .008 | -5.66  | -0.67 |

\*  $p \leq .05$ .

A significant difference was found between the satisfaction of students exposed to printed and Moodle-based courseware formats. Also, a significant difference was observed between the satisfaction of students exposed to video and Moodle-based courseware formats.

## Discussion

The finding of Hypothesis 1 shows the existence of a significant difference in the achievement of students exposed to printed, video, and Moodle-based courseware. The finding indicates that while all students, whether taught using printed, video, and Moodle-based versions of the courseware, had improved performance after the treatment, students taught with printed courseware particularly achieved better.

Students find printed courseware handy; they can make notations and highlight sections as they study, leading to better cognitive mapping. This finding is in agreement with those of Hautea-Arendain (2019), who found a significant difference in the achievement of students exposed to print and other courseware formats. It also tallies with results found by Ziegler (2019), whose study on the effect of reading digital text versus printed text in comprehension revealed that students performed better when exposed to printed materials compared with digital materials. This finding equally agrees with those of Dikshit et al. (2013), who researched the effectiveness of print, interactive multimedia, and online resources and discovered a significant difference among the three groups. But the use of interactive multimedia through a CD-ROM was more effective than print and face-to-face support that was presented online. Conversely, our finding disagrees with Sidabutar et al. (2022), who compared the effectiveness of digital and printed texts in English and discovered that students using digital text outperformed students using in print text. Additionally, Whelan (2020) compared the effectiveness of digital and print media on students' performance and reported a significant difference in the scores of the two groups in favor of digital media. Similarly, this finding is not in tandem with that of Donkor (2010), who checked the comparative effectiveness of print versus video courseware and discovered no significant difference between the two platforms because they were equivalent in their effectiveness. Also, the finding disagrees with that of Utami and Saefudin (2017), who looked at the comparative effectiveness of adopting e-learning and printed materials on independent learning and creativity and discovered no significant difference in independence and creativity of the students exposed to e-learning and printed formats. The finding also disagrees with the findings of Falode et al. (2019), who studied the effectiveness of Moodle and WIZIQ toward enhancing students' achievement and found no significant difference in the effectiveness of the two platforms.

The result of Hypothesis 2 shows the existence of a significant difference in the retention scores of students exposed to printed, video, and Moodle-based courseware. This shows that while students who were taught using printed, video, and Moodle-based courseware were able to retain the concepts they learned, the students taught with video-based courseware showed higher rates of retention. This finding is connected to the fact that using video-based courseware simultaneously appeals to students' visual and auditory senses: they can see, pause or rewind, and watch and listen to contents. Students retain concepts better when they can see and hear what is taught. This finding agrees with Bupo's (2019) finding that a significant difference exists in the retention of students exposed to the Moodle platform and other media formats. The finding also agrees with Falode et al.'s (2019) findings, which revealed no significant difference in students' retention of educational technology concepts in favor of Moodle. Similarly, this finding is in agreement with that of Tukura et al. (2020), who recorded a significant difference in the retention scores of the students exposed to an online e-learning instruction using different formats. This finding also agrees with that of Foster et al. (2021), who reported that students had higher learning retention when exposed to video courseware format.

The result of Hypothesis 3 shows the existence of a significant difference in the satisfaction of students exposed to printed, video, and Moodle-based courseware formats. The students in all three groups were all satisfied with their format (printed, video, or Moodle). However, the students taught with video courseware were more satisfied. This finding could be due to the fact that using video courseware format was more enjoyable as students could see and hear at the same time. Video courseware is flexible and has the capacity to combine entertainment with education. This will surely increase learning satisfaction because learning

when more than one sense is involved caters to students' different learning preferences. This finding agrees with that of Choe et al. (2019), who studied students' satisfaction and learning outcomes in asynchronous online lecture videos and discovered that combining different media in a multimedia learning format is highly satisfying. This finding is also in agreement with that of Nagy (2018), who evaluated online video usage and learning satisfaction using the technology acceptance model and discovered that online learning has a significant effect on learning and satisfaction. Also, our finding is in conformity with those recorded in the studies of Dooley et al. (2018), Green et al. (2018), and Riddle and Gier (2019), all of whom reported that learning through different online courseware was highly satisfying for students and also that learners using online courseware achieved better learning outcomes than those taught using conventional methods. However, it disagrees with the findings of Pickering and Swinnerton (2019), whose study showed no significant difference in terms of students' satisfaction when learning with different course formats.

## **Conclusion and Implication**

The findings of this study revealed that printed, video, and Moodle-based courseware formats all have the possibilities of catering to different learning preferences of students given that all students had high achievement and retention and equally found their courseware formats very satisfactory. The implication of these findings is that ODL experts and distance learning policy makers in Nigeria have a viable reason to incorporate different mixed-media formats, including printed, video, and Moodle-based courseware, in education to meet the different learning preferences of students, thus enhancing learning outcomes. When printed, video, and Moodle-based courseware formats are available for students to choose from, the problem of students' lack of interest in academic endeavors and poor academic performance will be lessened because learning will be self-paced, flexible, learner-centered, and satisfactory.

## **Recommendations**

Based on the finding of this study, the authors make the following recommendation: ODL administrators and experts in Nigeria should liaise with educational technology experts, instructional designers, and education policy makers to design, develop, implement, and incorporate print, video, and Moodle-based courseware into distance learning program curriculum in order to meet the learning preferences of different students so as to enhance learning outcomes.

## **Limitation and Suggestion for Further Study**

The study was limited to one geographical location in Nigeria, and the population used in the study was restricted to students in one particular location; thus, the authors cannot make generalizations about the findings. It is hereby suggested that similar studies should be conducted across various locations in Nigeria using a much larger population.



## References

- AbdulRahman, N. A., Hussein, N., & Aluwi, A. H. (2015). Satisfaction on blended learning in a public higher education institution: What factors matter? *Social and Behavioral Sciences*, 211, 768–775. <https://doi.org/10.1016/j.sbspro.2015.11.107>
- Agustina, I., Nasrudin, N., Putra, S., Akrim, A., & Maharani, D. (2020). The effect of Moodle implementation in English for multimedia classroom on students' achievement in reading and writing. In R. Rahim, A. S. Ahmar, J. Simarmata, & D. Abdullah (Eds.), *Proceedings of the third workshop on multidisciplinary and its application* (pp. 11–14). European Alliance for Innovation. <https://doi.org/10.4108/eai.11-12-2019.2290814>
- Al-Balas, M., Al-Balas, H. I., Jaber, H. M., Obeidat, K., Al-Balas, H., Aborajoo, E. A., Al-Taheer, R., & Al-Balas, B. (2020). Distance learning in clinical medical education amid COVID-19 pandemic in Jordan: Current situation, challenges, and perspectives. *BMC Medical Education*, 20, Article 341. <https://doi.org/10.1186/s12909-020-02257-4>
- Al-Mawee, W., & Gharaibah, T. (2021). Student's perspective on distance learning during COVID-19 pandemic: A case study of Western Michigan University, United States. *International Journal of Educational Research*, 2, Article 100080. <https://doi.org/10.1016/j.ijedro.2021.100080>
- Arifin, M. (2020). The effect of blended learning model with Moodle on students' writing achievement. *Indonesian Journal of Education and Mathematical Science*, 1(2), 100–110. <https://doi.org/10.30596/ijems.v1i2.4639>
- Bawa, S., Nzegwu-Ossayogi, L. O., & Koroka, M. U. S. (2021). Effects of video-based instructional package on achievement of secondary school biology students in Suleja, Niger State, Nigeria. *Journal of Information, Education, Science and Technology (JIEST)*, 7(1), 238–243. <http://repository.futminna.edu.ng:8080/jspui/handle/123456789/10279>
- Bupo, G. O. (2019). Effects of blended learning approach on business education students' academic achievement and retention in financial accounting in universities in Rivers State Nigeria [PhD dissertation, Nnamdi Azikiwe University, Awka]. Research Repository. <https://phd-dissertations.unizik.edu.ng/onepaper.php?p=474>
- Campillo-Ferrer, J. M., & Miralles-Martínez, P. (2021). Effectiveness of the flipped classroom model on students' self-reported motivation and learning during the COVID-19 pandemic. *Humanities and Social Sciences Communications*, 8, Article 176. <https://doi.org/10.1057/s41599-021-00860-4>
- Chen, Y. C., Chen, C. J., & Lee, M. Y. (2022, April 19). Effects of Moodle-based e-learning management system on e-collaborative learning, perceived satisfaction, and study achievement among nursing students: A cross-sectional study. *Research Square*. Advance online article. <https://doi.org/10.21203/rs.3.rs-1402422/v1>

- Choe, R. C., Scuric, Z., Eshkol, E., Crusier, S., Arndt, A., Cox, R., Toma, S. P., Shapiro, C., Levis-Fitzgerald, M., Barnes, G., & Crosbie, R. H. (2019). Student satisfaction and learning outcomes in asynchronous online lecture video. *Life Science Education*, 18(4), Article 55.  
<https://doi.org/10.1187/cbe.18-08-0171>
- Colasante, M., & Douglas, K. (2016). Prepare-participate-connect: Active learning with video annotation. *Journal of Educational Technology*, 32(4), 68–91. <https://doi.org/10.14742/ajet.2123>
- Colomo-Magana, E., Civico-Ariza, A., Ruiz-Palmero, J., & Sanchez-Rivas, E. (2021). Problematic use of ICTs in trainee teachers during COVID-19: A sex-based analysis. *Contemporary Educational Technology*, 13(4), Article ep314. <https://doi.org/10.30935/cedtech/10988>
- Coyne, E., & Frommolt, V., Rands, H., Kain, V., & Mitchell, M. (2018). Simulation videos presented in a blended learning platform to improve Australian nursing students' knowledge of family assessment. *Nurse Education Today*, 66, 96–102. <https://doi.org/10.1016/j.nedt.2018.04.012>
- Dikshit, J., Garg, S., & Panda, S. (2013). Pedagogic effectiveness of print, interactive multimedia, and online resources: A case study of IGNOU. *International Journal of Instruction*, 6(2), 194–210.  
<https://eric.ed.gov/?id=ED544083>
- Donkor, F. (2010). The comparative instructional effectiveness of print-based and video-based instructional materials for teaching practical skills at a distance. *The International Review of Research in Open and Distance Learning*, 11(1), 97–116.  
<https://doi.org/10.19173/irrodl.v11i1.792>
- Dooley, M. L., Frankland, S., Boller, E., & Tudor, E. (2018). Implementing the flipped classroom in a veterinary pre-clinical science course: Student engagement, performance, and satisfaction. *Journal of Veterinary Medical Education*, 45(2), 195–203. <https://doi.org/10.3138/jvme.1116-203>
- Falode, O. C. (2019). Components and attributes of open and distance learning interactive courseware. In E. J., Ohire (Eds), *A Book of Reading in Instructional Pedagogy* (pp. 37-43). Usmanu Danfodio University Press.
- Falode, M. E., Alabi, T. O., Nsofor, C. C., & Alhassan, J. K. (2019). Effects of WizIQ and Moodle learning platforms on students' academic achievement in undergraduates' educational technology concepts. *Journal of Science, Technology, Mathematics and Education (JOSTMED)*, 15(2), 146–156. <http://repository.futminna.edu.ng:8080/jspui/handle/123456789/11589>
- Foster, M., Maur, A., Wieser, C., & Winkel., K. (2022). Pre-class video watching fosters achievement and knowledge retention in a flipped classroom. *Computers & Education*, 179, Article 104399.  
<https://doi.org/10.1016/j.compedu.2021.104399>

- Green, R. A., Whitburn, L. Y., Zacharias, A., Byrne, G., & Hughes, D. L. (2018). The relationship between student engagement with online content and achievement in a blended learning anatomy course. *Anatomical Sciences Education*, 11(5), 471–477. <https://doi.org/10.1002/ase.1761>
- Gudkova, Y., Reznikova, S., Samoletova, M., & Sytnikova, E. (2021). Effectiveness of Moodle in students' independent work. *E3S Web Conference*, 273, Article 12084. <https://doi.org/10.1051/e3sconf/202127312084>
- Hautea-Arendain, C. C. (2019). A comparative study on the effectiveness of print and non-print reading materials in improving reading comprehension. [Master's thesis, Central Philippines University]. Bahándian. <https://hdl.handle.net/20.500.12852/317>
- Kayii, N. E., & Dambo, B. I. (2019). Effectiveness of blended learning strategy on undergraduate business education students' achievement scores in Rivers State University. *International Journal of Innovative Technology Integration in Education*, 3(1). <https://ijitie.aitie.org.ng/plugins/generic/pdfJsViewer/pdf.js/web/viewer.html?file=https%3A%2F%2Fijitie.aitie.org.ng%2Findex.php%2Fijitie%2Farticle%2Fdownload%2F179%2F107%2F624>
- Khoo, Y. Y., Khuan W. B., Abd-Hadi, F. S., & AbuBakar, M. S. (2020). The effect of video-based collaborative learning among economics' undergraduates in Malaysia. *International Journal of Advanced Science and Technology*, 29(6), 272–281. <http://sersc.org/journals/index.php/IJAST/article/view/11448>
- Lau, K. H., & Thomas, S. (2018). The role of textbook learning resources in e-learning: A taxonomic study. *Computer & Education*, 118, 10–24. <https://doi.org/10.1016/j.compedu.2017.11.005>
- Li, K. C. (2018). The evolution of open learning: A review of the transition from pre-e-learning to the era of e-learning. *Knowledge Management & E-Learning*, 10(4), 408–425. <https://eric.ed.gov/?id=EJ1247658>
- Mlotshwa, N., Tunjera, N., & Chigona, A. (2020). Integrating Moodle into the classroom for better conceptual understanding of functions in mathematics. *South African Journal of Education*, 40(3), 1–14. <https://doi.org/10.15700/saje.v40n3a1570>
- Morton, C. E., Saleh, S. N., Smith, S. F., Hemani, A., Ameen, A., Bennie, T. D., & Toro-Troconis, M. (2016). Blended learning: How can we optimize undergraduate student engagement? *Medical Education*, 16, Article 195. <https://doi.org/10.1186/s12909-016-0716-z>
- Nagy, J. T. (2018). Evaluation of online video usage and learning satisfaction: An extension of the technology acceptance model. *The International Review of Research in Open and Distance Learning*, 19(1), 160–185. <https://doi.org/10.19173/irrodl.v19i1.2886>
- Pickering, J. D., & Swinnerton, B. J. (2019). Exploring the dimensions of medical student engagement with technology-enhanced learning resources and assessing the impact on assessment outcomes. *Anatomical Sciences Education*, 12(2), 117–128. <https://doi.org/10.1002/ase.1810>

- Riddle, E., & Gier, E. (2019). Flipped classroom improves student engagement, student performance, and sense of community in a nutritional sciences course (PO7-007-19). *Current Developments in Nutrition*, 3(S1), 657–659. <https://doi.org/10.1093/cdn/nzz032.P07-007-19>
- Sidabutar, M. N. A., Sayed, B. T., Ismail, S. M., Quispe, J. T., Vicente, J. S. Y., Wikke, I. S., Shanan, A. J., & Nourabadi, S. (2022). Reading digital texts vs reading printed texts: Which one is more effective in Iranian EFL context? *Education Research International*, 2022, Article 7188266. <https://doi.org/10.1155/2022/7188266>
- Sobowale, F. M., Nsofor, C. C., Ojo, M. A., & Abdullahi, M. B. (2019). Effects of Moodle and lecture method on learning outcomes in agricultural science among undergraduate students in North-Central, Nigeria. *Journal of Science, Technology, Mathematics and Education*, 15(3), 66–79.
- Tukura, C. S., Adamu, A., & Kanu, J. (2020). Effects of e-learning on retention and performance of basic science and technology students in Minna, Niger State Nigeria. *International Journal of Research and Scientific Innovations*, 7(9), 33–38. <http://repository.futminna.edu.ng:8080/jspui/bitstream/123456789/3704/1/33-38.pdf>
- Utami, N. W., & Saefudin, A. (2017). Comparative study of learning using e-learning and printed materials on independent learning and creativity. *Journal of Physics: Conference Series*, 954, Article 012004. <https://doi.org/10.1088/1742-6596/954/1/012004>
- Weng, C., & Cox, J. (2018). Effects of interactivity e-textbooks on 7th graders science learning and cognitive load. *Computers & Education*, 120, 172–184. <https://doi.org/10.1016/j.compedu.2018.02.008>
- Whelan, L. (2020). *The effects of digital media and print media on the performance of a 4th grade ELA class* [Master's thesis, Milligan University]. Milligan Digital Repository. <http://hdl.handle.net/11558/5084>
- Yu, Q. (2022). Factors influencing online learning satisfaction. *Frontiers in Psychology*, 13, Article 852360. <https://doi.org/10.3389/fpsyg.2022.852360>
- Ziegler, A. (2019). *Effect of students reading digital text versus print text on comprehension* [Master's thesis, Minnesota State University]. RED: A Repository of Digital Collections. <https://red.mnstate.edu/thesis/183>

