

Investigating the Relationships Among Instructional Strategies and Learning Styles in Online Environments

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Abstract

Researchers investigated differences in learner preferences for different types of instructional strategies and learning styles in online environments. Results suggested that matches between students' learning styles and instructional strategies did not affect their perception of their own learning outcomes, level of effort and involvement, and level of interactions in the course. Data also indicated that no single instructional strategy, among three instructional strategies tested, emerged as superior for high and low field dependent online students.

Introduction

The Internet has taken center stage today as a preferred medium for the delivery of distance education. Many universities offer online courses that respond to the diverse distance and time needs of today's learners. These universities provide course instructors with online tools to manage course participation and facilitate learning. Instructors can continuously monitor student progress, provide learners with time to reflect on content and feedback before participating, prompt active participation with content and peers, and offers instructional modules that are designed to appeal to a variety of learning styles and preferences (Hamilton-Pennell, 2002).

Learning style can be thought of as the combination of the learners' motivation, task engagement, and information-processing habits (Aragon, Johnson, & Shaik, 2002). Each learner can have different preferences as to how s/he receives, processes, and recalls information during instruction. Many researchers however, have not controlled for students' characteristics in their analyses of students' satisfaction of online instruction (Thurmond, Wambach, & Connors, 2002). Understanding the relationships among learning styles and instructional preferences holds great promise for enhancing educational practice (Claxton & Murrell, 1987).

The primary purpose of this exploratory pilot study was to investigate the relationships among learning styles, defined as high and low field dependence, and preferences for, and evaluation of, instructional strategies used in an online course. Field dependence describes the degree to which a learner's perception or comprehension of information is affected by the surrounding contextual field (Jonassen & Grabowski, 1993). Learning styles are useful because they provide information about individual differences from a cognitive and information-processing standpoint (Smith & Ragan, 1999). Field dependent individuals are more likely to succeed at learning tasks that engage them in:

- Group oriented and collaborative work situations
- Situations where individuals have to follow standardized pattern of performance
- Tests requiring individuals to recall information in the form or structure that it was presented (Jonassen & Grabowski, 1993).

High-field dependent individuals have more difficulty locating the information they are looking for than low field dependent individuals. Low field dependent individuals are more likely to excel at learning tasks involving identification of important aspects of information from a poorly organized body of information. High field dependent individuals tend to accept the information without reorganizing it from the way it was presented to them so low field dependent individuals are likely to reorganize information to fit their own perceptions. Muir (2001) recommends teaching methods that match instructional strategies to field dependence-independence style.

Instructional strategies represent a set of decision that result in plan, method, or series of activities aimed at obtaining a specific goal (Jonassen, Grabinger, & Harris, 1990). Instructional strategies are the activities used to engage learners in the learning process. Many types of instructional strategies are used to engage learner in different ways such as reading, collecting, thinking, etc. Expository strategies may include providing learners with lecture notes. Explanations are often kept simple and direct. Students usually use lecture notes to complete learning activities or respond to posed questions. Collaborative and group work instructional strategies require individuals, often at various levels, to work together to achieve a common goal. Individuals are prompted to analyze, synthesize, and evaluate their ideas collaboratively. Inquisitive (discovery learning)

instructional strategies require individuals to formulate investigative questions, obtain factual information, and build knowledge, which reflects their answer to the original question. Students develop several questions, which eventually lead them to answer the original question, use extensive resources to gather data, and answer the original question.

The characteristics of high field dependent individuals appear to match with expository (presentation), and collaborative (group work) types of strategies because these types of instructional strategies require learners to complete learning activities that are usually kept simple, and sometimes require learners to work together. The characteristics of low field dependent individuals suggest a match with inquisitive type of strategies because low field dependent individuals prefer generating their own hypothesis and testing their hypothesis. Table 1 illustrates the suggested match and mismatch of learning style and instructional strategy for this study.

Table 1. *Match and Mismatch of Learning Style and Instructional Strategy*

	Expository	Collaborative	Discovery
High Field Dependent	Match	Match	Mismatch
Low Field Dependent	Mismatch	Mismatch	Match

Abraham (1985) found that matching instructional styles to students' field-dependent or independent style improved students' performance in the course. In the study, researchers used two computer-assisted instruction lessons, one rule oriented, and the other deemphasizing rules, to test whether a teaching approach that did not emphasize rules would be of greater benefit to field-dependent students in an English as a second language class. The results of the study showed that field-independent students performed better with rule oriented approach whereas field-dependent students performed better with the approach deemphasizing rules. There has also been research that was contradictory to these results. Macneil (1980) found that learning did not increase when students categorized as field dependent and field independent receive instruction oriented to their style. In the study, researchers used discovery and expository approaches to test whether randomly assigned field dependent students learn more from the discovery approach and field independent students learn more from expository approach. Results of the study revealed that achievement of field dependent and field independent students did not vary as a function of style. The question remains can matching learning styles and instructional strategies in distance education better support student learning. This study was designed to address the following research questions:

1. Is there a difference in perceived learning outcomes for students whose learning style matches with the instructional strategy?
2. Is there a difference in students' effort and involvement for students whose learning style matches with the instructional strategy?
3. Is there a difference in students' perceived level of interaction for students whose learning style matches with the instructional strategy?
4. Is there a difference in perceived learning outcomes for low field dependent learners in match and mismatch instructional strategy situations?
5. Is there a difference in perceived learning outcomes for high field dependent learners in match and mismatch instructional strategy situations?

Method

Instructional Context

The pilot study was conducted at a private university located in the northeastern United States with graduate students enrolled in an online graduate course entitled *Design and Management of Distance Education*. This investigation focused on determining if students who were classified as low or high field dependent perceived different types of instructional strategies differently in an online instructional environment. Specifically, students would be queried about their perceptions of learning outcomes, their effort and involvement in the activities, and their level of interaction during the course.

The *Design and Management of Distance Education* course consisted of three modules. Each module was delivered online using a different instructional strategy including, expository (presentation), collaborative (group work), and inquisitive (discovery learning). All three units were experiential and generative in nature, requiring learners to interact in different ways with the content to facilitate learning. On average, each unit was completed over a four-week period.

Expository type of instructional strategy was utilized primarily to present module one content. Each student read the assigned chapters in the course text, specified web pages, and power point slides regarding the

growth and development of the field of distance education. Students were then required to participate asynchronous discussions responding to initial question posted by course professor and at least two other postings from their peers supporting their responses with references from readings. Finally students were required to write a reflection journal and complete content quizzes.

Module two was presented using collaborative group work. Four teams of 3 to 4 students were established. A case scenario was presented and each team was asked to design a prototype distance education course based on specified criteria. A private discussion forum and workspace was made available to each team to support their collaboration while completing the module. Throughout the module, each team was expected to submit status reports, and a final instructional design report. Quality of the deliverables and level of participation were used as evaluation criteria.

Inquisitive (discovery learning) types of strategies were used to present module three. Students were prompted to explore methods, media, and materials in distance education, to identify most important points of their implementation, and to prepare a mini presentation describing benefits and challenges of each. In addition to the course text, and additional web links, students were expected to utilize other resources to prepare the mini presentation. Then, students were expected to participate in a bulletin board discussion, write a reflection journal describing the at least five web sources helping them to better understand on hot topic in distance education related to methods, media, or materials. For example, if a student was curious about copyright s/he would explore the topic and report findings back to class. Ultimately, students were prompted to respond to inquiries into, and learn about distance education by investigating a variety of distance education areas of their own choice, and share their findings with the class.

Subjects

The subjects included twelve graduate students registered for this course. Sixty-six percent of the students were doctoral students and others were master degree students. Four students reported their technical skill as advanced. The other eight studied described their technical skills as intermediate. Sixty-six percent of the students had taken at least one online course before enrolling in this course. The results of the Psychological Differentiation Inventory showed that 25% of the students were high field dependent and others were low field dependent students.

Instruments

In order to conduct this research a valid and reliable measure of learning style had to be secured that could be implemented online. One such measure used for decades to study learning styles is the Group Embedded Figures Test (GEFT) (Witkin et al., 1971). The GEFT is used for measuring field dependence and independence. However, the use of this instrument is problematic for online environments because of the requirement to time participant responses and because participants have to draw responses in a given booklet. Given that distributed nature of students, the reliability of each participant completing the instrument per instruction is questionable. Therefore, the investigator searched for a version of the instrument that could be implemented online. The Psychological Differentiation Inventory (PDI), a questionnaire measure of field dependence was reconstructed as an online questionnaire for this study and used to measure high field dependence and low field dependence of participating learners. The PDI has good test-retest reliability (.69) and correlates ($r = 0.46 - 0.76$) with Embedded Figure Test which is frequently used as a single measure of field dependence (Evans, 1969).

In this research the evaluation system used to assess students' achievements in each module included three components. These components were (1) self-assessment of outcome, (2) individual effort and involvement, and (3) interaction and feedback between and among the instructor and students (Robles & Braathen, 2002). The modified version of Student Instructional Report II developed by John A. Centra in 1998 was used with permission to assess components 1 and 2. This instrument contains five items for assessing perceived unit outcome of students, and three items for assessing student effort and involvement. Returns indicated the student's perception of the effectiveness of each aspect of a unit to the same aspects in other units using a five-point scale. A rubric developed by Roblyer & Wiencke in 2003 was used to assess the level of interactivity in each module by having students evaluate elements of interactions including social goals, instructional goals, types and uses of technology, and impact of interactivity-changes in learner behaviors.

Procedure

The *Design and Management of Distance Education* course consisted of three modules. Each module had to be completed in order, and in a given time frame by all students. Data were collected after each unit was

completed. The online unit evaluation form at the end of each unit measured learner satisfaction and involvement with the instruction specifically through (1) perceived unit outcomes, (2) student perception of effort and involvement in the unit, and (3) student perception of interaction and feedback levels between and among the instructor and students during the unit (Roblyer & Wiencke, 2003; Centra, 1998). A java script was written for the online unit evaluation form to ensure that students answered all questions before submitting it. Using java script eliminated the risk of missing question response. Upon completing the online unit evaluation form, the data were automatically emailed to the researchers.

Students also had to complete the online questionnaire version of the Psychological Differentiation Inventory to measure their level of field dependence. A java script was also written for the online questionnaire version of the Psychological Differentiation Inventory to ensure that students answered all questions on the inventory. Researchers also received the results of the Psychological Differentiation Inventory through email.

Analysis

All data were ported into a statistical analysis package (Stata version 8.0) for later analysis. One way analysis of variance was used to test the hypotheses that there were differences in students perceived learning outcomes, students effort and involvement, and students' perceived level of interaction when students learning style matches with the instructional strategy, and to test whether one instructional strategy emerges with higher perceived learning outcomes for online students who are categorized as high field dependent and low field dependent. All statistical analysis reported in this research were conducted with a significant level of .05.

Results

Learning style

The results of the online questionnaire version the Psychological Differentiation Inventory revealed that nine students were low field dependent and three students were high field dependents. The mean score for students categorized as low field dependent was 19.55 (S.D. = 3.53) while the mean score for students categorized as high field dependent was 26.33 (S.D. = 0.57) (see Table 2).

Table 2. Means and Standard Deviations for Students Categorized as Low Field Dependent and High Field Dependent

Categories	N	Mean	Standard Deviation	Min	Max
Low Field Dependent	9	19.55	3.53	14	23
High Field Dependent	3	26.33	0.57	26	27

Matching Learning Style with Instructional Strategy

The first hypothesis stated that there would be no significant difference in the perceived learning outcomes of students whose learning style matched the instructional strategy. The results of the one-way analysis of variance supported this null hypothesis, $F(2,18) = 0.11$, $p = 0.89$ (see Table 3). No significant difference was found in the perceived learning outcomes of students whose learning style matched the instructional strategy. Both low and high field dependent students perceived learning outcomes in the three instructional strategies the same. Table 4 shows the descriptive statistics for perceived learning outcomes of students whose learning style matched the instructional strategy.

Table 3. Results of One-way Analysis of Variance for Perceived Learning Outcomes of Students whose Learning Style Matched the Instructional Strategy Used to Present the Online Course Module

Source	Sum of Squares	D.F.	Mean Squares	F ratio	F Prob.
Between groups	.18031733	2	.090158665	0.11	0.8947
Within groups	14.4977771	18	.805432064		
Total	14.6780945	20	.733904724		

Table 4. The Descriptive Statistics for Perceived Learning Outcomes of Students whose Learning Style Matched the Instructional Strategy

Matched Group	Instructional Strategy	Mean	N	S.D.	Min	Max
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Low Field Dependent	Expository	3.71	9	0.85	2	5
Low Field Dependent	Collaborative	3.55	9	0.88	2	5
High Field Dependent	Discovery	3.46	3	1.1	2.4	4.6

The second hypothesis stated that there would be no significant difference in the effort and involvement of students whose learning style matched the instructional strategy used to present the online course module. The results of the one way analysis of variance supported this null hypothesis, $F(2,18) = 1.02$, $p = 0.37$ (see Table 5). No significant difference was found in the effort and involvement of students whose learning style matched the instructional strategy used to present the online course module. When low and high field dependent students' learning styles matched three types of instructional strategies used in the study, low and high field dependent students reported they put equal effort and involvement to instructional activities. Table 6 shows the descriptive statistics for the effort and involvement of students whose learning style matched the instructional strategy.

Table 5. *Results of One way Analysis of Variance for Effort and Involvement of Students whose Learning Style Matched the Instructional Strategy Used to Present the Online Course Module*

Source	Sum of Squares	D.F.	Mean Squares	F ratio	F Prob.
Between groups	1.06779522	2	.533897609	1.02	0.3795
Within groups	9.39358058	18	.521865588		
Total	10.4613758	20	.52306879		

Table 6. *The Descriptive Statistics for the Effort and Involvement of Students whose Learning Style Matched the Instructional Strategy*

Matched Group	Instructional Strategy	Mean	N	S.D.	Min	Max
Low Field Dependent	Expository	3.71	9	0.5	3	4.4
Low Field Dependent	Collaborative	3.81	9	0.64	3	5
High Field Dependent	Discovery	3.13	3	1.41	1.6	4.4

The third null hypothesis stated that there would be no significant difference in the perceived level of interaction of students whose learning style matched the instructional strategy. The results of the one way analysis of variance supported this hypothesis, $F(2,18) = 0.03$, $p = 0.97$ (see Table 7). No significant difference was found in the perceived level of interaction of students whose learning style matched the instructional strategy. Low and high field dependent students perceived their level of interactivity same for all three types of instructional strategies used in these modules. Table 8 shows the descriptive statistics for the level of interaction perceived by students whose learning style matched the instructional strategies.

Table 7. *Results of One-way Analysis of Variance for Perceived Level of Interaction of Students whose Learning Style Matched the Instructional Strategy Used to Present the Online Course Module*

Source	Sum of Squares	D.F.	Mean Squares	F ratio	F Prob.
Between groups	.054603198	2	.027301599	0.03	0.9703
Within groups	16.2755553	18	.904197518		
Total	16.3301585	20	.816507926		

Table 8. *The Descriptive Statistics for the Level of Interaction Perceived by Students whose Learning Style Matched the Instructional Strategies*

Matched Group	Instructional Strategy	Mean	N	S.D.	Min	Max
Low Field Dependent	Expository	3.82	9	0.92	2.6	5
Low Field Dependent	Collaborative	3.77	9	0.95	2.66	5
High Field Dependent	Discovery	3.66	3	1.0	2.6	4.6

One Superior Instructional Strategy

The fourth null hypothesis stated that there would be no significant difference in the perceived learning outcomes for low-field-dependent learners in match and mismatch instructional strategy situations. The results of the one way analysis of variance supported this null hypothesis, $F(2,24) = 0.19$, $p = 0.82$ (see Table 9). No significant difference was found in the perceived learning outcomes of low-field-dependent students who

completed three online course modules. The characteristics of low field dependent students showed match with expository and collaborative type of instructional strategies, and mismatch with discovery type of instructional strategies. Statistical analysis showed no significant difference in the perceived learning outcomes of low field dependent students in match and mismatch instructional strategy situations. Table 10 shows the descriptive statistics for the perceived learning outcomes for low field dependent learners in match and mismatch instructional strategy situations.

Table 9. *Results of One-way Analysis of Variance for Perceived Learning Outcomes of Low-Field-Dependent Students in Match and Mismatch Instructional Strategy Situations*

Source	Sum of Squares	D.F.	Mean Squares	F ratio	F Prob.
Between groups	.234073991	2	.117036996	0.19	0.8286
Within groups	14.8266668	24	.617777781		
Total	15.0607407	26	.579259259		

Table 10. *The Descriptive Statistics for the Perceived Learning Outcomes for Low Field Dependent Learners in Match and Mismatch Instructional Strategy Situations*

Low Field Dependent Learners Match and Mismatch Situations	Instructional Strategy	Mean	N	S.D.	Min	Max
Match	Expository	3.71	9	0.85	2	5
Match	Collaborative	3.55	9	0.88	2	5
Mismatch	Discovery	3.77	9	0.58	3	4.8

The last null hypothesis stated that there would be no significant difference in the perceived learning outcomes for high-field-dependent learners in match and mismatch instructional strategy situations. The results of the one way analysis of variance supported this null hypothesis, $F(2,6) = 0.13, p = 0.88$ (see Table 11). No significant difference was found in the perceived learning outcomes of high-field-dependent students who completed three online course modules each of which used different instructional strategy. Perceived learning outcomes of high field dependent students did not change when they were taught with different instructional strategies matching and mismatching their characteristics. Table 12 shows the descriptive statistics for the perceived learning outcomes for high field dependent learners in match and mismatch instructional strategy situations.

Table 11. *Results of One-way Analysis of Variance for Perceived Learning Outcomes of High-Field-Dependent Students in Match and Mismatch Instructional Strategy Situations*

Source	Sum of Squares	D.F.	Mean Squares	F ratio	F Prob.
Between groups	.267654316	2	.133827158	0.13	0.8824
Within groups	6.28740728	6	1.04790121		
Total	6.5550616	8	.8193827		

Table 12. *The Descriptive Statistics for the Perceived Learning Outcomes for High Field Dependent Learners in Match and Mismatch Instructional Strategy Situations*

High Field Dependent Learners Match and Mismatch Situations	Instructional Strategy	Mean	N	S.D.	Min	Max
Mismatch	Expository	3.66	3	0.94	2.6	4.4
Mismatch	Collaborative	3.88	3	1.01	3	5
Match	Discovery	3.46	3	1.1	2.4	4.6

Discussion and Conclusion

Delivering instruction on the Internet has become very popular in recent years. Often face-to-face courses are converted to online course activities and materials with little thought of learners' preferences for instruction. Understanding the effects that learning styles and learners' perceptions of engagement in online environments have potential to improve the planning, producing, and implementing of online educational experiences. Thus, learning styles can be utilized to enhance students' learning, retention, and retrieval (Federico, 2000). This study provides insight into the relationships among learning style and instructional strategies used in online environments.

The statistical analysis revealed no significant differences among three match situations for low and high field dependent students. When the characteristics of low and high field dependent students matched with instructional strategies, match groups did not show any statistically significant difference in their perceived learning outcomes, their perceived effort and involvement in units, and level of interactivity that they perceived during the unit. This result showed that when low and high field dependent students receive instruction utilizing instructional strategies matching their characteristics, they gain equal learning benefits from the instruction. Using expository and collaborative type of instructional strategies for high field dependent students, and using discovery type of instructional strategies for low field dependent students in online courses provided equal benefits for students in terms of their perceived learning outcomes, their perceived effort and involvement, and level of interactivity that they perceived in the class. However, considering the fact that mean scores of students for match situations were more than the average score, matching instructional strategies with low and high field dependent learners appears to show some positive effect on student learning. Online course instructors may utilize expository and collaborative types of instructional strategies for high field dependent students, and discovery types of instructional strategies for low field dependent students to make the instruction more appealing and effective. Ultimately online students may gain more learning benefits from the course in terms of their perceived learning outcome, their effort and involvement, and level of activity that they perceive in the online class.

The results also revealed that there is no single superior instructional strategy for high and low field dependent students among the three types of instructional strategy used in the study. The characteristics of low field dependent students matched expository and collaborative instructional strategies and mismatched discovery type of instructional strategies. When low field dependent student groups were statistically compared, no significant differences were detected for three constructs used in the study. Matching and mismatching instructional strategies for low field dependent students did not affect students' perceived learning outcome, their perceived effort and involvement in units, and level of interactivity that they perceived during the unit. Similar statistical analysis was conducted for high field dependent students whose characteristics matched discovery type of instructional strategies and mismatched expository and collaborative type of instructional strategies. However, statistically no significant results were found for high field dependent students as well. Results of this study showed that utilizing expository, collaborative, and discovery types of instructional strategies to design online courses provided almost equal learning benefits for low and high field dependent students.

Although, this pilot study provided valuable information on gathering learner style information from online learners, results of the study should be interpreted with caution. These findings may have been due to a number of factors. Finding no significant results could have been due to small number of subjects. Considering the fact that there were twelve-subjects involved to the study and only three subjects were categorized as high-field dependent individuals, more subjects are required to validate the results of this pilot study. There appears to be other factors that may have affected the results of the study. Existing course structure may not have provided pure experiences in different instructional strategies. Furthermore, the time allocated to complete units was not same so it may have influenced the experiences of students in three units. Finally the content of units were different so the content may have influenced the level of effort that each student put into completing units.

Future researchers should consider testing environments that do strictly follow instructional strategy guidelines to confirm these findings. Researchers should also consider testing other learning style instruments and instructional strategies in their future research. Although no significant differences were identified in this study, there is much to learn about how individuals interact and learn in online environments.

References

- Abraham, R. (1985). Field Independence-Dependence and the Teaching of Grammar. *TESOL Quarterly*, 2, 689-702.
- Aragon, S. R., Johnson, S. D., & Shaik, N. (2002). The influence of learning style preferences on student success in online versus face-to-face environments. *American Journal of Distance Education*, 16, 227-244.
- Centra, J. (1998). *The development of student instructional report II*. Educational Testing Service.
- Claxton, C. S. & Murrell, P. H. (1987). Learning Styles: Implications for improving educational practices. *ASHE-ERIC Higher Education Report No.4*. Washington, D.C.: Association for the Study of Higher Education.
- Evan, F. (1969). The Psychological Differentiation Inventory: A questionnaire measure of field dependence. A Paper presented at the Eastern Psychological Association, Philadelphia, PA., April 1969

- Federico, P. (2000). Learning styles and student attitudes toward various aspects of network-based instruction. *Computers in Human Behavior*, 16, 359-379.
- Hamilton-Pennell, C. (2002). Getting Ahead by Getting Online. *Library Journal*, 127, 32-35.
- Jonassen, D. H., Grabinger, R. S., & Harris, N. D. C. (1990). Analyzing instructional strategies and tactics. *Performance and Instruction Quarterly*, 3, 29-45.
- Jonassen, D. H. & Grabowski, B. L. (1993). ***Handbook of individual differences, learning, and instruction***. Hillsdale, N.J.: Lawrence Erlbaum Associates.
- Locatis, C. & Weisberg, M. (1997). Distributed learning and the internet. *Contemporary Education*, 68, 100-103.
- Macneil, R. (1980). The relationship of cognitive style and instructional style to the learning performance of undergraduate students. *Journal of Educational Research*, 73, 354-359.
- Muir, D. J. (2001). *Adapting online education to different learning styles*. National Educational Computing Conference, Chicago, IL.
- Robles, M. & Braathen, S. (2002). Online Assessment Techniques. *The Delta Pi Epsilon Journal*, 44, 39-49.
- Roblyer, M.D. & Wiencke, W. R. (2003). Design and use of a rubric to assess and encourage interactive qualities in distance courses. *The American Journal of Distance Education*, 17, 77-98.
- Smith, P. L. & Ragan, T. J. (1999). *Instructional Design*. New York, N.Y.: John Wiley & Sons Inc.
- Thurmond, V. A., Wambach, K. & Connors, H. R. (2002). Evaluation of student satisfaction: Determining the impact of a WBE by controlling for student characteristics. *American Journal of Distance Education*, 16, 169-189.
- Witkin, H. A., Oltman, P. T., Raskin, E. and Karp, S. A., (1971). *Group Embedded Figures Test Manual*. Palo Alto: Consulting Psychologists Press.