Efficacy and Efficiency: Self-Designed Versus Instructor-Designed Study Tools

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During the course of their education, occupational therapy students learn to administer complex structured assessments. For easier administration of these assessments, students design note cards, which then replace cumbersome test manuals during administration. This study considered whether students could learn test administration with equal efficiency and efficacy if given test administration note cards rather than having to design their own.

The results showed that the subjects using instructor-designed cards earned written test and practical examination scores similar to those of the subjects using self-designed cards. The subjects using instructor-designed cards spent significantly less (p = .003) total time in study than did the subjects using self-designed cards. The difference in time between the two groups was attributable to the time spent designing note cards. Therefore, distribution of instructor-designed note cards appears to offer equally effective and significantly more efficient learning when compared with that produced when students design their own cards. The differences in efficacy and efficiency were found to be similar for students of different learning styles.

In the course of their professional education, students of occupational therapy must learn to administer, score, and interpret complex assessment instruments that measure any of several behaviors (e.g., hand function, perception, sensorimotor skills). Such assessments typically require specific verbal instructions and placement of assessment materials. Testers often find it difficult to manipulate both the assessment materials and the test manual during administration. To permit easier administration of these assessments, students design assessment administration note cards. They place the pertinent administration information on these note cards and then use the note cards in place of the test manual during administration. Thus, many of the tests studied in occupational therapy curricula require that students use their time outside of class to design test administration note cards as well as to study and practice testing procedure.

In informal discussion on the topic, some educators suggest that developing administration note cards provides a valuable learning experience for students. They reason that while students design administration note cards, they transform (and thus integrate) information from the original source. Thus, the time spent designing note cards serves as study time and also produces a permanent learning aid. Other educators suggest that little learning occurs during the time spent designing administration note cards. They view the design of cards as a transferring (rather than a transforming) task and thus argue that the time spent in card design does not serve as meaningful study. These instructors believe that students’ learning would be better served if educators were to copy and disseminate well-designed note cards created by others. This would permit the students to focus on their practice of the test and thus would provide a more efficient learning experience.

Different types of students may respond differently to the design experience. Typically, learning experiences are most successful when adjusted for the individual learner’s characteristics (Stiehl & Steit, 1984). Chickering (1976) noted that “the impact of an [educational] experience depends upon the characteristics of the person who encounters it. When individuals differ, a single experience can have diverse... outcomes” (p. 82). Cognitive style is one learner characteristic with the potential to guide instructional style. Although there are several different theoretical approaches to cognitive style, that of field-dependence/field-independence has been well researched over the past five decades (Guilford, 1980; Moran, 1985; Witkin, 1976; Witkin & Asch, 1948; Witkin, Dyk, Faterson, Goodenough, & Karp, 1962; 1967; Witkin, Goodenough, & Karp, 1981; Witkin, Goodenough, & Karp, 1967; Witkin, Moore, Goodenough, & Cox, 1977).
Characteristics Associated With Field-Dependence and Field-Independence

Witkin's field-dependence/field-independence theory classifies individuals' learning styles and skills along a continuum, depending on the amount of externally imposed structure that the individuals require to interpret experiences or to successfully complete tasks. At one end of the continuum are the field-dependent persons, who habitually rely on externally provided structure. They tend to absorb an experience in its totality, rarely separating cognitive or perceptual figure from background and refraining from "breaking a stimulus into its parts" (Witkin, Kowadson, & Rorer, 1980, p. 116). Because they are unable to create and impose the external structure needed to separate pertinent information from its context, field-dependent persons tend to make more and larger errors when asked to differentiate between relevant and irrelevant auditory or visual stimuli (Avolio, Alexander, Barrett, & Sterns, 1979). They also tend to need more time to gather information visually (Shinar, McDowell, Rackoff, & Rockwell, 1978). Generally, field-dependent persons attend poorly to cues in the presence of distracting elements (Davis & Cochran, 1982).

Field-independent persons occupy the opposite end of the continuum. They have been described as analytic (Messick, 1976), a term that conveys their tendency to break a stimulus into its component parts and automatically separate pertinent stimuli from the whole, without distraction from or reliance on the stimulus' surroundings. Field-independent persons are also more likely and better able to provide their own personal structure during a learning experience, spontaneously breaking complex experiences into components (Coward & Lange, 1979; Witkin & Goodenough, 1981; Witkin et al., 1977). Because they are able to structure an experience, field-independent persons are less likely to be distracted by nonsalient elements than are field-dependent persons (Witkin et al., 1977).

Field-Dependence/Field-Independence and Learning Aids

Several research studies have compared the learning efficacy of field-dependent and field-independent persons when presented with different types of learning aids (e.g., lecture notes, outlines, study guides) (Annis, 1979; Brooks, Dansereau, & Spurlin, 1981; Frank, 1984; Satterly & Telfer, 1979). This research indicates that field-independent persons learn better than field-dependent persons in both structured and unstructured learning experiences. Although both field-dependent and field-independent students benefit from external structure, field-dependent students make the more striking gains from the addition of external structure (Frank, 1984; Satterly & Telfer, 1979). Thus, field-independent persons appear able to create and superimpose their own structure on a learning task or use an externally imposed structure with equal ease. Field-dependent persons tend to be far less successful in a nonstructured experience than in a structured experience.

The creation and use of test administration note cards rely on a person's ability to separate pertinent information from less salient data as well as his or her ability to create a personal organization for the separated elements. Therefore, one's status on the field-dependence/field-independence continuum could relate to his or her ability to design and use either self-designed or instructor-designed assessment administration note cards.

Because the value attached to making one's own note cards could differ across cognitive styles, the present study was developed to determine differences in learning efficacy and efficiency of field-dependent and field-independent occupational therapy students with the use of instructor-designed and self-designed cards.

Method

Subjects

A convenience sample of 54 occupational therapy students (52 female, 2 male) agreed to participate in the study. Subjects were divided into experimental and control groups by randomly assigning two laboratory classes to receive instructor-designed administration note cards (n = 26; 12 field-dependent and 14 field-independent) and two classes to design their own cards (n = 28; 12 field-dependent and 16 field-independent).

A chi-square analysis of frequencies showed no significant difference (p = .81; df = 1; $\chi^2 = .06$) in the distribution of field-dependent and field-independent subjects between the control and experimental groups. The lack of a statistically significant difference permitted the groups to be considered similar in composition.

Instruments

Field-dependence/field-independence. Two published tests are commonly used to determine an adult's place on the field-dependence/field-independence continuum: the Embedded Figures Test and the Group Embedded Figures Test (Witkin, Oltrim, Raskin, & Karp, 1971). Both are paper-and-pencil tests in which subjects locate and trace a simple geometric figure embedded within a background of several complex interlocking geometric figures. The Embedded Figures Test is designed for individual administration; the Group Embedded Figures Test, for group administration. Its ease of administration and frequent use in research makes the Group Embedded Figures Test the preferred test instrument for large group studies, thus it was selected for the present study.
The construct validity of the Group Embedded Figures Test has been assessed through a comparison with other assessment instruments of field-dependence/field-independence, including the Embedded Figures Test. Correlation coefficients between the two tests for undergraduate students are — .82 for men and — .63 for women (Witkin et al., 1971). The negative correlations are to be expected, because the Embedded Figures Test and the Group Embedded Figures Test are scored in the reverse fashion (i.e., number of errors vs. number correct, respectively).

The Group Embedded Figures Test is scored on the basis of the total number of forms correctly isolated and traced in two of its three sections. The resulting scores range from 0 to 18. National norms are published for college-age men and women (Witkin et al., 1971). In the present study, subjects scoring in the lower two quartiles of their normative group on the Group Embedded Figures Test were classified as relatively field-dependent. Those whose Group Embedded Figures Test score placed them in the upper two quartiles were classified as relatively field-independent.

**Hand function.** The Jebsen-Taylor Hand Function Test (Jebsen, Taylor, Trieschmann, Trotter, & Howard, 1969) is a standardized hand function assessment tool used to assess dexterity in tasks similar to those used in daily living skills. Each of its seven subtests is measured by the number of seconds taken to complete the task. The Jebsen-Taylor test is regularly used in clinical assessment because of its relatively low fabrication cost and its functional parallel to a variety of daily hand uses (Carlson & Trombly, 1983; Hildebrand, 1988; Stern, 1991).

Therapists administering the Jebsen-Taylor test must position a wide variety of test materials (e.g., checkers, kidney beans, index cards) in specific configurations for each subtest. The assessment is complex to administer, and Jebsen et al.’s (1969) article, in which the test’s fabrication and administration are described, is awkward to use during clinical testing. As a result, most occupational therapists create administration note cards so that they can more efficiently handle the test materials when administering the assessment. The Jebsen-Taylor test was chosen as the clinical assessment for this study because of its common clinical use, the variety of its subtests, and the practical necessity of administration note cards.

**Learning efficacy.** Learning efficacy was measured across a written posttest, a written retention test, and a practical examination. The score on a written pretest served as covariate.

The pretest, posttest, and retention test consisted of 20 computer-graded questions following a parallel format. The tests were reviewed by three experienced occupational therapists, who reported that the test questions were clearly phrased, covered the subtests within the Jebsen-Taylor test equally, and demonstrated reasonable expectations to place on occupational therapy students.

In the practical examination, each subject was assessed while he or she was administering selected portions of the Jebsen-Taylor test to another student. A form developed by the researcher (the first author) was used to record the subject’s accuracy in administration. In a validity check, 6 subjects were graded by both the first author and a second rater experienced in teaching and testing. The two raters’ scores were compared with the use of the Pearson correlation coefficient ( \( r = .99 \) ) and paired \( t \) tests ( \( t = 1.00, p = .36 \) ). Lack of a statistically significant difference between the means of the two raters and strong correlation of the raters’ scores served as convincing evidence that the researcher’s scoring of the practical examination demonstrated no significant bias.

**Learning efficiency.** The subjects recorded the time that they spent daily in pertinent study during the 2 weeks between their instruction on the Jebsen-Taylor test and their practical examination. Study time was classified across eight areas: (a) reading the Jebsen-Taylor article (Jebsen et al., 1969), (b) designing their assessment administration cards, (c) reviewing a videotape that demonstrated the administration of the Jebsen-Taylor test, (d) reviewing their administration note cards, (e) practicing the Jebsen-Taylor test as the testee, (f) practicing the test as the testee, (g) reviewing their notes, and (h) other.

**Procedure**

The present study most closely conformed to a randomized group design (Ary, Jacobs, & Razavieh, 1972). As suggested by Moore (1983), a pretest–posttest design was selected to permit the researcher to consider preexisting differences between the instructor-designed note card group and the self-designed note card group when statistically analyzing the data.

Instructor-designed administration note cards were given to the experimental subjects for their use during study, practice, and practical examination. Subjects in the control group designed their own administration note cards, selecting pertinent information and organizing the cards in a manner that they thought best suited their personal learning needs. All subjects received a copy of the article by Jebsen et al. (1969) detailing the materials and procedure for assessment and timing of the Jebsen-Taylor test. Subjects also viewed a videotaped demonstration designed to teach the Jebsen-Taylor test. Use of the videotape ensured that each group of subjects received identical information regarding the materials, administration, and timing of the Jebsen-Taylor test.

The control group began its participation in the study 2 weeks before the experimental group, thereby ensuring that control subjects were not exposed to instructor-designed note cards. Subjects in the control and experimental groups did not study together. Subjects sat for the written posttest and practical examination 2 weeks after taking the pretest. The written retention test
was administered 7 weeks after the practical examination and written posttest session.

Examinations and assignments required by other classes in the occupational therapy curriculum were scheduled so that those external stressors were timed similarly for both the control and experimental groups.

Results

Learning Efficacy

A $2 \times 2 \times 3$ (Type of Card $\times$ Field Style $\times$ Test/Examination Scores) analysis of covariance with repeated measures was performed with the pretest score as covariate (see Table 1). Two main effects demonstrated significant difference. The field-dependent subjects' mean test and practical exam score ($m = 16.23$, $sd = 2.12$) was significantly lower ($p = .003$) than that of the field-independent subjects ($m = 17.41$, $sd = 1.81$), indicating that the field-independent subjects scored better on the whole than did the field-dependent students. The second significant difference was found in the Test/Examination Scores main effect ($p = .009$), with the mean retention test score (16.35) being lower than both the mean posttest score (17.19) and the mean practical examination score (17.12). The lower retention score was not surprising; it supported the empirical observation that information is lost from memory unless periodically reviewed.

No significant difference was found between the mean test score of subjects using instructor-designed note cards ($m = 16.89$, $sd = 1.85$) and that of subjects using self-designed cards ($m = 16.88$, $sd = 2.04$), indicating that the two learning aids were similarly effective. The absence of a significant interaction effect among trait (field style), treatment (type of note card used), and test/examination scores ($p = .51$) indicates that field-independent and field-dependent students demonstrated similar trends in their test and examination scores regardless of the type of administration note card used.

Table 1
Analysis of Covariance With the Pretest Used as Covariate

<table>
<thead>
<tr>
<th>Source</th>
<th>Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>$F$</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of Card</td>
<td>0.02</td>
<td>1</td>
<td>0.02</td>
<td>0.00</td>
<td>.95</td>
</tr>
<tr>
<td>Field Style</td>
<td>58.75</td>
<td>1</td>
<td>58.75</td>
<td>9.72</td>
<td>.003</td>
</tr>
<tr>
<td>Test/Exam Scores</td>
<td>26.81</td>
<td>2</td>
<td>13.40</td>
<td>4.98</td>
<td>.009</td>
</tr>
<tr>
<td>Pretest Covariate</td>
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<td>1</td>
<td>6.91</td>
<td>1.14</td>
<td>.29</td>
</tr>
<tr>
<td>Error</td>
<td>296.17</td>
<td>49</td>
<td>6.04</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Test $\times$ Card</td>
<td>0.35</td>
<td>2</td>
<td>0.18</td>
<td>0.07</td>
<td>.94</td>
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<tr>
<td>Card $\times$ Field</td>
<td>0.44</td>
<td>1</td>
<td>0.44</td>
<td>0.07</td>
<td>.79</td>
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<tr>
<td>Test $\times$ Field</td>
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<td>2</td>
<td>6.50</td>
<td>2.41</td>
<td>.09</td>
</tr>
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<td>Text $\times$ Card</td>
<td>3.65</td>
<td>2</td>
<td>1.83</td>
<td>0.68</td>
<td>.51</td>
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<tr>
<td>Error</td>
<td>269.24</td>
<td>100</td>
<td>2.69</td>
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<td></td>
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</table>

Table 2
Analysis of Variance for Total Study Time

<table>
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<tr>
<th>Source</th>
<th>Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>$F$</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of Card</td>
<td>192209.56</td>
<td>1</td>
<td>192209.56</td>
<td>9.80</td>
<td>.003</td>
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<tr>
<td>Field Style</td>
<td>59766.66</td>
<td>1</td>
<td>59766.66</td>
<td>2.05</td>
<td>.14</td>
</tr>
<tr>
<td>Card $\times$ Field</td>
<td>37589.56</td>
<td>1</td>
<td>37589.56</td>
<td>1.92</td>
<td>.17</td>
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<tr>
<td>Error</td>
<td>980447.69</td>
<td>50</td>
<td>19608.95</td>
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<td></td>
</tr>
</tbody>
</table>

Table 3
Analysis of Variance for General Study Time

<table>
<thead>
<tr>
<th>Source</th>
<th>Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>$F$</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of Card</td>
<td>12090.57</td>
<td>1</td>
<td>12090.57</td>
<td>0.79</td>
<td>.38</td>
</tr>
<tr>
<td>Field Style</td>
<td>54039.81</td>
<td>1</td>
<td>54039.81</td>
<td>3.53</td>
<td>.07</td>
</tr>
<tr>
<td>Card $\times$ Field</td>
<td>30775.70</td>
<td>1</td>
<td>30775.70</td>
<td>2.16</td>
<td>.15</td>
</tr>
<tr>
<td>Error</td>
<td>764989.69</td>
<td>50</td>
<td>15297.97</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Excludes time spent designing cards.

Discussion

Use of instructor-designed note cards produced test scores that did not differ significantly from those earned by subjects using self-designed cards. This indicated that instructor note cards were as effective (and as well retained) a learning aid as the traditional self-designed note card. In addition, this equally effective learning technique saved the subjects who used instructor-designed note cards almost 2 hours of study. These results support Singer's (1977) contention that when teaching "activities
which require fixed responses to fixed cues, heavily guided learning is the most expedient method to achieve goals" (p. 491). Thus, educators may improve the efficacy and efficiency of their teaching by using externally developed organizers when teaching highly structured cognitive and psychomotor information, such as manual muscle testing, range of motion assessment, and standardized test administration. The same may also be true for the more abstract, but equally closed-loop, study of anatomy with the use of flash cards.

Study Limitations
The relatively small sample size of the study, combined with the question’s original nature (i.e., a question not yet replicated by a second independent researcher) permits only cautious generalization of the results. In addition, because 52 of the 54 subjects were women, generalizations to largely male groups should be avoided.

The results of the present study are most applicable to administration note cards designed for standardized assessments similar to the Jebsen-Taylor Hand Function Test. Data relating to other types of tests have not been gathered. In addition, application of even these preliminary results presumes that the instructor-designed note cards are organized carefully and incorporate highlighting, graphics, and other elements recommended by learning-aid research (Beck, 1984; Smith, Farquhar, & Thomas, 1965).

In future studies, a larger sample size would permit upper and lower quartile comparisons of field style in place of the median split used in the present study. Such upper and lower quartile comparison would allow a clearer differentiation between the field-dependent and field-independent subjects and might result in greater differences being demonstrated between the two cognitive styles.

In addition, researchers attempting future studies may wish to consider the manner in which time in study (both including and excluding the time spent making cards) is measured. In the present study, we based our analysis of time in study on the subjects’ self-report. Although we cannot assume that one group of subjects would be more or less likely to report longer time on task, it is possible that subjects may overestimate or underestimate the time spent at study tasks.

Conclusion
Instructor-designed and self-designed administration note cards produced equally effective learning in both field-independent and field-dependent learners, with the instructor-designed note cards providing a more efficient means of study than the self-designed note cards. Occupational therapy academic and fieldwork educators may, therefore, wish to relieve their students of the time-consuming design of cards by providing them with copies of instructor-designed administration note cards. Recognizing the same need for economy of time among clinical therapists, we should encourage publishers of standardized assessments to include administration note cards in commercial test kits.

It could be argued that many occupational therapy educators lack the time to design note cards, despite the time savings that may result for their students. If so, educators may wish to divide the class into groups and assign each group the responsibility of designing a set of note cards for a specific test. A busy educator could also ask to review students’ note cards at the time of the practical examination, copy the best of these, and start a file of select sets designed by individual students.

In closing, we must caution against the overuse of external structure to expedite study. Occupational therapy curricula are intended to teach not only therapeutic skills, but also learning skills. As such, continuous structure could reinforce a field-dependent person’s tendency toward passivity in learning and potentially place field-dependent students at a disadvantage if the same structure is absent in later learning or performance situations (Kiewra & Frank, 1986). Use of external organizers must therefore be carefully weighed against the potential for encouragement of indiscriminate dependence on outside forces, thereby reducing “the opportunity to develop that processing method for themselves” (Bovy, 1981, p. 209). The present study supports the use of strong external organization when the study goal is itself highly structured (e.g., use of a technique or administration of a standardized assessment), but not when the goal is one more strongly characterized by critical thinking or problem solving.

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References


