Comparison of Video Instruction and Conventional Learning Methods on Students' Understanding of Tablet Manufacturing

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The objective of this study was to compare the effectiveness of video teaching to conventional learning techniques using a pretest/posttest questionnaire. The tablet manufacturing process was selected as the focus of the video. Students in the second professional year of the Doctor of Pharmacy curricula at the University of New Mexico College of Pharmacy were randomized into three groups. One group of students viewed the tableting video and a second group read a section of text related to tableting. A third group watched an unrelated video and served as a control. Average pretest and posttest scores were calculated and the data were analyzed. Pretest scores among the three groups did not vary significantly ($P=0.48$). Only students who viewed the tableting video showed a statistically significant improvement in posttest scores ($P<0.001$). The results from this project suggest that video instruction to support conventional lectures is a more effective teaching technique than conventional lectures alone or in combination with reading assignments.

INTRODUCTION

In order for a pharmacy student to be a successful practitioner, he or she must understand fundamental principles of pharmacy practice. Comprehension of the rationale for various administration routes and the mechanisms of drug release from dosage forms enables one to grasp the concepts of bioavailability and therapeutic effectiveness. Understanding the principles of drug manufacturing is necessary to appreciate the release mechanisms of more complex drug delivery systems such as sustained- and delayed-release products. These concepts, however, are generally taught in a lecture style format, and students often have difficulty understanding the complex processes involved in tablet production.

Videotapes have been used in academic environments for various instructional purposes. Student performance in pharmacist-patient role-playing situations has been evaluated through the use of videotape(1). Videos have been used as recruitment tools to educate and attract students to the profession of pharmacy(2,3). Interactive television and videos have provided continuing education training for pharmacists and have been used as tools to educate patients(4,6).

Certain principles that cannot readily be observed in a conventional classroom setting may be demonstrated by using videotape(7). In a study conducted by Sause and co-workers, videotapes were developed to demonstrate extemporaneous compounding techniques and students viewed these tapes prior to compounding the preparations(8). Based on a survey, most students found the video instruction very helpful. However, no objective methods were used to assess student outcomes. The objective of this study was to compare the effectiveness of video instruction to conventional learning techniques including lectures and reading assignments using a pretest/posttest questionnaire. The complex process of tablet manufacturing was selected as the focus of the video.

METHODS

A videotape was developed by the investigators to illustrate the various steps of tablet manufacturing, testing, and packaging. The techniques, tableting excipients, and processing equipment used in tablet production and testing were filmed to create a videotape that could be used as an instructional tool for pharmacy students and other healthcare professionals. Subjects covered in the video included function and rationale for use of excipients, powder sieving and blending, and tablet dedusting/polishing. The parts of a tablet press were shown in the video as well as a tablet press in operation. The video also depicted various physical and analytical tests performed on tablets, including weight uniformity, tablet hardness, friability, disintegration, and dissolution. The footage for the video was filmed at the Veteran's Affairs Cooperative Studies Program Clinical Research Pharmacy Coordinating Center using a digital video camera (Sony DCR-TRV103). The raw footage was edited using a Studio DC 10 (Pinnacle Systems) computer-based software program. The voice overlays were recorded at Phayland Playland Studios (Albuquerque, New Mexico). Background music and title slides were then added.

In order to measure the effectiveness of the videotape compared to conventional teaching methods in promoting students' understanding of the tablet manufacturing process, a multiple choice questionnaire was developed (see Appendix A). Various questions about tablet production and testing were included. The test questions were designed to assess students' overall knowledge regarding tablet manufacturing, testing, and packaging. The questionnaire served as both a pretest and
posttest. The same posttest was given to ensure that the results of the study would be due to the content of the tableting videotape, reading assignment, or lectures and not derived from any outside sources.

The project was reviewed by the University of New Mexico Health Science Center Human Research Review Committee and was given exempt status. Subjects consisted of 70 second-year Doctor of Pharmacy students at the University of New Mexico College of Pharmacy enrolled in the Pharmaceutics III (Pharmaceutical Dosage Forms) course at the time of the study. All study subjects were given conventional lectures on tableting, and then randomly assigned to one of three groups. The control group (Group 1, n = 23) was shown a videotape unrelated to pharmacy. A second group (Group 2, n = 24) viewed the tablet manufacturing video. The final group (Group 3, n = 23) read a section of text from “Pharmaceutical Dosage Forms and Drug Delivery Systems” (Ansel, Popovich, and Allen 6th Edition, Williams & Wilkins, Media, 1995, pp. 186-187, 189, 190, 192, 202-204) pertaining to tablet production and testing. The selected text contained the same material that was presented in the tablet manufacturing video.

RESULTS AND DISCUSSION

The average pretest scores for each group were calculated and the data are presented in Table I. An analysis of variance (ANOVA) was performed on the pretest scores and no statistically significant difference between the three groups of students was found (P=0.48). These data demonstrate the equality of knowledge among the pharmacy students regarding the tableting process before intervention was initiated.

The average posttest results for each group were calculated and the data are presented in Table I. A repeated measures one-way analysis of variance performed on the average posttest scores found a significant difference between the pretest and posttest scores for the three groups (P<0.001). Pairwise comparisons using the Tukey test were then performed. As shown in Table I, the tableting video group (Group 2) was the only group to show statistically significant improvement in posttest scores (P<0.001). These findings suggest that video instruction to support conventional lectures may be a more effective teaching technique than either conventional lectures alone or in combination with reading assignments.

The number of correct responses to each test question for the pretest and posttest for all groups is shown in Figure 1. A comparison of the pretest and posttest scores revealed that many questions were answered correctly with greater frequency after watching the tableting videotape or reading the required text. In contrast, students in the control (unrelated video) group exhibited very limited improvement in posttest scores. As shown in Table II, 96 percent students who viewed the tableting video had improved test scores compared with 56 percent of students who read the required section of text. Finally, the questionnaire was administered as a posttest. The questionnaires were scored and the data analyzed.

Table I. Average and standard deviation of pretest and posttest scores

<table>
<thead>
<tr>
<th>Group</th>
<th>n</th>
<th>Pretest</th>
<th>Posttest</th>
<th>P-valuea</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Unrelated Video</td>
<td>23</td>
<td>4.70 (±1.61)</td>
<td>4.17 (±1.72)</td>
<td>0.844</td>
</tr>
<tr>
<td>2. Tableting Video</td>
<td>24</td>
<td>4.79 (±1.14)</td>
<td>6.88 (±1.42)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>3. Reading of Text</td>
<td>23</td>
<td>5.22 (±1.83)</td>
<td>5.74 (±1.79)</td>
<td>0.844</td>
</tr>
</tbody>
</table>

Table II. Comparison of the posttest performance of each group

<table>
<thead>
<tr>
<th>Group</th>
<th>Improved</th>
<th>No change</th>
<th>Decreased</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Unrelated video</td>
<td>13%</td>
<td>52%</td>
<td>35%</td>
</tr>
<tr>
<td>(n=3)</td>
<td>(n=12)</td>
<td>(n=8)</td>
<td></td>
</tr>
<tr>
<td>2. Tableting video</td>
<td>96%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>(n=23)</td>
<td>(n=1)</td>
<td>(n=0)</td>
<td></td>
</tr>
<tr>
<td>3. Reading of text</td>
<td>56%</td>
<td>9%</td>
<td>35%</td>
</tr>
<tr>
<td>(n=12)</td>
<td>(n=2)</td>
<td>(n=8)</td>
<td></td>
</tr>
</tbody>
</table>

Fig. 1. Comparison of the number of correct responses for each question between pretest and posttest examinations, (n) Pretest; (n) Posttest
significant improvement in posttest scores ($P<0.001$). In fact, the increased number of correct responses from the text group was not sufficient to make these findings statistically significant in comparison to the pretest scores ($P=0.26$, paired $t$-test). In addition, 35 percent of students who read a section of text showed a reduction in posttest scores, as did 35 percent of the students in the control group (unrelated video group). In contrast, no students in the tableting video group exhibited lower posttest scores, as shown in Table II. Thus, these findings further indicate that video instruction to support classroom lectures may be a more effective teaching method than either conventional lectures alone or in combination with reading assignments.

Students in the tableting video group did not show an improvement for all posttest questions, as shown in Figure 1. For example, correct responses for Question 4 in the posttest (see Appendix A) decreased for the tablet video group. A decrease in posttest scores for Question 4 was also noted for the other two groups of students. These findings may be due to the video and text not adequately differentiating the topics of disintegration and dissolution. The tableting video group also showed no change in the number of students who responded correctly to Question 8 and Question 9, although one additional student in the text group responded correctly to Question 9 and two additional respondents in the control group answered Question 8 correctly. It should be noted that the pretest/posttest questionnaire was not validated for this study and certain flaws may be inherent in the questions asked. Also, pretests in general may provide clues for the study subjects, making the posttest questions easier for all study groups. However, the overall findings demonstrate that students in the tableting video group performed better on the posttest than either of the other two groups.

CONCLUSION

The findings from this study demonstrated that students' understanding of the tablet manufacturing process was enhanced through the viewing of a videotape. Students who read a section of text related to tableting also showed some improvement in their knowledge of tablet production, although the improvement was not statistically significant. The results from this project suggest that video instruction to support conventional lectures is a more effective teaching technique than either conventional lectures alone or in combination with reading assignments.

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References

(5) De Muth, J.E., “A national pharmacy survey on the availability of hard-

APPENDIX A. TABLET QUIZ

Name _______________________________

1. Which of the following statements regarding lubrication is true?
   A) The equipment used to mix lubricants is generally the same equipment used to mix powders during the blending stage of tableting.
   B) Extended mixing of the lubricant can produce weaker tablets.
   C) Extended mixing of the lubricant can produce tablets with slower dissolution.
   D) All of the above.
   E) None of the above.

2. All of the following are functions of the feed frame on the tablet press except
   A) spread the powdered material across the die table of the tablet press.
   B) knock the formed tablet off the die table into the collection bin.
   C) accepts powder from the hopper.
   D) all of the above (i.e. all are false statements).
   E) none of the above (i.e. all are functions of the feed frame).

3. Which of the following statements regarding problems encountered during tableting is true?
   A) Inconsistent weight uniformity is generally associated with good powder flow properties.
   B) Picking is when the tablet press operator picks tablets out of the collection bin.
   C) Spotted or discolored tablets, often caused by an excess of grease on the tablet press, are called marbled tablets.
   D) Capping is when the top of the tablet splits off.
   E) None of the above.

4. Which of the following statements regarding tablet disintegration is (are) true?
   A) Disintegration of a dosage form does not influence drug release.
   B) Disintegrating agents absorb water and swell, making the tablet rupture.
   C) A USP disintegration apparatus is a paddle-type device.
   D) USP Methods I and II are the most common tablet disintegration testing techniques.
   E) None of the above.

5. Friability testing of tablets is used to analyze and predict:
   A) Weight loss during shipping.
   B) Tablet hardness.
   C) Drug content uniformity throughout the tablet.
   D) Aesthetic appeal of the tablet to patients.
   E) None of the above.

6. A variety of different excipients are used in making tablet formulations. Which of the following statements is (are) true?
   A) Binders swell in the presence of body fluids making the
tablet fracture.
B) Blending times for diluents can significantly effect tablet dissolution.
C) Lubricants are used to prevent sticking of the powders and finished tablets to the machinery.
D) Diluents are added to promote adhesion of the particles within the tablet.
E) None of the above.

7 Which of the following statements regarding dissolution testing is false?
A) In the USP Method II, the basket-device is dipped into the test media using a reciprocating motion.
B) For USP Methods I and II, the appropriate test media is placed in rounded-bottom flasks and then equilibrated to 37°C prior to starting the dissolution test.
C) In the USP Method I, individual tablets are placed in baskets.
D) Dissolution is directly related to drug absorption, bioavailability, and therapeutic effect.
E) None of the above (i.e. all statements are true).

8. The flow of powder through the tablet press will influence all of the following except

A) the tablet hardness.
B) the shape of the tablet.
C) the weight uniformity of the tablet.
D) the thickness of the tablet.
E) none of the above (i.e. all are influenced by powder flow).

9. Which of the following factors will influence the drug content uniformity of the tablet?
A) Particle size of excipients.
B) The blending process.
C) Flowability of the powdered material.
D) All of the above.
E) None of the above.

10. Which of the following statements regarding packaging is false?
A) A 'tablet de-duster' may be used to remove residual powders from the tablets.
B) A 'cottoner' may be used to place cotton in bottles.
C) A 'heat induction sealer' may be used to provide an inner seal across the top of the bottle.
D) All of the above (i.e. all statements are false).
E) None of the above (i.e. all statements are true).