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From Arabic to English Handwriting: Performance Levels, Cognitive and Behavioral Characteristics among Arabic-Native Students: An Assessment Based on College Students' Archival Scripts

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Abstract

A substantial body of literature suggests a significant relationship between handwriting characteristics and poor performance, though not all poor handwriting implies learning difficulties. This descriptive study scrutinized the archival scripts of 519 Arab college students whose language of instruction was English to find common characteristics among low-achieving students whose handwriting deviates from the English-Roman alphabet. Two protocols were utilized to further select participants who met all the criteria that encompassed: Protocol I: (1) The presence of non-English/Roman alphabet in text, (2) the raters' difficulty in reading student's essay, (3) low grades on multiple choice and essay questions. Twenty-three student scripts passed the criteria and were included, suggesting 4.43% of all scripts. A second inspection protocol was proposed to detect the included students' scripts deeply and reveal further possible discrepancies. Protocol II: (1) The number of crossings-out (note quality), (2) cognitive or behavioral related difficulties, (3) unusual/nonstandard practice and or production (in the essay). Four scripts (.78%) were finally retained and included that met all criteria. Detailed descriptions of students' handwriting differences are provided, and suggestions are made to help students before their higher education journeys.

Key words: Arabic to English handwriting, Cognitive,archival scripts

Cognitive Impairments and Handwriting Associations

Handwriting has been often associated with poor abilities among people diagnosed with mental deficiencies. In this regard, a substantial body of research including experimental studies (Cilia et al., 2018) has investigated handwriting variations as possible analytics for intellectual disabilities such as attention deficit hyperactivity disorder (ADHD). The results of several studies revealed the measurement of handwriting as a potent predictor of ADHD and its related learning disabilities (ADHD-LD) (Li-Tsang et al., 2018; Borella et al., 2011; Brossard-Racine et al., 2015). Findings suggested that analyzing student handwriting could help as a means for specialists in the field to differentiate between ADHD and ADHD-LD among individuals ahead of proper diagnosis.

It was further argued that Child learners who display precise learning disabilities regularly face problems with handwriting and spelling (Bray et al., 2021). For example, it was documented that qualitative aspects of fine motor skills, sensory processing, and perceptual abilities echo the development and maturity of the central nervous system, suggesting that these mentioned factors are crucial for the early diagnosis of developmental disabilities to prevent succeeding academic obstacles, such as difficulties in handwriting achievement (Coppede et al., 2012).

In the same vein, the results in Li-Tsang et al., (2018) demonstrated high prediction rates with strong sensitivities, specificities, and positive predictive values (PPVs). These assessments of Chinese student handwriting proved to be more effective than those of English for distinguishing ADHD and ADHD-LD from typically developing peers. Participant students who had ADHD showed similar writing times and speeds compared to their peers, yet their handwriting was less legible. Equally, participant students who had ADHD-LD revealed slower writing speeds in both Chinese and English languages, with greater inconsistency in speed and pen pressure compared to control groups. Propositions were made for health providers to distinguish the differences between these disorders and include handwriting assessments as a reference for effective therapeutic strategies.

Based on the paramount role of handwriting in learning, it is useful to assess it to get insights into the manifestations of ADHD given that an increasing number of student learners are diagnosed with ADHD who face handwriting challenges. A study revealed that about 70% of these students show handwriting impairments (Brossard-Racine et al., 2015). Previous studies have recognized that handwriting difficulties among learners who have ADHD are regularly manifested by speedy, well-organized actions that affect quality and legibility (Racine et al., 2008). It has been suggested that these people with difficulties could exhibit more hyperkinetic, efficient movements when writing, which can result in quicker yet less precise writing (Langmaid et al., 2014). The literature also suggests that not all uncommon handwriting styles are associated with Mental disabilities.

Handwriting and Academic Performance

Research findings revealed that better note quality was associated with faster writing, quicker reaction times, and more attention. Handwriting speed appeared as the strongest predictor of note-taking success among students. These findings emphasized the positive influence of handwriting on information processing, supporting its continued importance in

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education, despite the rise of typing as a common practice (Manzi et al., 2017). It is important to note that not all atypical handwriting indicates the presence of psychological disorders, suggesting that each case should be appraised exclusively to avoid misinterpretation. A study whose first objective was not to associate Learning difficulties with handwriting quality was based on a sample of 64,060 words including 120 high-scored, mid-scored, and low-scored reports and letters written by applicants of the Hong Kong Diploma of Secondary Education (HKDSE) English Language Writing paper. The results suggested that lexical and syntactic complexity features can distinguish and predict the quality of L2 writing. It was found that lexical complexity, when compared to syntactic complexity, is a stronger predictor of L2 writing quality (Lee, Ge, & Chung, 2021).

In another study conducted by Roy, Mukherjee, Dwivedi, et al. (2024), the researchers developed an instrument to gauge student common errors. To accomplish this, the researchers started a wide review of the literature on student script presentations, methods of evaluation, and shared errors committed by students. The developed instrument measured common errors committed by learners from the point of view of both students and their instructors and included the following areas: Illegible handwriting, disorganization, incorrect numbering, incomplete diagrams, unclear drawings, confusing arrangement, inefficient space use, lack of emphasis, inconsistent handwriting, insufficient margins, misalignment, and cluttered presentation. Student raters and instructor raters displayed some controversial scores.

A thorough review of the literature suggests that past research has not yet investigated the handwriting of college students' handwriting whose first language is Arabic who are learning and using English as their language of instruction. It is believed that the shift between two different languages with completely dissimilar alphabets can reveal opportunities or challenges.

The current study

The present study aimed to highlight the handwriting of college students who were not diagnosed with any learning disabilities, or psychological or behavioral problems, thereby, adding to the existing literature about how Arabic-native students handwrite English letters, and whether the handwriting of the participants was associated with student low performance and unusual psychological and behavioral attributes. The present study also aimed to investigate college student preparedness to use English as their language of instruction in college. The first objective was to search for non-English letters/characters. The second objective was to assess the readability of student scripts. The third objective was to establish a possible association between student handwriting and performance. The fourth objective was intended to establish psychological and behavioral features with student handwriting. The study attempted to answer the following questions:

1. Do Arabic-native speaker college students have difficulties in handwriting English letters/characters?
2. Are their handwritten essays readable?
3. Are there any associations between handwriting and student performance?
4. Are there any behavioral and psychological issues associated with student handwriting?

Method

Participants

The archival scripts used in this study were 519 and belonged to male undergraduates whose ages ranged from late adolescence to early adulthood. The students who owned the scripts came from several areas of study, including, but not limited to, finance, law, engineering, accounting, and aviation. Participants were enrolled in psychology as a core course for all students.

Procedure

At the moment of the study, participants had already left college. The researchers collected exam scripts that became archival documents that were at least 5 years old. Those students have been in college since 2015. Students' names and college ID numbers were removed to make the scripts anonymous before scrutiny and each script was assigned a code number. Eye visualizations were used to select participant scripts. Scripts were first inspected for their contents. Exam papers that entailed a grade of C or better were discarded. Documents that entailed incommensurable/good-to-see, good-to-read handwriting as per common sense were also removed. Scripts that were included revealed distinctive hand shaping from the standard English/roman alphabet, and the student failed to write/spell words that were typewritten in the essay question, and the grades (including multiple choice and essay) were low.

Measures

To conduct this descriptive study, the authors who were two faculty members used observation/ visualization to collect the data. Since the authors used archival data, limited demographic information was available. Demographics collected included students' gender and areas of study based on the university departments and colleges. All participants were male undergraduate students whose major areas of study included but were not limited to finance, law, engineering, computer science, accounting, and aviation.

The researchers used two protocols. The first one encompassed four tests to identify participants who could face learning difficulties: (1) Scripts that revealed two or more unlikely English/roman letters. (2) The student's essay was rated as unreadable by

at least two faculty members who acted as raters. (3) The students' grades on the multiple-choice questions and essays were equal to or below grade D. Points one and three addressed the student's handwriting inabilities. The last point used the students' grades as an indication of learning problems and poor performance.

A second protocol of inspection was suggested to deeply screen the students' scripts to reveal further possible difficulties and behaviors. The second protocol encompassed (1) the number of crossings-out (note quality), (2) cognitive or behavioral related difficulties such as thinking, knowing, remembering, and communicating (The script was then inspected for the student's inability to handwrite or copy a word that was typed in the essay questions at least twice, addressed the student's inability to recall recently seeing a word in a question), (3) unusual/nonstandard practice (in the multiple-choice responses) and production (in the essay). The two faculty members collaborated to select the first batch of scripts that met the criteria of the first protocol. Then the first faculty member worked alone on selecting the scripts that met the criteria on the second protocol. The findings were compared with the work of the second faculty member. An interrater agreement of 100% was obtained for the included articles. Interrater reliability was computed regarding the assessment of student handwriting quality/ readability by the two faculty members. Another interrater reliability included three independent student raters to compare students' and instructors' perceptions of student handwriting and achievements.

Statistical analysis

The present study was more qualitative than quantitative. Using descriptive statistics, the researchers computed the percentage of scripts that were included for students facing some learning difficulties. They also computed the number of students/ scripts that met the criteria in the inclusion protocol. The researchers furthermore computed the average scores as assessed by the three student raters and the faculty raters.

Results

Descriptive statistics

Regarding descriptive statistics, 23 scripts (out of 519) were included and coded that met the criteria on protocol 1, suggesting 4.43% of participant scripts. A more advanced scrutiny was made based on protocol II and 4 scripts (Coded 8, 11, 12, & 21) were retained suggesting .78% of all participants. See Table 1 for the results of Protocol 1 and Table 2 for details on Protocol 2. Only the four scripts retained were deeply investigated for further inferred behavioral and psychological issues associated with handwriting.

Table 1: Results of Protocol I

Codes	Presence of Non-English Letters	Failure to hand-copy words	Unreadability of text	Low grade on MCQ and Essay
1	Yes	No	No	Yes
2	Yes	No	No	Yes
3	No	No	No	Yes
4	No	No	No	Yes
5	No	No	Yes	Yes
6	Yes	Yes	No	No
7	No	No	No	Yes
8*	Yes	Yes	Yes	Yes
9	No	No	Yes	Yes
10	No	No	Yes	Yes
11*	Yes	Yes	Yes	Yes
12*	Yes	Yes	Yes	Yes
13	Yes	No	No	No
14	No	No	No	Yes
15	Yes	No	No	No
16	Yes	Yes	No	Yes
17	Yes	No	Yes	Yes
18	No	No	No	Yes
19	Yes	No	No	Yes
20	Yes	Yes	No	Yes
21*	Yes	Yes	Yes	Yes
22	Yes	No	Yes	Yes
23	No	No	Yes	Yes

*Passed criteria 1

Participant coded 8 reported non-English/Roman characters and showed an inability to handwrite/copy words that were printed for them.

The essay was deemed unreadable based on the score assigned by the raters, and the learner earned a

Table 2: Student participant and instructor comparisons of scripts

	Student Rater 1	Student Rater 2	Student Rater 3	Student Rater Average Score	Faculty Rater 1	Faculty Rater 2	Faculty Rater Average Score
Script Readability							
Code 8	1	0	3	**1.33**	1	1	**1**
Code 11	6	1	2	**3**	0	1	**.5**
Code 12	3	3	6	**4**	5	4	**4.5**
Code 21	7	8	4	**6.33**	7	8	**7.5**
Presence of Non-English Letters							
Code 8	1	2	0	**1.00**	9	8	**8.5**
Code 11	0	6	1	**233**	7	8	**7.5**
Code 12	0	9	3	**4**	6	7	**6.5**
Code 21	0	0	2	**.66**	7	7	**7**
Script Quality/ Cleanliness/ Cross-outs							
Code8	2	3	7	**4.00**	9	9	**9**
Code 11	2	10	4	**5.33**	7	8	**7.5**
Code 12	1	8	4	**4.33**	6	5	**5.5**
Code 21	4	3	2	**3**	7	8	**7.5**

Qualitative description of scripts based on protocols 1 & 2.

Figure 1: Student script (Code 8)

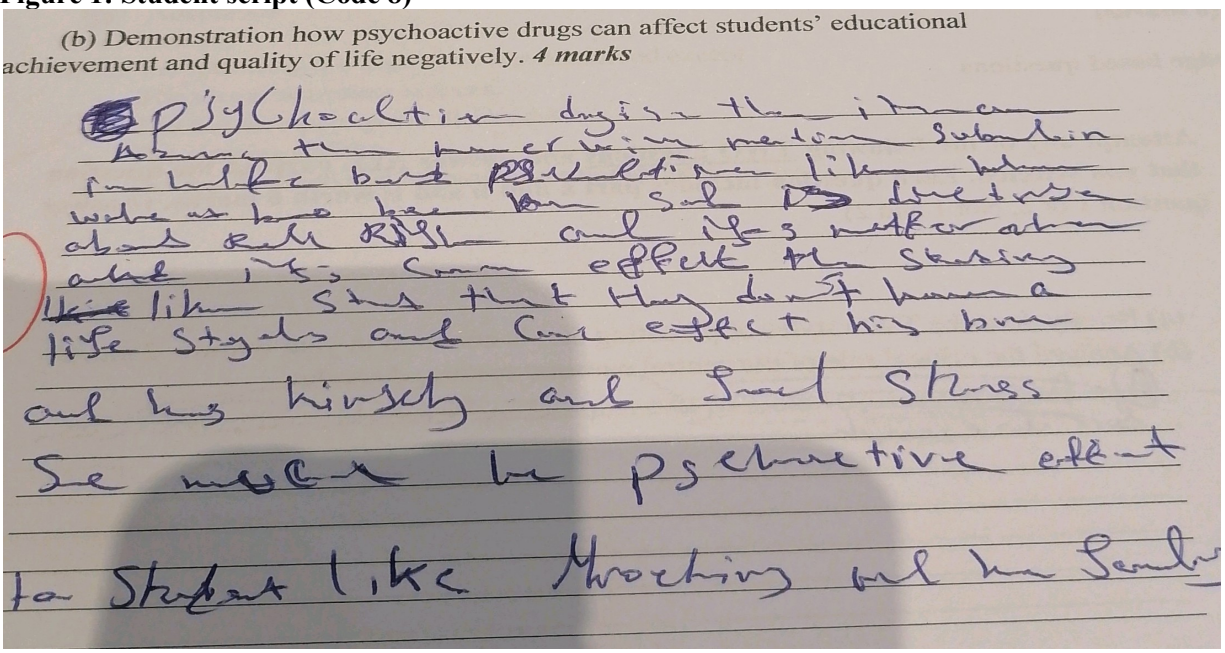
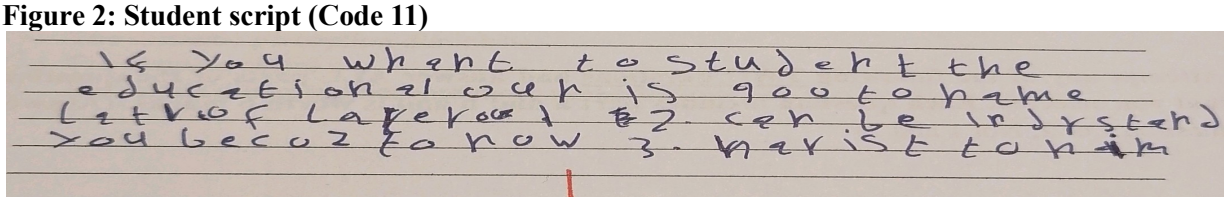


Figure 2: Student script (Code 11)



grade below letter D (5 out of 20). Regarding protocol 2, the script of participant 8 was crossed out at eight different locations by the student. The handwriting was ineligible, disorganized, confusing, and inconsistent. Multiple choice selected letters were not transferred to the provided table and special feedback was written by the exam marker as "Cannot read" the essay. Finally, one essay in three was not attempted.

Figure 3: Student script (12)

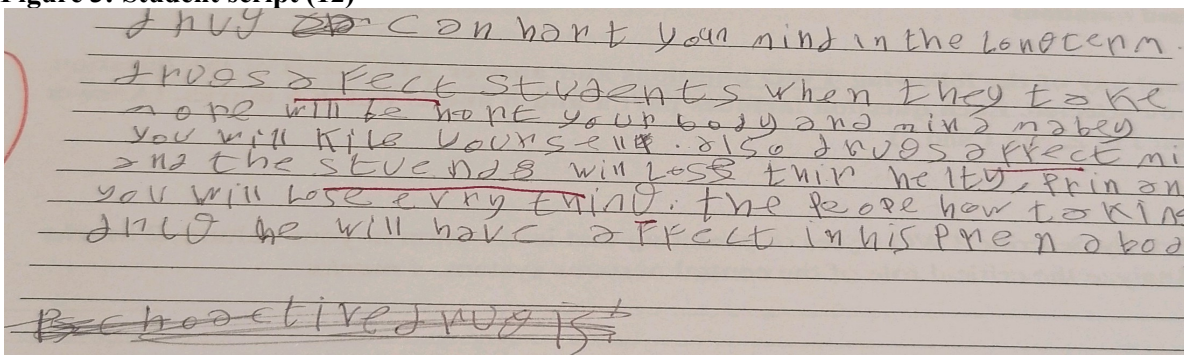
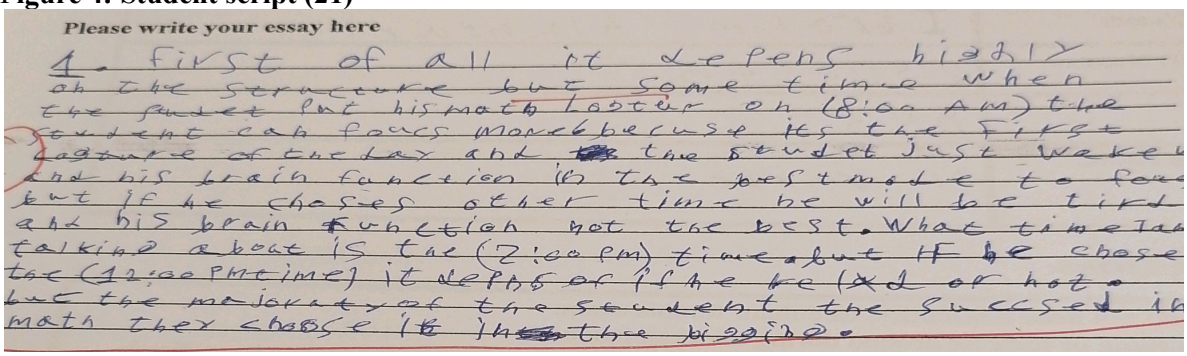


Figure 4: Student script (21)



Participant coded 11 reported non-English /Roman characters as well and displayed an inability to hand copy words initially typed in the essay questions. See Table 2 for more details about raters' scores. The student obtained 5 correct MCQs out of 16, suggesting a grade of 2.5/8, and only tried to answer one essay question out of three. The attempted essay was rated unreadable. The student began sentences with lowcase letters and did not finish sentences with a period. The script was ineligible, disorganized, confusing, and inconsistent as well. Eight cross-outs were found in the script. The participant's overall grade was 4/20.

Regarding participant coded 12, MCQ suggested eight correct answers, yet multiple non-English characters were found in the essay text and the table proposed to report MCQ letters. Six cross-outs were pinpointed in six different spots on the script. The student only attempted to answer one essay question out of two. Uppercase letters were found in the middle of words. The participant believed that the rubric for grading was an assignment and wrote "answers" in four of the six points. The participant's overall grade was 8/20. See Table 2 for raters' scores on script readability, presence of non-English letters, and script quality.

Regarding participant coded 21, MCQ correct answer counts reported eight in 16. Eleven cross-outs were found on the script. A note "You don't answer the question" was commented by the grader. Sentences started with lowcase letters and uppercase letters were also found in the middle of words. Multiple non-English/Roman characters were found on the exam paper. The participant's overall grade was 10/20. See Table 2 for raters' scores on script readability, presence of non-English letters, and script quality.

Discussion

Results suggested that faculty members who were non-Arabic speakers attributed learners scores that implied poor script readability, presence of non-English letters/ not well-shaped letters, and poor script quality encompassing cross-outs when compared to student raters' evaluations. Student raters were more tolerant, implying that they did not as much perceive their fellow students' scripts as deviating from the English Alphabet. Past studies also found similar discrepancies between student raters and faculty raters of sample scripts (Roy, Mukherjee, Dwivedi, et al. 2024). See Table 2 for the interraters' scores.

Cognitive and behavioral issues were inferred from some scripts. Either the students of the script coded 8 believed that their essay could be read without any difficulties by their instructors, they thought that the faculty members would only mark their exam paper without attempting to read the content, or the

student did not care about the exam result, causing them to suggest such quality of handwriting. Regardless of the reason, the script revealed student unpreparedness. Other cognitive-related findings include students not being able to remember the spelling of words typed in the essay questions and the combination of lowercase and uppercase letters in one word. See Pictures 1, 2, 3, & 4 for more details.

The attempted essay by script coded 11 suggested that the student was unprepared and had insufficient English knowledge to undertake higher education in an institution whose language of instruction is English. A lack of inconsistency was found with the script coded 12. The student spelled two words differently at different locations (affect/student). A meticulous scrutiny of the essay yielded issues with English letter shaping (A, G, D). Script 21 also encompassed similar spelling, letter shaping, and semantically related difficulties, resulting in more time to read and understand the essay. Unlike Script 8 though, behavioral issues were not found. Cognitively, scripts suggested that the students needed more preparation to understand college writing and student assessment.

The results of the present study suggested a qualitative association between handwriting and academic achievement or failure, a possible association between handwriting and cognitive and behavioral issues related to academic production. Handwriting also suggested a lack of readiness to undertake higher education among a certain type of learners. The reduced number of participants based on the second protocol did not suggest enough support for the argument, regardless of the qualitative nature of the study. The findings in the present study are consistent with the results of past studies. Several quantitative studies yet found a relationship between the quality of handwriting and students' academic aptitudes. In a recently conducted study (Roy, Mukherjee, Dwivedi, et al. 2024), students suggested that their most frequent errors were inconsistent handwriting and disorganized production. Teachers' reported errors were illegible and had varying handwriting. Both learners and instructors acknowledged inconsistent handwriting as the most important error. It was argued that handwriting and spelling deficits were common difficulties that children diagnosed with specific learning disabilities experience (Bray, Skubik-Peplaski, & Ackerman, 2021).

Another study investigated the aptitude of a short-period speed assessment to predict written production under assessment circumstances, and factors believed to impact written production. The researchers collected data on the manner pencil is grasped, text legibility, student writing style, felt pain, tiredness, and academic aptitude. The findings did not support the use of a short-period speed assessment to predict written production. Furthermore, pencil grasp, pain, and academic achievement were found to correlate with written production. The researchers advocated the need to establish normative data for written production and the development of exam techniques (Summers & Catarro, 2003).

Similar difficulties were found among students who were diagnosed with learning disabilities. A study conducted a comparative study about the occurrence of typing difficulties among higher education students who have hyperactivity disorders including the underlying functions such as language, fine–motor, and attention deficit associated with these disabilities compared to students with only Hyperactivity Disorder alone. These results suggested that handwriting and typing share language developments. The results also revealed that keyboarding may not be an acceptable writing mode for learners who have learning disabilities, proposing personalized accommodation for them (Rosenberg-Adler, & Weintraub, 2020).

Despite this, handwriting was encouraged as a way of learning. Acknowledging the difficulties associated with handwriting, it was argued that keyboarding has become an important writing method even though several people do not reveal faster skills in using a keyboard as they use their hands. Weigelt-Marom and Weintraub (2018) conducted a study to assess the instant and extended-term outcome of a touch-typing package on reducing the breach between the speed of keyboarding and the one of handwriting, using college students as participants. Although findings revealed at the end of the experiment that handwriting was faster than typing, the findings were short-lived, as keyboarding became faster than handwriting at the end of the program. Importantly it was argued that this change was important only for the student participants who were diagnosed with specific learning disabilities. The researcher emphasized the importance of using keyboarding among learners who have impacting disabilities. This assertion also supports the finding that handwriting is impacted by cognitive impairments, leading researchers to investigate the scrutinize handwriting adjustments as diagnostic symptoms for this disability (Cilia, De Stefano, Fontanella, et al. 2018).

Another study investigated the association between college students' note quality, and their handwriting speed, in addition to their impartial and self-report measures of attention. The study assessed handwriting speed using verbal tasks such as copying the alphabet copying and sentences alongside nonverbal tasks such as copying symbols. The findings revealed that note quality was associated with student participants who were faster in writing, and who displayed faster general reaction times. Handwriting speed significantly predicted note-taking achievement. The results also suggested

some evidence of the positive effect of handwriting on how students process information. Acknowledging the increased popularity of keyboarding, the investigators proposed that higher education enhances the use of handwriting in education (Manzi, Martinez, & Durmysheva, 2017).

Finally, the present study does not suggest significant handwriting issues stemming from the passage from Arabic to English language. The study reveals instead that the vast majority of Arabic-native speakers and writers have high handwriting-based control of the English/ Roman alphabet which they start learning early in life.

Some limitations were found related to the four scripts. This small sample of scripts did not allow generalization of the findings. Next, deciphering a letter as English or non-English indicates a subjective interpretation unless trained to make such an interpretation. This latter limitation was evidenced by the score discrepancy between non-Arabic speaker faculty members and student raters who are Arabic-native speakers. Although female faculty members who acted as raters of the scripts also complained about the handwriting of Arab female college students, the sample scripts (519) did not include any female students' scripts. More quantitative studies are recommended that will enroll large sample sizes of college students to investigate their handwriting. Results from such research will help make decisions about emphasizing the importance of handwriting in the area of computerized cutting-edge technology education.

Conclusion

A very limited number of students whose native language is Arabic who use English as their language of instruction were found who could show some difficulties in all the areas investigated in this study. In general, Arabic-native speakers can spell English characters accurately. The few students' failures can be accounted for by their poor handwriting skills as suggested by the current findings. Students should be tested for their handwriting skills alongside other tests for learning difficulties in the earlier years of education who display some signs of difficulties. Once in college, difficulties may not be perceived as learning disabilities by the instructors. It was argued that limited written production is of concern for students sitting examinations. Referral for assessment often states that students face difficulties such as the ones related to poor handwriting speed.

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