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Addressing Learning Style Needs to Improve Effectiveness of Adult Health Literacy Education

Leah A. Grebner[1]

Abstract

Context: Low health literacy has an impact on the ability of an individual's understand healthcare provider communication. It also contributes to reduced access to healthcare services increased rates of mortality. **Objectives:** The purpose of this study was to evaluate the impact of learning style on adult health literacy education. **Design, Settings, and Participants:** The research questions addressed the effectiveness of educational intervention adjusted to their appropriate learning style in comparison to a standardized health literacy intervention and potential difference, according to type of learning style, in the amount of change in performance between administration of pretest and posttest. A sample of 80 adults in an urban community was recruited through organizations serving low-income individuals. The participants were assessed for baseline health literacy level, followed by identification of learning style, educational intervention, and posttest assessment, which led to determination by **Intervention(s):** Participants in the study received a health literacy educational intervention, according to learning style, in order to provide participants with basic health literacy education. **Main Outcome Measure(s):**Variables of learning styles were evaluated to determine if participants in the study group would perform differently than the participants in the control group, who received the standardized health literacy intervention. **Results:** t-test that changes between pretest and posttest scores were statistically significant between the control group and the study groups. **Conclusions:** This finding suggests that health education should be delivered to patients according to individual learning style in order for patients to comprehend and retain information provided. Social change implications include healthcare professionals appropriately addressing health literacy so that patients may become more active participants in personal healthcare management to improve outcomes of healthcare quality, decrease long-term healthcare delivery costs, and improve the community's general health status.

[1] PhD, RHIA, CCS, FAHIMA, Assistant Professor, Director, Health Information Technology, Midstate College. Phone: 309-692-4092, Fax: 309-692-3893, E-Mail: lgrebner@midstate.edu

Background

Health literacy is the ability to comprehend and respond to healthcare provider communication, both written and verbal. Low health literacy may result in decreased access to healthcare services, increased mortality rates, and increased cost of care. According to the Institute of Medicine (IOM), approximately 90 million U.S. adults experience difficulty understanding medical information and responding to healthcare instructions.[1]

Inadequate and marginal health literacy levels correlate with greater potential for contribution to death during periods of follow-up after receiving medical care.[2]Approximately doubled mortality rate is associated with low health literacy levels in comparison to individuals with satisfactory levels of health literacy.[3]

If healthcare providers develop competence in assessing patient health literacy needs and personalization of educational interventions to meet unique needs of each healthcare consumer, a significant gap will be bridged in health literacy education.[4]Appropriately addressing health literacy provides potential for improved healthcare outcomes and the potential for long-term healthcare delivery cost reduction simply through improving the overall population health status.[5]

The IOM has suggested necessity for health literacy education to correspond with individual needs and backgrounds.[6]

The 2009 Illinois County Health Rankings program ranked Peoria County in first place for clinical care, regarding quality of care and accessibility to healthcare services; however, Peoria ranked 86th out of 101 counties in the state in health behaviors and 71st in health outcomes.[7]

The Peoria City/County Health Department 2011-2016 strategic plan cited a need to provide health literacy and other health information to those in areas deemed difficult to reach, as well as addressing health and behavioral health education/awareness as one of the 12 health and social problems in the plan.[8]

Methods

Setting and Study Participants

The study included individuals living in Central Illinois, including Peoria, Tazewell, and Woodford counties. Data collection was performed at the South Side Mission, Common Place, and Midstate College in Peoria, Illinois. Individuals visiting these organizations are generallymiddle to lower socioeconomic levels.

This research project was based on an assumption that that a correlation exists between health literacy education and administration of an educational intervention that addresses individual learning style, based onpre-assessment prior to intervention administration. Additional assumptions were that individuals living in the community would be willing to become participants in the study, cultural aspects and translation of the intervention tools would have minimal to no impact on the outcome, and that the participants would be willing to cooperate with the preintervention questionnaire and postintervention test, being honest and accurate when responding to all questions.

Participants were selected through nonprobability sample, based on convenience with individuals in the target population. A systemic sample approach was used by assigning every fifth participant to the control group.

The study was approved by Walden University Institutional Review board and was assigned approval number 06-27-13-0037872.

Copyright permission for the VARK tool was obtained from Neil D. Fleming via e-mail on May 21, 2011. The Short Test of Functional Health Literacy in Adults (STOFHLA), published by Peppercorn Books & Press, was purchased it as part of a package, including administration instructions, guidelines to score the tests, and licensing information.[9]The license allowed copies to be made for private research and testing.[9]

Measures

Variables were evaluated to determine if participants in the study group would perform differently than the participants in the control group, who received the standardized health literacy intervention.A questionnaire was completed by each participant for collection of descriptive data. The VARK tool was used for determination of the learning styles of visual, aural, read-write, or kinesthetic.[10] Following completion of the VARK questionnaire, each participant completed the Short Test of Functional Health Literacy in Adults (S-TOFHLA) as the pretest.

The content of the educational materials was identical for all participants; however, there were different versions of the intervention were developed, according to learning style, in order to provide participants with basic health literacy education. The most appropriate educational intervention method was determined, based on VARK questionnaire responses.

The VARK tool has been determined to have face validity.[11]It has also been determined that the validity and reliability of VARK are satisfactory via factor analysis techniques.[12] For the purpose of this study, the content of these references was analyzed and it was determined that they supported the concept that the content being measured by the VARK tool was reasonable in the sense that the factors being assessed were aligned with the content or subject of the measured outcome. Testing and validation were performed on the S-TOFHLA following development.[9]

Reliability for the reading comprehension component of the STOFHLA has been determined to be $\alpha = 0.97$.[13] However, the there is a lower reliability level for the numeracy component at $\alpha = 0.68$[13]. The STOFHLA has been determined to have good reliability and is considered to provide a valid measurement of health literacy.[14]

Evaluation of grade level of the educational tool used for the study intervention was measured using the Flesch-Kincaid Grade Level Formula in Microsoft Word.[15]The intervention tool was validated through peer review. Thembi Conner-Garcia, MD, MPH, Assistant Professor of Medicine at the University Of Illinois College Of Medicine in Peoria, Julie Wolter, Associate Professor at Doisy College of Health Sciences at Saint Louis University, and David R. Kaufman, Ph.D. from the Department of Biomedical Informatics at Columbia University reviewed the data collection and intervention.

Read-write learners received a printed educational intervention, which differed from the control intervention by being changed to a fifth grade reading level. Size 14 Times New Roman font, which is easy to read, was used for the printed version of the tool.[15] The visual learning intervention included image samples of physician instructions and a segment of a Medicaid application, both with pertinent components labeled using the same terminology that was used in the printed version. Aural learner participants received the intervention as a recorded audio file, which was recorded verbatim from the read/write intervention. The kinesthetic intervention had two components, laminated documents for a hands-on exercise and an accompanying video that referenced color-coded items on the laminated documents so that participants could identify specific areas. These tools are outlined in Table 1.

Table 1: Educational Intervention Tools

Learning style	Brief description of intervention
Visual	Examples of diagnostic test instructions and Medicaid instructions with written explanation of pertinent components at fifth grade reading level
Aural	Recorded audio file read from script
Read/write	Printed educational intervention written at fifth grade reading level
Kinesthetic	Video with hands-on exercise to follow explanation of examples of diagnostic test instructions and Medicaid instructions
Control group	Examples of diagnostic test instructions and Medicaid instructions without simplified terminology or additional explanation

The S-TOFHLA was delivered as a posttest immediately following provision of the intervention and control group participants were offered the learning style-appropriate intervention following the posttest in order to provide all participants equal access to the test intervention.

Statistical Analysis

G*Power 3.1.3 was used to perform a compromise analysis for the purpose of calculating implied α and power.[16] I based the compromise analysis on a total sample size of 80, using 1 variable with 5 predictors, which include the four different learning styles and a control group.

Analysis of variance (ANOVA), was based on β/α ratio of 1 and a power (1 – β) of 0.7494461 with a medium effect size f2=0.25 with α error probability of = 0.2505539 and β error probability of 0.2505539.[17] β represented the chance of Type II error, in which the null hypothesis is accepted when it is actually false. There were also 80 participants, 16 of whom were randomly assigned to a control group.

The study sample included 80 adults between the ages of 18 and 84. Gender distribution included 68.8% females and 31.3% males. The largest racial group was white at 63.8%, followed by 32.5% black, African American, or Negro group, and 3% other. Frequency distribution of educational levels in the sample is outlined in Table 2.

Table 2: Frequency Distribution of Descriptive Data for Study Group and Control Group Education Level

	Study group (n = 64)		Control group (n = 16)	
Educational level	Frequency	Percentage	Frequency	Percentage
Less than 9th grade	5	7.8%	2	12.5%
9th to 12th grade, no diploma	19	29.7%	1	6.3%
High school graduate or GED	10	15.6%	4	25.0%
Some college, no degree	16	25.0%	5	31.3%
Associate degree	1	1.6%	1	6.3%
Bachelor's degree	7	10.9%	2	12.5%
Graduate degree	5	7.8%	1	6.3%
Undisclosed	1	1.6%	0	0.0%

The learning style distribution had the greatest proportion in the read/write intervention group with 26.3%, followed by the aural intervention group at 25.0%, kinesthetic at 20%, control group at 20.0%, and the visual group only represented by 8.8% of the participants. This is outlined in Table 3.

Table 3: Frequency Distribution of Intervention Learning Style

Learning style assessed	Frequency	Percentage
Visual	7	8.8%
Aural	20	25.0%
Read/Write	21	26.3%
Kinesthetic	16	20.0%
Control	16	20.0%
Total	80	100%

The S-TOFHLA scores for the study ranged from 1 to 36. Of the 80 participants, 21 completed the pretest with a perfect score of 36, which meant that only 59 of the 80 participants were able to improve following the intervention. Table 4 reflects the frequency distribution of pretest scores for the study group and control group. Posttest scores are provided in Table 5 and details of the change from pretest to posttest is reflected in Table 6.

Table 4: Frequency Distribution of Baseline Functional Health Literacy Levels for Study Group and Control Group following removal of perfect pretest scores

	Study group (n = 48)		Control group (n = 11)	
STOFHLA score level	Frequency	Percentage	Frequency	Percentage
Inadequate functional health literacy (0-16)	4	8.3%	1	9.1%
Marginal functional health literacy (17-22)	6	12.5%	0	0.0%
Adequate functional health literacy (23-36)	38	79.2%	10	90.9%

Table 5: Frequency Distribution of Posttest Functional Health Literacy Levels for Study Group and Control Group following removal of perfect pretest scores

	Study group (n = 48)		Control group (n = 11)	
STOFHLA score level	Frequency	Percentage	Frequency	Percentage
Inadequate functional health literacy (0-16)	2	4.2%	1	9.1%
Marginal functional health literacy (17-22)	2	4.2%	0	0.0%
Adequate functional health literacy (23-36)	44	91.7%	10	90.9%

Table 6: STOFHLA Change from Pretest to Posttest According to Learning Style Following Removal of Perfect Pretest Scores

	Average pretest score	Average posttest score	Average change
Visual	32.60	33.00	0.40
Aural	27.06	29.50	2.44
Read/Write	29.92	33.00	3.08
Kinesthetic	31.08	33.50	2.42
Control	29.55	31.00	1.45

ANOVA was used to evaluate impact relative to each of the four different learning styles. The educational intervention was the independent variable for this study and the dependent variable was the observed outcome that followed the intervention. Paired t-test was performed to determine statistical significance of pretest and posttest differences among learning styles, as several data groups were addressed according to independent variables with continuous data on the dependent variable of health literacy level. Bonferroni's correction was applied to the calculations, due to performance of multiple tests to compare the groups of data.[18]This was accomplished by dividing the significance level of 0.05 by 20, which was the total number of tests performed on the data groups. This resulted in an adjusted significance level of 0.0025.

T-test performed on the full data set demonstrated that there was a statistically significant difference between pretest and posttest for all participants of the combined study and control groups. Statistically significant differences were noted between pretest and posttest for the full data set. A statistically significant difference was also found to exist between pretest and posttest for the study group. Paired t-test between pretest and posttest for the control group, the visual study group, and the read/write study group did not reflect any statistically significant difference. Borderline significance was also determined for the aural and kinesthetic study groups, which is consistent with the results that included the perfect scores. ANOVA demonstrated that there was no statistical significance of difference between the learning styles, between the study group and control group, or between the learning style study groups without the control group.

Following analysis of the full data set collected, the participants with the pretest score of 36 were removed. Analysis findings were similar to data including perfect scores. Statistically significant differences were noted between pretest and posttest for the full data set with the exclusion of the perfect scores, as is demonstrated in Table 7, and a statistically significant difference was also found to exist between pretest and posttest for the study group with the exclusion of the perfect scores, as is demonstrated in Table 8. Paired t-test between pretest and posttest for the control group, the visual study group, and the read/write study group did not reflect any statistically significant difference, as found in Table 9, Table 10, and Table 11. Borderline significance was also determined for the aural and kinesthetic study groups (see Table 12 and Table 13), which is consistent with the results that included the perfect scores.

Tables 14, 15, and 16 provide evidence that ANOVA demonstrated that there was no statistical significance of difference between the learning styles, between the study group and control group, or between the learning style study groups without the control group.

Table 7: Paired t-test of Pretest and Posttest for all Data without Perfect Pretest Scores

	Paired differences							
				95% Confidence interval of the difference				
	Mean	Standard deviation	Standard error mean	Lower	Upper	t	df	Significance (2-tailed)
Pretest-posttest	-2.220	3.113	.405	-3.032	-1.409	-5.478	58	.000

Table 8: Paired t-test of Pretest and Posttest for Study Groups without the Control Group without Perfect Pretest Scores

	Paired differences							
				95% Confidence interval of the difference				
	Mean	Standard deviation	Standard error mean	Lower	Upper	t	df	Significance (2-tailed)
Pretest-posttest	-2.396	3.292	.475	-3.352	-1.440	-5.042	47	.000

Table 9: Paired T-Test for Control Group without Perfect Pretest Scores

	Paired differences							
				95% Confidence Interval of the Difference				
	Mean	Standard deviation	Standard error mean	Lower	Upper	t	df	Significance (2-tailed)
Pretest-posttest	-1.455	2.115	.638	-2.875	-.034	-2.281	10	.046

Table 10: Paired t-test for the Visual Study Group without Perfect Pretest Scores

	Paired differences							
				95% Confidence interval of the difference				
	Mean	Standard deviation	Standard error mean	Lower	Upper	t	df	Significance (2-tailed)
Pretest-posttest	-.400	3.286	1.470	-4.481	3.681	-.272	4	.799

Table 11: Paired t-test for the Read/Write Study Group without Perfect Pretest Scores

	Paired Differences							
				95% Confidence interval of the difference				
	Mean	Standard deviation	Standard error mean	Lower	Upper	t	df	Significance (2-tailed)
Pretest-posttest	-3.077	4.092	1.135	-5.550	-.604	-2.711	12	.019

Table 12: Paired t-test for the Aural Study Group without Perfect Pretest Scores

	Paired Differences							
				95% Confidence interval of the difference				
	Mean	Standard deviation	Standard error mean	Lower	Upper	t	df	Significance (2-tailed)
Pretest-posttest	-2.444	3.240	.764	-4.056	-.833	-3.201	17	.005

Table 13: Paired t-test for the Kinesthetic Study Group without Perfect Pretest Scores

	Paired differences							
				95% Confidence Interval of the Difference				
	Mean	Standard Deviation	Standard Error Mean	Lower	Upper	t	df	Significance (2-tailed)
Pretest-Posttest	-2.417	2.353	.679	-3.912	-.921	-3.557	11	.004

Table 14: ANOVA for all Learning Styles and Control Group Data without Perfect Pretest Scores

	Sum of squares	df	Mean square	F	Significance
Between groups	33.924	4	8.481	.867	.490
Within groups	528.211	54	9.782		
Total	562.136	58			

Table 15: ANOVA for Study and Control Group Without Perfect Pretest Scores

	Sum of squares	df	Mean square	F	Significance
Between groups	7.929	1	7.929	.816	.370
Within groups	554.206	57	9.723		
Total	562.136	58			

Table 16: ANOVA for Study Groups without Control Group without Perfect Pretest Scores

	Sum of squares	df	Mean square	F	Significance
Between groups	25.995	3	8.665	.789	.507
Within groups	483.484	44	10.988		
Total	509.479	47			

Results

Based on paired t-tests, the data analysis results verified that if participants received an educational intervention that was adjusted to meet appropriate learning style needs, they would perform differently, either better or worse, on posttest than the performance of the comparison group, who received a standardized health literacy educational intervention. The findings indicated that there was a statistically significant difference between pre and posttest scores for participants in the study group in comparison to the control group. Additionally, according to results of ANOVA, there was no statistically significant difference among different learning styles. T-tests on the full data set did not reflect any significant differences among learning styles. However, when the participants with perfect pretest scores were removed, the kinesthetic learning style was found to have a statistically significant difference, the aural group had a P value of 0.005, which may be considered to be borderline statistically significant, and the other two groups were not found to have statistically significant differences.

Comment

Patient education is commonly provided in terms that are inconsistent with literacy levels and without regard to health literacy levels.[19] Additionally, healthcare professionals do not use terms that are well-understood by laypersons, which may result in miscommunication of educational information.[19] The ability of healthcare professionals to impact patient comprehension is greater if the healthcare professionals are insightful regarding the level of health literacy, cognitive ability, and self-efficacy of the patient.[20] If educational models are applied to patient education, it will increase effectiveness and remove barriers.[21] This study provided further contributions to the development of patient education effectiveness through incorporation of health literacy needs and education-focused learning style needs.

This study was limited to the target population of Central Illinois, so it is important to recognize the fact that this was only a small representative sample. Future studies are recommended to increase the scope and evaluate the role of gender and level of education on outcomes, as these variables may have had an unrealized impact. Other aspects of the study that warrants further examination are the tools used for measurement of health literacy and learning style determination.

Healthy People 2020 has an objective to improve the health literacy of the population.[22] Social change potential related to this objective may be significant for the population If individuals are able to be impacted by improved effectiveness of health literacy education. Since this study analysis identified a need to adjust health literacy education to meet learning style needs, increased effectiveness may be appreciated by healthcare providers and public health educators if educational materials are developed in a manner that may allow delivery accordingto learning style.

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