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Teaching Language Effects on Students' Performance

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Abstract

We report our results on a study of our medical student's performance and its relation to the teaching language. We used the force concept inventory (FCI) as our study tool and gave it to our students before and after instructions in class on materials covered by the test. Our students' native language is Arabic and we teach in English and therefore they were given the test both in Arabic and English. This study is one part of a bigger project to assess the whole educational process (both teaching and learning) in our department. It was triggered by students' poor English proficiency shown in class. Our results indicate weak correlation between students' performance and the teaching language used.

Keywords: Physics education research; Force concept inventory; Pre-medical students; English as a second language; Students' performance

1. Introduction

The results we're reporting in this article are coming from a study that's part of a bigger project[1,2] we started to evaluate our physics education process at our university. Complaints from our instructors (not only in physics) about very poor students' English proficiency triggered this part of the study. The idea is to give students a standard well established test both in their language (Arabic in this case) and in English to check if they perform any differently. Our choice for such a test was the Force Concept Inventory (FCI).[1–7] One of the reasons for our choice was the kinds of topics it covers, we teach the same topics to students and they also already studied these topics in high school. Coming to this class, students are therefore expected to know about these general fundamental physics concepts and ideally do well on the test.

The test was given to students twice, as a pre-test before any instructions in class about the topics of the test and as a post-test after instructions both in Arabic and in English. This arrangement allowed a direct students' performance comparison in two different dimensions: one is related to effects of the language and the other is related to the persistence of these effects after English instructions in class. Our goal here is to test the effects of the teaching language on students' performance when the teaching language is different than their own. The other goal is to measure our English teaching instructions effectiveness in enhancing their performance. In the following, we talk briefly about our teaching methodology and how the data were collected and analyzed in Section 2. Results and discussions are presented in Section 3 and the last section is dedicated to our conclusions from this study.

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2. Data collection

Students participating in this study were pre-medical and pre-health sciences students enrolled in our "physics for health sciences" class. All students spoke Arabic as a first language and were in their first year of college. Their English proficiency ranged from excellent (which was only a small percentage) to very poor. Even though our class is offered for students in the second semester after they spend the first semester improving their English skills, the vast majority of our students were still lacking the needed English proficiency for the class. This created a challenge for us making it very difficult to teach physics concepts in English to a point that made us think; are we teaching English or physics? Our strategy was to teach in as simple English as possible so most students can follow.

Three different groups participated in this study including on average sixty students each. In order to make a fair informative comparison between the results of the before and after tests, we only included results of students attending both tests; the final included count of students was 152. All three sections were taught by the same instructor in an effort to eliminate any differences in the class environments. Each topic was taught and covered equivalently, same power points were used and same examples were discussed.

3. Results and discussion

Before we start our discussion of the results, we should mention that weak overall performance of students on the FCI has been reported all around the world.[1,2,8–11] Our students were no exemption as can be clearly seen from Table 1. It's not in the scope of this particular report to study this weakness, its causes or its solutions and therefore will not be discussed any farther. In this paper, our goal is mainly to study the effect of the teaching language on students' performance.

When we started this study, we were expecting students to perform much better on the test if it were in their own language. This expectation was based on the fact that most students showed poor English proficiency in class and their continuous indications of questions (from homework, quizzes or tests) being very hard to understand since they are written in English and they could do better if the test were in Arabic. To our surprise, the results in Table 1 suggest that no performance gap present that depends on the language of the test. On the contrary, students performed better in the post English test than they did in the post Arabic test.

Table 1
Comparison between students' performance on the Arabic and English FCI tests both before and after instructions.

	Pre-test		Post-test	
	Arabic	**English**	**Arabic**	**English**
Mean percentage score	27.2%	26.5%	34.7%	37.9%
Standard error of the mean	1.2%	1.1%	1.2%	1.3%

Looking more carefully at information given in Table 1, we find that students perform almost identically on the pre-tests; the mean FCI scores were 27.1% on the Arabic test and 26.5% on the English test. The difference in the mean scores is within the standard error of the mean and it's insignificant. This is an indication of no effects of the language used in the test on students' performance. Results of the post-tests indicates better performance on the English version of the test (mean score of 37.3%) than the Arabic version (only 34.7%).

Evidence of better performance in the English version of the post-test is also supported by Hake's normalized gain $<g>$.[12] It is customary with the results of this test to calculate Hake's normalized gain $<g>$ to measure the effectiveness of instructions. We can use this calculation here as a measure of the better performance in the post English test since the performance was similar in both pre-tests. Hake's normalized gain is calculated using an equation that considers the pre and post test scores together and measure the gain in performance which is usually explained to be due to the instructions students received in between the two tests.

Hake's normalized gain in the English version of the test was 14.8% which is almost 1.5 times more than that of the Arabic version of the test (10.4%). The FCI test we used contain 30 questions and therefore this difference means that students were able to answer two more questions (on average) on the English version of the test than they did on the Arabic one. We also shouldn't forget to mention that these gains are considered to be low suggesting little difference made by our instructions in students' performance similar to reports by Hake and Viiri.[12,13] Interested readers are referred to our two other published reports from this project that contain detailed information about our findings.[1,2]

To get a better look at students' performance in these tests, we present in Fig. 1 the number of students (normalized to the total number of students) answering correctly each item in the inventory. Upon close examination of Fig. 1, one quickly realizes that its hard to come up with a firm conclusion about a clear winner. In the pre-

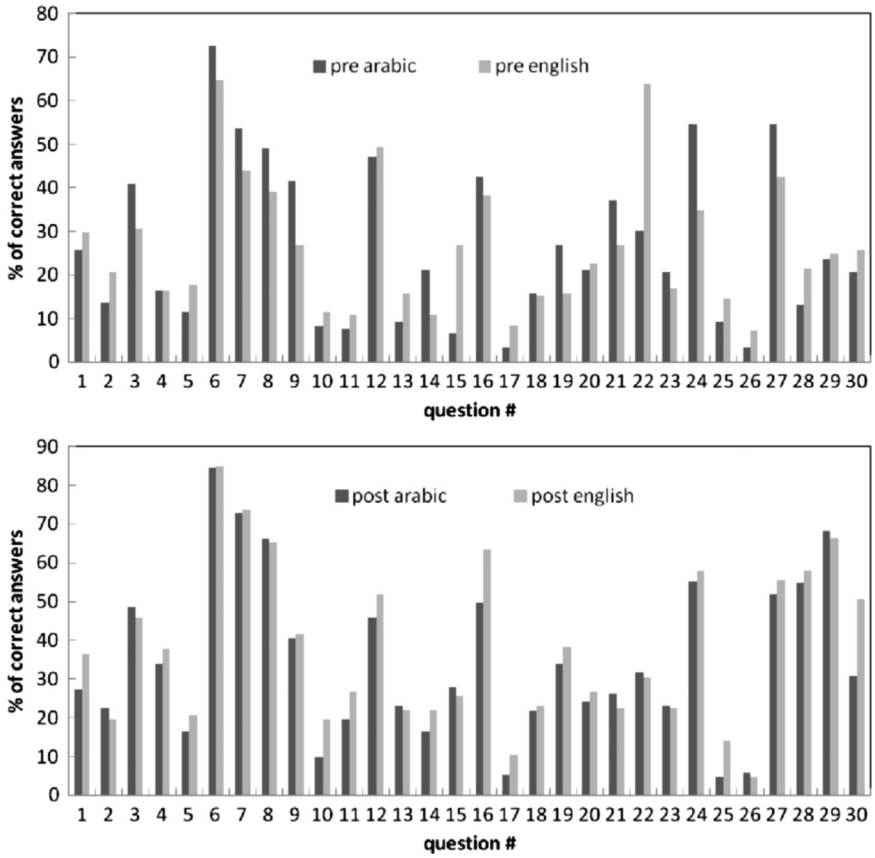

Fig. 1. Percentages of correct answers for each of the 30 questions in the FCI test for both versions Arabic and English in pre-test (up) and post-test (down).

tests, we can see that students did slightly better (less than 5%) in some questions in the Arabic version of the test than equivalent questions in the English version. And we find small outperformance in the English version in some other questions. This support our earlier conclusion from the mean scores about similar performance in both versions of the pre-tests.

Looking at post-tests we can confirm the better performance in the English version of the test. We see higher number of students getting the correct answer in almost all questions in the English version than the Arabic version. There could be many factors contributing to this interesting finding and would be very difficult to conclude a single reason. One of the factors could be the fact that our instructions are in English and students are being reminded or forced to learn the English terminology needed to understand questions in the test. All students have studied these physics concepts at one point before, mostly in Arabic and some in English and therefore (ideally speaking) the only thing stopping students from getting the correct answer is understanding the question. In this case, teaching students the needed English terminology will help them perform better in the English version of the test but not the Arabic one. Of course there is a high possibility of the existence of a misconception in students' mind and even if they understand the question they would still answer incorrectly. We have studied these misconceptions and reported a full list in a previous work.[1,2]

Other factors that can contribute to the performance difference is the way they been taught in Arabic and what have they been taught. We can never be sure if what they learned in Arabic about physics concepts is accurate. In this class, they never had a chance to correct misconceptions in Arabic and therefore performed worse than they did in the English version. On the other hand, our English instructions must have helped some students learn the physics concepts and some other students correct any existing misconceptions about these concepts. This must have contributed to the better performance of students in the English version of the test.

4. Conclusions

Our goal from this study was to test the effects of the teaching language on students' performance. We expected students to perform better if they were given

any test in their own language (Arabic). To make the comparison, we gave a standard test in this field of study (FCI) to our students twice (pre and post test) in two different versions; one in Arabic and one in English. To our surprise, students' performance was not affected by the language of the test in the pre-tests and to add to the surprise, they even performed better in the English version of the test in the post-tests. One major conclusion from this is: whatever reason students have for their weak performance in this class in general and in this test in particular can't be the different teaching language than their own. We expect that whatever applies to our students in physics concepts should also apply in other science fields and we look forward to cooperate with our colleagues to test this conclusion.

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