The relationships between EFL student cognitive functioning, curriculum diversification, and ethnic culture differences[1]

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This study examines the relationship between student cognitive functioning and curriculum diversification, Arabic-speaking students' patterns of strategy use, and how Arab learners differ from other ethnic groups in their learning strategy use. The study made use of survey research (research strategy), standardized questionnaires (data collection method), and MANOVA (Lambda) and ANOVA (Scheffé) (data analysis techniques). Working with college EFL students, the results indicate a relationship between course diversification and student use of compensation (but not memory, cognitive, metacognitive, affective, and social) strategies in favour of the scientific track of study. Arab learners were frequent users of metacognitive and social strategies but moderate users of memory, cognitive, compensation, and affective strategies. Disagreement about establishing a relationship between ethnic culture and patterns of strategy use continue. The study casts serious doubt on unmediated deterministic relationships between ethnic culture and cognitive functioning. It recommends more recognition of influential cognitive factors, including curriculum designs, instructional strategies, strategy training, and individual differences as more decisive in learning strategy use than ethnicity. Clear identification of effective cognitive strategies can guide classroom-level and school-level curriculum developments and facilitate curriculum implementation.

1. Introduction

Despite having similar academic abilities, some learners significantly outperform their counterparts in academic achievement. Other learners give up within-ability cognitive enterprises and even courses. Concerns have therefore been voiced about the patterns of strategy use that influence student cognitive functioning and ultimately academic success. Learning strategies have long been a major factor for effective language learning in general, and English as foreign language learning (EFL) in particular since early 70s (Oxford, 1990a; Shawer, Gilmore & Banks-Joseph, 2009). For example, cognitive strategies enable students to process information, whereas metacognitive strategies enable them to plan, organise and monitor their learning (Cohen, 1998; O'Malley & Chamot, 1990; Oxford, 1989; Shawer, Gilmore & Banks-Joseph, 2008).

Practical concerns have been also expressed about the influence of different curriculum diversification programmes on student development and use of different learning strategies. Curriculum diversification concerns matching curriculum to different tracks of learning. For example,

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secondary education students can be diversified into a general, technical, or agricultural track of study (Pollard & Triggs, 1997; Saez &Carretero, 1998; Shawer, 2010). Further concerns pointed to the influence of ethnic culture on student cognitive functioning in terms of learning strategy use (Rahimi, Riazi & Saif, 2008). Some empirical research examined various variables, including motivation, proficiency, gender, age, language background, cognitive style, and methods of teaching (e.g., Abu Shmais, 2003; Chamot, Barnhardt, El-Dinary & Robbins, 1996). Other research has studied the relationships between ethnic culture and learning strategy use, but their findings contradicted each other (e.g., Hong-Nam & Leavell, 2007; Grainger, 1997; Qingquan, Chatupote & Teo, 2008).

Finding contradictions in previous research results, this study examined possible relationships between learning strategy use and ethnic culture. Because actual student records indicate that science track students outperform their counterparts in the humanities track in language performance, this study further examined possible relationships between curriculum diversification programmes and learning strategy use. It addressed these concerns through testing the following hypotheses:

1. There are no statistically significant differences at the 0.05 level of the mean scores between the four programmes of study (Arabic, Community Service, Biology, and Mathematics departments) in student use of memory, cognitive, compensation, metacognitive, affective, and social learning strategies.

2. There are statistically significant differences at the 0.05 level of the mean scores between EFL Arabic-speaking learners and learners from other ethnic backgrounds in their use of the six learning strategy types.

Because of insufficient research evidence to assume relationships between learning strategy use and curriculum diversification programmes, the first hypothesis was null; whereas the previous research findings contradictions about cultural stereotypes of learning strategy use required a two-tailed research hypothesis.

2. Conceptual Framework

To put this study into context, this section critically reviews the literature around the main research issues: cognitive styles, learning strategy use, cognitive functioning, curriculum diversification, and ethnic culture.

2.1 Cognitive styles, Learning Strategy Use, and Cognitive Functioning

Cognitive style concerns student 'preferred and habitual approach to *organising and representing* information' (Riding & Rayner, 1998, p. 15). When learning tasks contradict student congenital predispositions, they find difficulty in processing incompatible tasks because they do not possess the strategies that concur with their inborn cognitive processors (styles). For example, some students prefer to deal with words rather than numerals, because they possess innate verbal processors. When faced with abstract tasks, including numerals, they need to develop strategies that enable them to process mathematical tasks that they are not naturally equipped to handle. This causes some people to process comfortably verbal tasks while they have difficulty in processing numbers, and vice versa.

As such, cognitive style is the psychological make-up whereby learners process information in particular fixed ways rather than others, while learning strategies are the mental operations students employ to process tasks incompatible with their habitual style (Shawer, et al., 2008). Coordination between curriculum content and classroom instruction is therefore necessary in order to equip students

with learning strategies compatible with their habitual styles. If cognitive styles affect learning strategy use and ultimately cognitive processing, will different learning strategies influence cognitive functioning?

2.2 Learning Strategies and Cognitive Functioning

Learning strategies play a significant part in language processing and production in real-life communication and assist learners in processing, storing, and retrieving information (Brown, 1994; Chamot & Kupper, 1989). Students use cognitive strategies as 'steps or mental operations used in learning or problem-solving that require direct analysis, transformation, or synthesis of learning materials in order to store, retrieve and use knowledge' (Wenden, 1986, p. 10). Precisely, cognitive strategies are in action when students ask questions and check and revise (Riding & Rayner, 1998) in addition to making analogies, memorization, repetition, writing things down, self-testing, and making inferences (Hedge, 2000).

On the other hand, students use metacognitive strategies to plan, regulate, and monitor first-order cognition (Shawer, et al., 2008), being 'general skills through which learners manage, direct, regulate and guide their learning, i.e. planning, monitoring and evaluating' (Wenden, 1998, p. 519). Metacognitive operations therefore enable students to overview, pay attention, set goals and objectives, organise and self-monitor learning (Hedge, 2000), debrief discussions, and document progress through learning logs (Rasekh & Ranjbary, 2003). Communication strategies also play an important role in facilitating communication as 'techniques learners use when there is a gap between their knowledge of the language and their communicative intent' (Wenden, 1986, p. 10).

However, some learning strategies facilitate learning particular language skills and tasks better than others. Writing skill makes more use of planning, self-monitoring, deduction, and substitution, whereas speaking skill benefits more from risk-taking, paraphrasing, circumlocution, self-monitoring, and self-evaluation. By contrast, listening comprehension depends on strategies of elaboration, inference, selective attention, and self-monitoring. Moreover, reading comprehension better occurs through previewing, skimming, reading aloud, guessing, deduction, and summarizing.

Research found positive correlations between language improvement and strategy use (e.g., Chamot & Kupper, 1989; Cotterall & Murray, 2009; Hong-Nam & Leavell, 2007; Kasper, 1997; O'Malley & Chamot, 1990; Oxford, 1993; Rasekh & Ranjbary, 2003; Rossi-Le, 1989; Rubin & Thompson, 1994; Yu & Wang, 2009). If learning strategies influence the route and rate of cognitive processing, will diversification programmes of study determine strategy use?

2.3. Curriculum Diversification and Patterns of Strategy Use

Diversification involves a number of educational tracks of study (e.g., vocational and general secondary education) and curriculum designs for each track to offer secondary and university students in particular several study options from which they can choose a preferred career (Sifuna, 1992). Being so, it involves paying 'attention to the classroom with a heterogeneous group of students; attending to special needs students; and helping to produce curricular adaptations for the diversification programme' (Saez & Carretero, 1998, p. 727). Differentiation involves adapting a course to match specific student needs (Pollard & Triggs, 1997). However, diversification involves differentiation within tracks. For example, students can be diversified into science and humanities tracks in secondary education who can be differentiated according to ability into slow or fast learners (Oakes, Gamoran & Page, 1992; Saylor & Alexander, 1966).

Curriculum differentiation seeks to address different abilities by categorizing students according to *learning ability* into mentally retarded, slow, average, fast, and gifted. Moreover, differentiation could occur according to cultural or economic status by categorizing students into culturally- or economically-deprived. Students could be also grouped according to *overt behaviour* and *emotional stability* (problem learners) into pre-delinquent, delinquent, socially maladjusted, and emotionally disturbed (Saylor & Alexander, 1966). This study, however, is concerned only with examining the relationship between students' track of study (diversification) and their learning strategy use, by examining if different programmes of study imply certain patterns of information processing.

Previous research examined almost all possible factors that influence EFL learning strategy use. For example, high proficiency and motivation rather than gender influence student strategy use (Rahimi et al., 2008), whereas high graders outperform low graders in cognitive and metacognitive strategy use (Chen, 2009). Similarly, successful students outperform unsuccessful counterparts in metacognitive strategy use (Qingquan, et al., 2008). Moreover, monolinguals use compensation strategies most and affective strategies least, whereas bilinguals use metacognitive strategies most and memory strategies least (Hong-Nam & Leavell, 2007). In addition, tutored students make more use of metacognitive strategies, whereas non-tutored counterparts often use social strategies (Alptekin, 2007).

Despite such abundant research on strategy use, none seems to have investigated the impact on or relationship between curriculum diversification and patterns of learning strategy use. If a paucity of research exists on the relationship between curriculum diversification and patterns of strategy use, could it also be the case regarding ethnicity and patterns of strategy use?

2.4 Ethnic Culture and Cognitive Functioning

The debate over the influence of ethnic culture on cognitive functioning is far from agreement. Culture refers to accepted behaviour patterns a group of people share, which distinguish them as a particular race, ethnicity, religion, or social class (Savignon & Sysoyev, 2002). Some believe ethnic culture influences cognitive functioning and ultimately information processing (Hofstede, 1986; Oxford, 1990a; Watson-Raston, 2002). "There are, in every society, unstated assumptions about people and how they learn, which... invisibly guide whatever educational process may occur there" (Singleton, 1991, p. 120).

Previous research provides contradictory results about the influence of ethnic culture on learning strategy use. Some studies indicate that college EFL learners from certain ethnic backgrounds are predisposed to use certain strategies rather than others. For example, Eastern students tend to use traditional cognitive strategies of repetition and rote learning (O'Malley & Chamot, 1990; Politzer & McGroarty, 1985). Taiwanese and Japanese students are structured, analytical, memory-based, and do not favour social interaction (Rasekh & Ranjbary, 2003). Similarly, Chinese learners use memory and cognitive strategies more than metacognitive and other strategies (Peacock & Ho, 2003; Yu & Wang, 2009). However, recent research evidence challenged these results. Students of Eastern ethnicity used metacognitive strategies most and memory strategies least, including Chinese (Chang, 1991; Qingquan et al., 2008), Koreans (Hong-Nam & Leavell, 2007; Oh, 1992), and Iranians (Riazi & Rahimi, 2005; Rahimi et al., 2008).

Other studies report that European students outperform Eastern counterparts in use of higher-order strategies, such as metacognitive, social and affective (Grainger, 1997). Moreover, Americans were frequent metacognitive strategy users while low users of affective and memory strategies (Green, 1991). Again, other research challenged these findings. For example, Spanish

learners who are European tend to use traditional memory strategies (McGroarty, 1987), whereas French students are average users of cognitive and metacognitive strategies (Merrifield, 1996). Abu Shmais (2003) conducted a study that examined patterns of strategy use among EFL Arab students in Palestine. The findings indicate that metacognitive strategies were used most while compensation strategies were least used. If research findings disagree about the influence of ethnic culture on patterns of strategy use, can we find evidence that puts such influence to doubt? If so, what other factors influence learning strategy use?

2.5 Curriculum and Instruction, Ethnic Culture, and Cognitive Processing

Holliday (2005) and Palfreyman and Smith (2005) view with suspicion the attempt to establish deterministic relationships between ethnic culture and cognitive functioning. Alternatively, they indicate that influential factors, such as curriculum content, instructional strategies, strategy training, and individual differences (due to cognitive style and motivation), determine what strategies students tend to use, rather than ethnic culture.

Research seems to take their side. For example, Chinese EFL learners use memory and cognitive strategies more than other strategies due to teacher-centred instruction and information delivery. The study recommended moving classroom instruction culture away from fixed-type materials, such as textbooks, and toward multi-source and authentic curriculum materials. It also recommended a move from teacher-centred instruction and information delivery to communication-oriented and student-centred instruction in order to assist students in developing and using higher-order learning strategies (Yu & Wang, 2009). Coyle (2007) and Liggett (2008) reached similar results. In the light of the literature survey, the current study seeks to answer the following research questions:

1. To what extent are patterns of strategy use (memory, cognitive, compensation, metacognitive, affective and social) determined by course diversification (Arabic, Community Service, Biology, and Mathematics departments)?

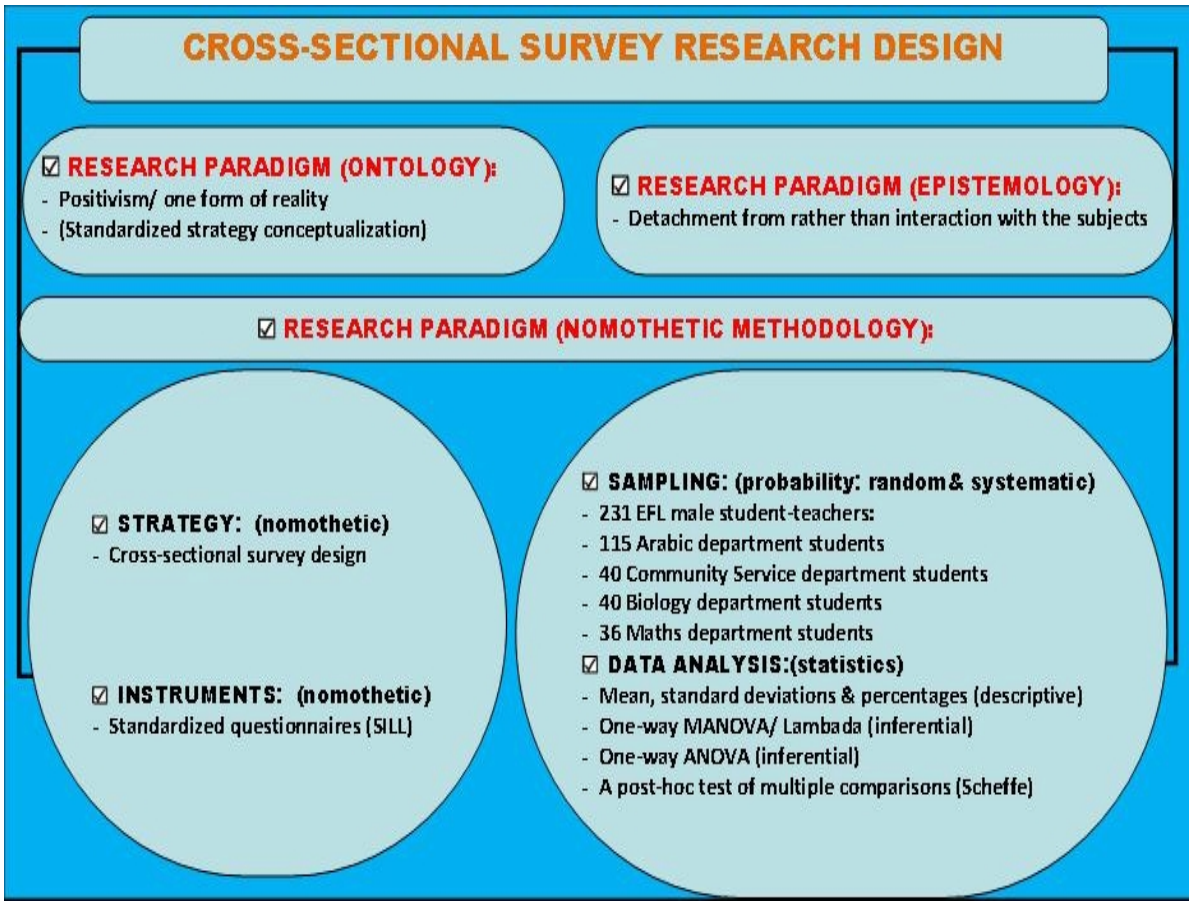
2. What language learning strategies do EFL Arabic-speaking learners tend to use?

3. To what extent do EFL Arabic-speaking learners differ from other ethnic learners in their learning strategy use?

3. Research Design

Figure 1 illustrates how this quantitative study used survey research to describe and interpret the *status quo* concerning the most frequently used learning strategies among the research subjects. A survey describes what is going on better than other research strategies. In particular, the study used a cross-sectional design to study different subjects at one point of time (Cohen, Manion & Morrison, 2000; Lester & Lester, 2010). Figure 1 also illustrates how the data were collected through standardized questionnaires and analyzed through descriptive statistical techniques, including percentages, means, and standard deviations. Inferential statistics were used to test mean differences for significance through one-way multivariate analysis of variance (MANOVA, Lambda) and simple analysis of variance (ANOVA), in addition to a *post-hoc* test of multiple comparisons (Scheffé) (Coakes & Steed, 2007).

Fig 1: Cross-sectional survey research design



3.1 Context and Sampling

The researcher officially taught the EFL compulsory university course to 290 first- and second-year students. The university provided the materials in the form of a coursebook. Teaching and testing revolved around reading, writing, grammar, and translation. By the end of the course, many students in group administration sessions voluntarily completed the Strategy Inventory for Language Learning (SILL) questionnaire in order to understand how they processed language learning. The researcher has not mentioned student names, in order to maintain anonymity, or revealed any other information about their identities in order to assure confidentiality (Burns, 2000; Burton, 2000; Lester & Lester, 2010). Teaching and data collection took place over a full semester.

The researcher drew four groups (samples) of 231 total from among the 290 first-year students from four departments—Arabic Language (115), Community Service (40), Biology (40), and Mathematics (36)—at Al-Azhar University in Cairo. The researcher opted for systematic random sampling in a number of steps. First, he received a list of names for each department arranged in alphabetical order. Second, he chose a sample size for each department based on the table of sample sizes in Cohen, et al. (2000, p. 94). For example, the Arabic Department population of 160 students required a sample of 115. Third, a frequency interval was chosen through the following formula:

F (frequency interval) = N (population) ÷ SN (required sample number).

With regard to the Arabic Language Department, the calculation was 160 (whole department) ÷ 115 (sample size) = 1.4 (rounded to the integer 1). For example, the researcher put a number that represented each name in a vessel to choose the starting number randomly. Student number 18 was randomly selected as the starting point from 160 students. Since the frequency interval was 1, the researcher picked name number 18, skipped 19, chose 20, skipped 21, selected 22, and so on until the 115 Arabic Language sample was populated. The researcher applied the same selection procedure to the remaining three departments. All students were males because the university imposed a single-sex education policy. Student ages ranged between 17 and 20.

3. 2 Instrumentation

The study examined patterns of strategy use among EFL Arabic-speaking learners through Oxford's (1990a) Strategy Inventory for Language Learning (SILL, version 7), as both a framework and data collection method. Ellis (1994) describes the SILL as the most comprehensive tool of its kind. The SILL has been tested in different contexts and languages for almost 18 years. It is a self-scoring, paper-and-pencil, Likert-scale inventory that requires subjects to self-report their frequency of strategy use on a scale from one to five. The SILL classifies strategy use frequency as follows:

Very high strategy use	Always or almost always used	4.5 – 5.0
High strategy use	Generally used	3.5 – 4.4
Medium strategy use	Sometimes used	2.5 – 3.4
Low strategy use	Generally not used	1.5 – 2.4
Very low strategy use	Never, almost never used	1.0 – 1.4

The SILL has been found to have a Cronbach's Alpha reliability between 0.93 and 0.98 (Ehrman & Oxford, 1990). It has been tested for social reliability and found to be free of cultural bias. Moreover, students tend to answer it honestly (Oxford, 1996). Oxford identified six learning strategy categories, totalling 50 items. The six categories are memory, mental processing (cognitive), compensation, organizing and evaluating (metacognitive), managing emotions (affective), and learning with others (social). The six categories comprise two groups—direct and indirect.

Direct strategies include memory, cognitive and compensatory. Memory strategies (9 items) deal with storing information into and retrieving it from memory. Cognitive strategies (14 items) are responsible for processing new information by incorporating it into existing schema. This involves operations of classification, analysis, revision, and synthesis of both new and existing information. Compensation strategies (6 items) are used when the learners feel a gap between their communicative intent and language knowledge. These include guessing, using gestures, describing difficult vocabulary, and switching to the mother tongue (Ehrman & Oxford, 1990).

Indirect strategies comprise metacognitive, social and affective strategies. Metacognitive strategies (9 items) are used for planning, organizing, monitoring, and evaluating learning tasks. Affective strategies (6 items) comprise the feelings, attitudes, and motivation that learners develop to decrease anxiety and internally motivate themselves to carry on learning. Social strategies (6 items) promote learning through interaction with others by asking questions and asking for clarification.

The survey instrument asks respondents to rate the frequency of their strategy use on a scale from one to five, with one indicating non- or rare use and five indicating all the time (Ehrman & Oxford

1990). The researcher translated the SILL into Arabic to avoid language problems. As highlighted below, the translation was field tested and checked for reliability and validity.

3.3 Validation, Reliability and Data Analysis Techniques

Although the SILL is an established valid instrument, four EFL professors examined the SILL content and agreed that it met the research purpose (Bloom, Fischer & Orme, 1995). Because the SILL had been translated into Arabic, the researcher rechecked it for reliability (i.e., internal consistency) to make sure that the wording had the same meaning across subjects.

Although split-half, Kuder-Richardson, and Alpha coefficients all measure internal consistency and require instruments to be administered only once, Kuder-Richardson and Alpha coefficients differ from split-half in that neither requires splitting an instrument into two sections. But, Kuder-Richardson is suitable only for dichotomous types of instruments (e.g., yes/ no questions), whereas the Alpha coefficient is suitable for scaled instruments where each item carries a different weight, as is the case in this research (Gall, Borg & Gall, 1996). The researcher used SPSS, version 14. The Cronbach's Alpha of the translated SILL was 0.86, which exceeds the threshold of 0.80 set by Gall, et al. Reliability for this questionnaire was calculated from a sample of 40 students.

One-way MANOVA examined the differences between sets of means of six dependent variables. The assumptions that underpin the use of MANOVA were met. For example, the size of each cell was greater than the number of dependent variables. In addition, homogeneity, univariate and multivariate normality and linear relationships among all pairs of dependent variables were addressed (see section 4.1). Based on the MANOVA significant F-ratio, one-way analysis of variance (ANOVA) was used to find out which levels of the four independent variables (groups) were significantly different on each of the six dependent variables. For this purpose, the *post-hoc* Scheffé test of multiple comparisons was used. Assumptions of population normality and homogeneity of variance that underpin the use of ANOVA were maintained through data screening before conducting the analysis (see section 4.2). Descriptive statistics, including percentages, were also used to determine the patterns of strategy use.

4. Results

Data analysis is presented in three sections. Each section addresses one research question and describes the test of the hypothesis posed for answering it.

4.1 Course diversification and cognitive functioning (strategy use)

This section addresses this first research question: *To what extent are patterns of learning strategy use (memory, cognitive, compensation, metacognitive, affective and social) determined by course diversification (Arabic, Community Service, Biology, and Mathematics departments)?* Table 1 shows that the MANOVA homogeneity of variance was established, since the Box's M test was not significant at .001 (Coakes & Steed, 2007). Table 1 also indicates that homogeneity of variance for each of the dependent measures was not violated apart from a marginal value of the *cognitive* variable ($p = .05$). The univariate Levene's test of homogeneity of variance was not significant for the remaining five dependent variables ($p \geq .05$). Therefore, the null hypothesis assuming group equality of variance was accepted apart from the cognitive variable. Table 2 indicates that a number of multivariate/ MANOVA tests of significance (Pillai's Trace, Wilks' Lambda, Hotelling's Trace, and Roy's Largest Root) were all significant ($p \leq .05$). This indicated a multivariate relationship between course diversification across the four groups and student use of the six categories.

Table 1. Box's M equality of covariance matrices and Levene's equality of error variances tests.

Box's M test (MANOVA)		
Box's M	F	Sig.
93.925	1.399	.020

Levene's Test (ANOVA)				
Strategy	F	df1	df2	Sig.
memory	0.094	3	226	0.964
cognitive	2.643	3	226	0.05
compensation	0.561	3	226	0.642
meta-cognitive	0.257	3	226	0.857
affective	0.587	3	226	0.624
social	1.872	3	226	0.135

According to Gall, et al. (1996), the researcher used ANOVA because the MANOVA F-ratio was significant in order to find out which diversification tracks were significantly different on each of the six variables. As shown in table 1, ANOVA homogeneity assumptions were not violated since Levene's test was not significant for the six dependent variables ($p \geq .05$) apart from one (*cognitive*: $p = .05$). Furthermore, population normality was not violated either since the four groups were drawn from a normally distributed population. The four groups showed no skewness or kurtosis as both approached zero. Using a Kolmogorov-Smirnov statistic with a Lilliefors significance level resulted in a significance greater than .05, which assumed normality.

Table 2. MANOVA/ Multivariate Tests.

Effect		Value	F	Hypoth-esis df	Error df	Sig.
Intercept	Pillai's Trace	.970	1176.222(a)	6	221	.000
	Wilks' Lambda	.030	1176.222(a)	6	221	.000
	Hotelling's Trace	31.934	1176.222(a)	6	221	.000
	Roy's Largest Root	31.934	1176.222(a)	6	221	.000
Group	Pillai's Trace	.197	2.616	18	669	.000
	Wilks' Lambda	.807	2.736	18	626	.000
	Hotelling's Trace	.234	2.852	18	659	.000
	Roy's Largest Root	.208	7.734(b)	6	223	.000

a. Exact statistic
b. The statistic is an upper bound on F that yields a lower bound on the significance level.
c. Design: Intercept + Group

As shown in table 3, the ANOVA F-ratios for the *memory*, *cognitive*, *metacognitive*, *affective,* and *social* (but not *compensation*) dependent variables were not significant ($p \geq .05$). Given these F-ratios, the null hypothesis stating equal *memory*, *cognitive*, *metacognitive*, *affective*, and *social* strategy use across the four groups was accepted. This indicated that students in the humanities track of study (Arabic and Community Service) did not differ in their strategy use from the scientific track

(Biology and Mathematics). Nor did it indicate differences in strategy use within both tracks. In other words, programme diversification did not result in differences between the humanities and scientific tracks in student use of *memory*, *cognitive*, *metacognitive*, *affective,* and *social strategies*. Moreover, all students who shared the same programme (department) were also similar in their use of these strategies.

In contrast, the ANOVA F-ratios of the *compensation* strategies variable were significant ($p \leq .05$). This provided evidence to accept the alternative hypothesis indicating differences between the four groups in their use of compensation strategies. The possible differences between the four groups on this dependent variable (compensation) were then examined via the Scheffé post-hoc test to determine where the differences lie and the direction of differences. It should be noted that there was no need to make post-hoc multiple comparisons for the other five dependent variables (*memory*, *cognitive*, *metacognitive*, *affective,* and *social strategies*) because ANOVA values were not significant. Post-hoc multiple comparisons are used only to determine the direction of differences. In these five dependent variables' case, there were no differences in the first instance to determine in favour of which one.

Table 3. ANOVA F-ratios.

		Sum of squares	df	Mean Square	F	Sig.
Memory	Between Groups	106.716	3	35.572	1.32	0.27
	Within Groups	6072.866	226	26.871		
Cognitive	Between Groups	500.749	3	166.916	2.51	0.1
	Within Groups	15010.834	226	66.42		
Compensation	Between Groups	280.17	3	93.39	6.52	0
	Within Groups	3235.674	226	14.317		
Meta-cognitive	Between Groups	24.419	3	8.14	0.16	0.92
	Within Groups	11485.412	226	50.82		
Affective	Between Groups	85.821	3	28.607	1.84	0.14
	Within Groups	3522.771	226	15.587		
Social	Between Groups	84.107	3	28.036	1.208	.308
	Within Groups	5246.193	226	23.213		

Table 4 shows significant F-ratios of *compensation* strategies (dependent variable) ($p \leq .05$) between the four groups as follows:

- Arabic (group 1) and Biology (group 3) in favour of Biology students
- Community Service (group 2) and Biology (group 3) in favour of Biology students

- Community Service (group 2) and Mathematics (group 4) in favour of Mathematics students

Given these significant F-ratios, the null hypothesis indicating equal use of compensation strategies across the four groups was rejected. The alternative hypothesis that indicated differences in the use of compensation strategies between these groups was therefore accepted. This finding showed that students who followed a humanities track (Arabic and Community Service) used compensation strategies less than their counterparts who followed a scientific track (Biology and Mathematics).

Table 4. Scheffé multiple comparisons between four groups on compensation strategy use.

Dependent Variable	(I) group		(J) group	Mean Difference (I-J)	Standard Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
compensation	1	=	2	0.93913	0.69457	0.61	-1.0172	2.8955
	1	<	3	-2.11087*	0.69457	0.03	-4.0672	-0.1545
	1	=	4	-1.86087	0.73045	0.09	-3.9183	0.1966
	2	=	1	-0.9391	0.69457	0.61	-2.8955	1.0172
	2	<	3	-3.05000*	0.84608	0	-5.4331	-0.6669
	2	<	4	-2.80000*	0.87578	0.02	-5.2668	-0.3332
	3	>	1	2.11087*	0.69457	0.03	0.1545	4.0672
	3	>	2	3.05000*	0.84608	0	0.6669	5.4331
	3	=	4	0.25	0.87578	0.994	-2.2168	2.7168
	4	=	1	1.86087	0.73045	0.09	-0.1966	3.9183
	4	>	2	2.80000*	0.87578	0.02	0.3332	5.2668
	4	=	3	-0.25	0.87578	0.994	-2.7168	2.2168

On the other hand, the results showed no differences in compensation strategy use between students of the same track as follows:

- No differences in compensation strategy use between Arabic (group 1) and Community Service (group 2) (humanities track)
- No differences in compensation strategy use between Biology (group 3) and Mathematics (group 4) (science track)

This meant that same track students used almost the same compensation strategies. In other words, students who join a science track tend to make more use of compensation strategies whereas those who join a humanities track tend to make little use of compensation strategies. Although differences were found generally between the humanities track and science track in favour of the

science track, no significant F-ratio ($p \geq .05$) was found between the Arabic department (a humanities track) and Mathematics department (a science track) in their use of compensation strategies.

4.2 Patterns of Learning Strategy Use

This section addresses this second research question: *What language learning strategies do EFL Arabic-speaking learners tend to use?* Table 5 indicates that Arab students were upper-intermediate users of *metacognitive* and *social* strategies (64 %) whereas being intermediate users of *compensation*, *cognitive*, *memory*, and *affective* strategies (59 %, 56 %, 55 %, and 54 % respectively).

Table 5. Strategy use frequency levels.

Strategy	N	Items	Lower Limit	Upper Limit	Sum	%	Mean	Rank	Frequency Use
Metacognitive	230	9	2070	10350	6597	64	39	1	Upper-intermediate
Social		6	1380	6900	4439	64	29	1	Upper-intermediate
Compensation		6	1380	6900	4054	59	25	2	Intermediate
Cognitive		14	3220	16100	9014	56	19	3	Intermediate
Memory		9	2070	10350	5706	55	18	4	Intermediate
Affective		6	1380	6900	3698	54	16	5	Intermediate

These results clearly indicated that Arabic-speaking learners tend to use almost all the six strategies at a moderate level in their attempt to learn English. However, the results showed that these learners tend to favour metacognitive and social strategies most. The third research question was answered by comparing this study's empirical findings in this section (4.2) with those of related, prior research studies in section 5 (Discussion).

5. Discussion

The current study examines the relationship between curriculum diversification and student cognitive functioning (through learning strategy use), patterns of strategy use that EFL Arab learners tend to use, and the differences between ethnic cultures in learning strategy use. Sections 5.1, 5.2, and 5.3, respectively, discuss these issues.

5.1 Curriculum Diversification and Student Cognitive Functioning

The results provide two answers to the first research question. Course diversification did not result in differences between or within the two tracks (four groups) in their use of memory, cognitive, metacognitive, affective, and social (but not *compensation*) strategies. The results, however, revealed differences between the humanities and science tracks in favour of the science track in *compensation* strategy use and that such differences were between the two tracks rather than between or within the groups of each track.

A very surprising finding was that no differences were found between the Arabic Department (humanities track) and Mathematics Department (science track) in their use of compensation strategies. Since there were differences between the humanities and science tracks in favour of the latter, the researcher also expected to find differences between the two groups in the humanities track and their counterpart groups in the science track in favour of each group in the science track, but this was not the case. The study could not provide explanations for this lack of difference between these two particular groups (Arabic and Mathematics).

5.2 Patterns of Learning Strategy Use

The findings indicate that Arab learners are upper-intermediate users of metacognitive and social strategies, while intermediate users of *compensation, cognitive, memory*, and *affective* strategies (second research question). These results concur to some extent with Abu Shmais's (2003) study that found EFL Arab learners in Palestine to be high users of metacognitive strategies, upper-intermediate users of social, affective, cognitive, and memory strategies, while low users of compensation strategies.

These findings probably indicate that Arab learners seem to be effective language learners, due to using metacognitive strategies most, since previous research indicated that frequent users of metacognitive strategies academically outperform users of traditional strategies (e.g., Cotterall & Murray, 2009; Kasper, 1997; Oxford, 1990b; Qingquan et al., 2008). This study can not explain why the research sample tended to favour metacognitive strategies. It, however, ruled out the impact of strategy training since none of the students trained in using metacognitive strategies.

5.3 Differences between Ethnic Culture in Cognitive Functioning

The influence of ethnic culture on student cognitive functioning yields inconclusive results (the third research question). Addressing this issue required comparisons between the second research question findings and those of previous research. The current study's findings indicate that Arab learners were upper-intermediate users of metacognitive and social strategies, while intermediate users of *compensation, cognitive, memory*, and *affective* strategies. The question here is: do all Arab students use higher-order cognitive functioning (e.g., metacognitive) strategies?

Although the current study's findings agree with Abu Shmais's (2003) conclusions about Arab students, research is far from linking strategy use to ethnic culture for several reasons. For example, Abu Shmais found that Arab students use compensation strategies least, whereas students in the current study are moderate users of compensation strategies. This means that though they are similar in metacognitive strategy use, they differ in compensation strategy use. Moreover, previous research was also far from agreement. For example, Eastern learners were frequent users of lower-order (memory) strategies (O'Malley & Chamot, 1990; Peacock & Ho, 2003; Politzer & McGroarty, 1985; Rasekh & Ranjbary, 2003; Yu & Wang, 2009). Although Arab students are Eastern, they favour metacognitive and social strategies, emphasizing the planning, monitoring and evaluation of learning.

On the other hand, Spanish students, who are European, are also frequent users of lower-order (memory) strategies (McGroarty, 1987). Moreover, French students are just average users of cognitive and metacognitive strategies (Merrifield, 1996). This contradicts Grainger's (1997) conclusion that European students outperform their Eastern counterparts in higher-order strategy use. The current research findings therefore concur with those studies indicating that students from Eastern ethnicities use metacognitive strategies most, while employing memory strategies least, including Chinese (Chang, 1991; Qingquan, et al., 2008), Koreans (Hong-Nam & Leavell, 2007; Oh, 1992), and Iranians

(Riazi & Rahimi, 2005; Rahimi, et al. 2008). On the other hand, this study's results, as well as those of, for example, McGroarty (1987), Qingquan, et al. (2008), and Rahimi, et al. (2008), contradict those of Grainger's and other studies that point to cultural strategy use stereotypes.

Therefore, the current study's null hypothesis (no differences between cultural groups in strategy use) is accepted because the differences between ethnicities are contradictory. This study can neither explain why Arab learners use metacognitive strategies most nor why they differ from other cultural groups because learners from both Eastern and Western ethnicities use almost the same higher-order (metacognitive) and lower-order (memory) learning strategies. Such dissonance in research findings indicates a need for further research. The current study's results cast serious doubts on the assumption of an unmediated deterministic relationship between national/ethnic culture and cognitive functioning, which previous research supported (e.g., Coyle, 2007; Liggett, 2008; Yu & Wang, 2009). Moreover, some (e.g., Holliday, 2005; Palfreyman & Smith, 2005) view with deep suspicion any attempts to establish such a deterministic relationship.

6. Conclusions

This study suggests that course diversification rarely influences EFL learners' patterns of strategy use with regard to memory, cognitive, metacognitive, affective, and social strategies. In contrast, students in scientifically diversified courses use compensation strategies more than students in humanities programmes. EFL Arab learners are frequent users of metacognitive and social strategies while moderate users of other strategies. This study also indicates no relationship between ethnicity and patterns of strategy use.

7. Practical Implications for Curriculum and Instruction and Future Research

More recognition should be given to complex and diverse influences of particular educational experiences than ethnic culture stereotypes. Issues of curriculum design, instructional strategy, strategy training, and individual differences (due to cognitive style and motivation) can better determine what strategies students develop and use. By structuring instruction in particular ways, we can help students to develop particular strategies. As research has shown (e.g., Coyle, 2007; Liggett, 2008; Yu & Wang, 2009), lower-order cognitive functioning results mainly from curriculum and instruction contexts. For example, memory strategies develop as a result of teacher-centred and information delivery instruction and the use of fixed-type materials, such as textbooks. By moving instruction to communication-oriented and student-centred instruction, students can develop and use higher-order learning strategies.

When students and teachers co-construct learning, effective learning strategies develop and form a classroom rather than an ethnic culture. This was one of the reasons behind the current study's examination of curriculum diversification influence on student cognitive functioning. Future research should therefore examine the influence of course materials, teaching strategies, and assessment types and tools in order to spot what and why certain strategies are used rather than others. For example, the focus of instruction on and assessment of lower levels of thinking, such as knowledge retention (remembering), would result in development and use of lower-order learning strategies, whereas a course focussing on higher-order thinking, such as evaluation (evaluating) and synthesis (creating) would result in development and use of higher-order learning strategies.

Concluding causal relationships between particular strategy use and improved performance between and within ethnic groups, genders, subjects, and diversified tracks of study can guide future

curriculum developments and facilitate curriculum implementation (instruction). Since no study, this researcher has found, has examined curriculum diversification's influence on strategy use, future research is needed to confirm the current findings. Although the current research findings do not support any relationship between ethnic culture and patterns of strategy use, there is a need for further research to examine the relationship between ethnicity and patterns of learning strategy use. Future comparative studies with null or two-tailed hypotheses can clear the dissonance among previous research findings. Learning strategy use should be measured through think-aloud and performance measures rather than self-reporting ones in order to avoid false reporting and misrepresentations. In addition, mixed research paradigms (quantitative and qualitative), strategies, and instruments may enrich understanding.

8. Caveats and Limitations

Any generalization from the current study's results to other contexts, including Arab contexts, should be met with caution, however, since the research sample was meant to represent a single institution. The subjects in this study were all males, therefore these results may not be applicable to mixed gender contexts. Strategy use was measured through self-reporting measures, which opens the door to possible false reporting or misrepresentations. This quantitative study collected data without giving the subjects an opportunity to explain or justify their responses. As a result, qualitative studies might provide different evidence. In addition, the study used a single data collection instrument which also suggests caution when looking at the results.

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