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Azize EL Ghouati AWEJ, *Arab Society of English Language Studies*

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Azize EL Ghouati

Department of English Studies, School of Arts and Humanities
Ibn Tofail University of Kenitra, Morocco

Abstract

The aim of the study is fourfold: to examine the nature of relationship between visual learning style (VLS), auditory learning style (ALS), kinesthetic learning style (KLS), and read/write learning style (R/WLS) and students' English achievement (EA) in technology-based learning environment among Moroccan university students. The present study adopts a quantitative research design. Therefore, the main instruments are questionnaires, and English achievement tests. Both the questionnaires and language tests are analyzed and interpreted quantitatively. The reliability of the questionnaire sections and scales as well as tests constructs matches the criterion for acceptable internal consistencies ($\alpha=70$). The statistical tools used in order to help analyze and interpret data include descriptive and inferential statistics which make use of frequencies, percentage, and Correlation tests. Following what has been hypothesized; the test results do not support the four research hypotheses claiming there is no statistically significant relationship between the VLS, ALS, KLS, and R/WLS and students' level of EA. The findings of the present study highlight some implications to improve students' achievement in English with the help of e-learning style preference.

Keywords: computer-based learning, educational technology, English achievement, learning styles, sensory modality, VARK strategies

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1. Introduction

Technology has become a significant means for the uplifting of educational quality. It has expanded globally and rapidly over the years to the extent that millions of university students are using it (Colley & Matlby, 2008). In Morocco, like any other parts of the world, the government has been an enthusiastic supporter of educational technology (El-Mandjra, 2001). Researchers (Parson, 1998; Alexander & McKenzie, 1998) pinpoint that while implementing the new technology into the process of teaching and learning, educators stress the paramount importance of assessing how this new technology can influence learning. Patently, exploring students' learning style preference, namely visual learning style (VLS), auditory learning style (ALS), kinesthetic learning style (KLS), and read/write learning style (R/WLS) in technology-based learning helps teachers understand how students learn in different ways. In such types of learning, information and communication technology (ICT) is considered as the glue that binds the learning achievement.

2. Related Review of Literature

It has been acknowledged that students have no single learning style, and there is no style more or less effective than the other. Therefore, if students are aware of their preferred learning styles, they would then be more able to acknowledge their learning strengths and weaknesses. According to researchers (e.g., Wynd & Bozman, 1996; Graf, Kinshuk., Chen & Yang, 2009; Lightner, Doggett & Whisler, 2010), the ultimate goal of identifying students' learning styles is that a "one size fits all" learning style does not cater for learner's unique differences in processing information. Admittedly, this may inhibit effectiveness in learning (Wynd & Bozman, 1996). Specifically, identifying students' learning styles is advantageous process. Therefore, it (a) provides instructors with more information about their learners, particularly the ways in which they retain and process information, (b) helps teachers spot learners' problems, and (c) enhances learners themselves to be aware of their strengths, and weaknesses in the learning (Graf *et al.*, 2009).

Given the fact that ICT has increased rapidly in the field of education, learners are now gaining more knowledge employing other educational technology forms in their learning approach. Knowingly, learning styles have been evidenced to play an influential role in students' reactions to ICT-based programs (Childress & Overbaugh, 2001). According to Battalio (2009), students' learning styles are closely related to high academic achievement in ICT-based learning contexts. The results "have shown significant associations between students' learning styles and success in distance education, and offer insight into the relationship between learning style and mode of delivery" (p. 83). In the same token, Lightner *et al.* (2010) also state that learners in ICT-enhanced learning must be capable of dealing with difficult learning situations because they are required to make immediate decisions. Hence, learning styles are significant for measuring, and predicting good achievement in such a context. For the same reasons, Topçu (2008) argues that, the teachers' "awareness of their students' learning styles and cultural context may be helpful to foster performance in web-based learning environments" (p. 916). Coole and Watts (2009) examined e-learning styles in computer-based learning, and propose the need for multiple learning styles modes for the purpose to cater for individuals' preferred learning styles, and therefore gain more proficiency in English.

3. Research Methodology

The present study primarily has the purposes to explore students' LS within a Moroccan institution of higher education, the Department of English Studies in Meknes. Inspired by the VARK learning style model (Fleming, 2006), the present study is designed to address the following hypotheses:

- **Research Hypothesis 1:** There is a significant relationship between VLS and students' achievement in English in ICT-based learning environment.
- **Research Hypothesis 2:** There is a significant relationship between the type of ALS and achievement in English among the participants.
- **Research Hypothesis 3:** There is a significant relationship between the type of KLS and students' achievement in English.
- **Research Hypothesis 4:** There is a significant relationship between EFL students' existing types of R/WLS adopted and their achievement in English.

The subjects of the present investigation are non-randomly sampled 81 respondents of Moroccan university students within the Department of English Studies, Meknes. They are targeted just because they are easier to recruit, and aware of their computer skills and learning style preference. The main instruments incorporated are questionnaires, and English achievement tests. Based on Fleming & Baume's (2007) model in the existing literature in the field of learning styles, the VARK learning style questionnaire is reported to be a sound, efficient and outstanding theoretical tool for examining e-learning style preferences among language learners. Therefore, the VARK learning style questionnaire (VARKLSQ) is used as a data collection tool to identify and assess students' learning styles in computer-based environment. Precisely, this measure consists of four dimensions: (a) visual learning style, (b) auditory learning style, (c) Kinesthetic learning style, and (d) read/write learning style.

Basically, the adapted English tests are administered as part of the present study. They are meant to collect data on English achievement (EA). Four constructed achievement tests are used: (a) listening, (b) reading, (c) writing, and (d) speaking.

To achieve the research purposes in terms of interpretation of the data obtained, two different types of data analysis are used. As a case in point, both the questionnaire and achievement tests are analyzed quantitatively using different statistical methods with the help of the Statistical Package for the IBM statistics program (SPSS). First, *Cronbach Alpha Coefficient* (α) is calculated to ensure the reliability of the questionnaire and test constructs. Descriptive statistics such as frequencies, means, and standard deviations are also calculated for all scales, statements and tests. Second, inferential statistics including *Correlation* tests are used to determine the strength of associations as well as the level of significance, the relationship between the two variables: Types of LS (IV) and EA dimensions (DV). For ordinal, and interval scales, *Spearman's rho Correlation* is commonly appropriate, and serves the purposes of the current research analysis. It ranges from -1 to +1, where the value $r = 0$ indicates an absence of correlation, the value $r = 1$ means a perfect positive correlation and the value $r = -1$ means a perfect negative correlation. In other words, the variables vary together in the same direction when there is a positive correlation. In a negative correlation, the

variables move in the opposite direction. A statistically significant correlation is shown by a probability *p-value* of less than 0.05.

4. Research Results

The Cronbach's reliability test for the LS scale is assessed by 20 items. The results of the Cronbach alpha range from the highest $\alpha=.74$ to the lowest reliability $\alpha=.70$, with the read/write scale demonstrating the highest reliability $\alpha=.74$, and the auditory scale representing the lowest. This is followed by both the visual and kinesthetic scales $\alpha=.71$. For the overall LS scale, the finding of the Cronbach alpha is $\alpha=.73$. Hence, the 20 items exhibit internally consistent measures of the four LS scales in this analysis. Worth noting is that the reliability evidence for all the four achievement test sections range from $\alpha=.69$ to $\alpha=.75$, with listening test section indicating the highest reliability $\alpha=.75$, and writing test section the lowest $\alpha=.69$. Reading, and speaking test sections have $\alpha=.71$ and $\alpha=.73$, respectively. The overall language test has an alpha coefficient of $\alpha=.67$ indicating, therefore, an acceptable internal consistency of the tests constructs.

4.1. The E-learning Style Questionnaire Section

The purpose of this section is to measure the e-learning style of 81 EFL students. The LS scale reflects students' *learning style* preference in ICT-based learning environments. The respondents are invited to choose from 1 to 5 points on a scale which ranges from "strongly disagree", one point, to "strongly agree", five points. The results shown, Table 1.1, refer to the number of responses to each of the five options of every item in the Likert.

Table 1.1: *Descriptive Statistics for each LS Scale: VLS, ALS, KLS, and R/WLS*

LS Scale	Minimum	Maximum	Mean	Standard Deviation
Visual Learning Style	5,00	19,00	14,4568	2,85504
Auditory Learning Style	5,00	20,00	14,0370	2,93873
Kinesthetic Learning Style	6,00	19,00	13,1111	3,02903
Read/Write Learning Style	4,00	20,00	12,3457	3,30968

Note: Number (N) of responses; $N = 81$; Scale Used: 1 = strongly disagree, 5=strongly agree.

As suggested by Table 1.1 the LS scale is designed to measure four LS dimensions: VLS, ALS, KLS, and R/WLS. The mean score of the VLS use among the participants is the highest with ($M=14.45$, $SD=2.85$). The mean score ($M=14.03$) which is scored by the same respondents concerning the use of ALS is rated the second with a spread of data around the mean ($SD=2.93$). However, the respondents' mean score on the KLS is ($M=13.11$, $SD=3.02$), followed by the lowest score for R/WLS ($M=12.34$, $SD=3.30$).

The choice of the two learning styles, VLS and ALS, indicated by the close mean scores is suggestive. That is, the participants prefer both "visual" and "auditory". However, the "kinesthetic", and "read/write" learning styles are used so often.

4.2. The English Achievement Tests

The total score of the English achievement tests in the present investigation is 40, ten out of ten for each of the four language skills: Listening, reading, writing, and speaking. As

suggested by Table 1.2, the achievement scores obtained through the English tests are grouped as the minimum (10.00), and maximum (32.50). The average mean scoring of the overall English achievement is identified as ($M= 22.11$) with ($SD= 5.16$). Specifically, the mean scores for the four language skills are reported in the following table:

Table 1.2: *Descriptive Statistics for English Achievement*

Descriptive Statistics				
Language Skills	Minimum	Maximum	Mean	Standard. Deviation
Listening (L)	2,00	10,00	5,9506	2,21304
Reading (R)	2,00	10,00	6,3210	2,15538
Writing (W)	2,00	8,00	4,9012	1,45220
Speaking (S)	2,00	7,00	4,9444	1,22729
Overall Achievement	10,00	32,50	22,1173	5,16313

The mean scores of the four language skills range from the lowest ($M=4.90$, $SD=1.45$) to the highest ($M=6.32$, $SD=2.15$). Overall, the highest mean score is reading ($M=6.32$, $SD=2.15$). This is followed by listening ($M=5.95$, $SD=2.21$), speaking ($M=4.94$, $SD=1.22$), and finally writing with ($M=4.90$, $SD=1.45$).

4.3. LS Relationship with EA

It has been hypothesized that there is a significant relationship between VLS score and EA score. However, the correlation analysis reveals that there is a weak, negative and non-significant correlation between VLS and both reading [$\rho(81) = -.049$, $p = .66$], and speaking [$\rho(81) = -.140$, $p = .21$]. In a dissimilar way, there is a weak positive correlation between VLS and both writing and listening which is statistically non-significant [$\rho(81) = .010$, $p = .93$]; [$\rho(81) = .007$; $p = .95$], respectively).

Table 1.3: *Correlations between VLS and EA*

Correlations			Visual Learning Style
Spearman's rho	Listening	Correlation Coefficient	,007
		Sig. (2-tailed)	,953
		N	81
	Reading	Correlation Coefficient	-,049
		Sig. (2-tailed)	,663
		N	81
	Writing	Correlation Coefficient	,010
		Sig. (2-tailed)	,932
		N	81
	Speaking	Correlation Coefficient	-,140
		Sig. (2-tailed)	,212
		N	81

Contrary to what we have hypothesized, the correlation between the two variables is statistically non-significant at Sig. (2-tailed) value, which is higher than the significance value $p=0.05$. Thus, we accept the null hypothesis, and conclude that the data do not support the research hypothesis that there is a significant relationship between VLS and EA.

For the Second research hypothesis, the Spearman's rank-order Correlation analysis is conducted to examine the strength of association (ρ), and level of significance (p -value) between ALS and EA. A further analysis of the Correlation test, Table 1.4, indicates that there is a negative, small non-significant correlation between ALS and both listening [$\rho(81) = -.119$, $p=.28$], and speaking [$\rho(81) = -.114$, $p=.31$]. However, the correlation is positive, small and statistically non-significant with reading [$\rho(81) = .153$, $p=.17$]; and positive, weak and non-significant with writing [$\rho(81) = .045$, $p=.68$].

Table 1.4: *Correlations between ALS and EA*

Correlations			Auditory Learning Style
Spearman's rho	Listening	Correlation Coefficient Sig. (2-tailed) N	-.119 ,289 100
	Reading	Correlation Coefficient Sig. (2-tailed) N	,153 ,174 100
	Writing	Correlation Coefficient Sig. (2-tailed) N	,045 ,689 100
	Speaking	Correlation Coefficient Sig. (2-tailed) N	-.114 ,310 100

If the p -value is larger than the theoretical value which is .05, the data do not give you any reason to conclude that the correlation is real. Therefore, we accept the null hypothesis, and conclude that the scores of students' ALS and EA are not significantly correlated. Admittedly, we have no compelling evidence that the non-significant correlation is due to chance.

For further analysis on the type of relationship between LS and EA, the Spearman's rank order Correlation test, Table 1.5, displays that there is a small, positive and non-significant correlation between KLS and reading score [$\rho(81) = .100$, $p=.37$]. However, it is weak, positive and non-significant with both writing [$\rho(81) = .068$, $p=.54$], and listening ($\rho(81) = .084$, $p=.45$), and weak, negative, and non-significant correlation with speaking [$\rho(81) = -.072$, $p=.52$].

Table 1.5: *Correlations between KLS and EP*

Correlations			Kinesthetic Learning Style
Spearman's rho	Listening	Correlation Coefficient Sig. (2-tailed) N	,084 ,456 81
	Reading	Correlation Coefficient Sig. (2-tailed) N	,100 ,374 81

Writing	Correlation Coefficient	,068
	Sig. (2-tailed)	,546
	N	81
Speaking	Correlation Coefficient	-,072
	Sig. (2-tailed)	,525
	N	81

Given the fact that the p -value is higher than the significance level ($p=0.05$), the correlation is not statistically significant and the two variables are not related. Therefore, we can accept the null hypothesis and conclude that the data do not support our research hypothesis.

To explore whether there is a significant relationship between R/WLS, and EA scores, a Spearman's Correlation test is run to address the fourth research hypothesis. The Spearman rank-order Correlation result, shown in Table 1.6, reveals that there is a weak, negative and non-significant correlation between 81 respondents' R/WLS score, and reading score [$\rho(81)=-.064$, $p=.57$], a very weak, negative and non-significant relationship with listening score [$\rho(81)=-.008$, $p=.94$], and a small negative non-significant relationship between R/WLS and speaking [$\rho(81)=-.205$, $p=.06$]. However, the relationship between R/WLS and writing is very weak, positive and non-significant [$\rho(81)=.014$, $p=.90$].

Table 1.6: *Correlations between R/WLS and EA Correlations*

			Read/Write Learning Style
Spearman's rho	Listening	Correlation Coefficient	-,008
		Sig. (2-tailed)	,942
		N	81
	Reading	Correlation Coefficient	-,064
		Sig. (2-tailed)	,571
		N	81
	Writing	Correlation Coefficient	,014
		Sig. (2-tailed)	,901
		N	81
	Speaking	Correlation Coefficient	-,205
		Sig. (2-tailed)	,066
		N	81

Therefore, these findings do not support the research hypothesis that respondents with higher R/WLS scores tend to have higher achievement scores. Otherwise, respondents with low scores in R/WLS would tend to have higher scores in their EA scores or the other way around. Hence, we accept the null hypothesis, and conclude that the two variables are not associated with each other.

5. Discussion of the Results

It has been discovered that the respondents within the Department of English Studies of Meknes prefer the visual and auditory learning style modes. As generally acknowledged, students have certain levels of preference in each type of learning style, and the majority of them have dominance in one or more styles of learning. This has been shown in the present study by

the mean scores of the visual and auditory learning styles indicating ($M=14.45$, $SD= 2.85$) and ($M=14.03$, $SD=2.93$), respectively. As a result, we can infer that most students possess multiple learning styles or a combination of learning styles. It is also suggestive when it comes to the general mean scores of the respondents' use of kinesthetic and read/write learning styles with ($M=13.11$, $SD=3.02$), and ($M=12.34$, $SD=3.30$). The results are in line with Halsne and Gatta (2002) who claim that online learners are predominantly visual and auditory learners. Obviously, preference for such learning styles seems to suit the very nature of ICT-based activities requiring students to read, and hear. Nonetheless, the efficiency of visual style could be influenced by cultural experiences or contexts given the fact that learning styles grow over time as a result of exposure to culturally driven practices.

In investigating the nature of relationship between visual learning style (VLS), and English achievement (EA) among the respondents, the findings of the Correlation analysis reveals that there is a non-significant correlation between VLS and listening, reading, writing, and speaking. Undoubtedly, for the sample of Moroccan university students, VLS is not a strong predictor of foreign language achievement. Simply put, the findings are in contradiction with other research findings (Ehrman & Oxford, 1995), reporting that academic achievement is related to students' learning styles. In their research, Kia, Alipour, and Ghaderi (2001) find that among their respondents, those with VLS have the greatest academic achievement. Possible explanations for these findings refer to the fact that students are taught in a way compatible with their learning style. Otherwise, the results are much related to the cultural context of the respondents.

The key findings that revolve around whether there exists any relationship between the types of auditory learning style (ALS) adopted and the respondents' level of English achievement (EA) concern Research Hypothesis 2. To be more precise, Moroccan students learn best when information is presented aurally, and educational technology can serve this learner' style. Though most information is not presented aurally, students' participation and collaboration are accomplished well in technology-based learning. However, the Correlation test value displays a non-significant relationship between ALS and listening, reading, writing, and speaking. This is further confirmed by a study of Asian international students whose general academic performance is not related to their learning style preference when the primary mode of instruction in their courses is auditory (Ladd & Ruby, 1999). On the other hand, Carbo (1983) explores the perceptual learning styles of readers, and concludes that high reading achievers prefer to learn through their auditory senses, while poor readers have a stronger preference for other learning styles. This could be explained by the fact that culture is a strong determining factor influencing students' preferred learning styles.

Though the kinesthetic learner learns best by doing, it is quite difficult to sit still for long periods of time. Unlike the VLS and ALS, the respondents of the present study do not largely depend on processing information via kinesthetic mode as they study on their computers. The findings of the Spearman's rank order Correlation test also shows that there exists a non-significant correlation between the type of KLS and listening, reading, writing, and speaking scores. These findings are in contradiction with Carbo's (1983) study which examines the learning styles of readers. The results of the study reveal that poor readers have a stronger preference for tactile and kinesthetic learning style. This could be explained by the fact that

preference for KLS seems to be culture-specific, and fits the very nature of web-based activities requiring students to practice hands-on tasks.

Different from VLS, and ALS, read/write learners do not depend extensively on reading e-materials, and written e-notes. Unfortunately, e-notes often do not capture the same information that a student is taught at class. The findings also reveal a non-significant relationship between R/WLS score and listening, reading, writing, and speaking. Differently, Rakap (2010) investigates the impact of learning style variable on learners' achievement in a web-based education. The findings reveal that students with read/write learning preference exhibit the highest level of success in the test scores ($M=55.133$, $SD=6.151$).

6. Conclusion

The ultimate purposes of the present investigation are to examine the nature of relationship between the four independent variables: VLS, ALS, KLS, R/WLS and respondents' level of EA in ICT-based environment. By addressing our research hypotheses, there is no statistically significant relationship between the four types of LS, and EA as reflected in the four-skill scores. The present study is an attempt to explain and make a better use of respondents' existing types of LS preference and fix any flaws affecting their EA. Among its implications, top courseware designers and decision makers should devise courseware with considerable attention to students' learning styles, and the language skills being taught. Therefore, one way to identify students' e-learning style preference, and maximize their English attainment is through appropriate quantitative tools. Then, students should report and interpret their learning styles to fully understand what helps their learning so that they can learn with technology tools which best suit their learning style preference (Cutolo & Rochford, 2007). Finally, teachers/courseware designers should adopt a multiple teaching style approach to their pedagogy to foster positive learning outcome at different language levels among students (Smith & Dalton, 2005).

About the Author:

EL GHOUATI Azize is a teacher of English. He is also a Ph.D candidate in the Centre of Doctoral Studies, Ibn Tofail university of Kenitra. El Ghouati graduated from the School of Arts and Humanities with a BA in Linguistics, and MA in Language Acquisition and Research. His main research interests are in the areas of language learning, learning styles, and ICT.

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