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Motivating Bilingual Arab Pre-university Students to Learn Mathematics through Grouping and Advising[1]

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Motivating students to study mathematics is a concern for many mathematics educators. In this paper, we present the outcome of a one semester experiment in which group-work and academic advising were used as teaching strategies in order to improve the motivational level of our students in learning mathematics. Although the students' performance did not show any statistically significant difference between the experimental and control groups, qualitative and other quantitative data collected indicate that the participants in the experiment, especially weak students, have in one way or the other benefited from the teaching approaches. Details of the experiment, the findings and their educational implications are presented.

Keywords: motivation, mathematics, bilingual Arabs, preparatory year program, group work, advising
MESC Classification: A05
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INTRODUCTION

Mathematics is an inherently difficult subject. Various efforts have been put in place with the aim of motivating students to develop interest and to perform better in mathematics. It is known that factors which motivate students vary with different students,

[1] A draft version of the article was presented at the 45th Korean National Meeting on Mathematics Education held at Dongkook University, Gyeongju, Korea; October 8–10, 2010 (*cf*. Yushau; Omar; Al-Attas & Al-Absi, 2010).

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and sometimes within different cultures. As a result, an argument has been advanced that the issue of motivation is not only local, but can only be understood by examining it through a social lense (Laversy, 1999).

Although several studies have been done on how to motivate students to do mathematics, not much is known about students from Arab cultures, especially those at the Preparatory Year level. These students are special in many ways and for many reasons. They are at a transition level, new to the university system and hence, at a crossroads. One of the most serious challenges these students face is that of the new language of instruction – English. Moving suddenly from an Arabic medium to an English medium is shocking for many students. Despite their weak background in the new language of instruction, English is the means through which teachers communicate with them in classrooms, and the textbook is in English. Therefore, proficiency in English is important for the students in order to follow class lectures, and efficiently read the textbook. As a result of the lack of proficiency in the new language of instruction, a language barrier occurs and quite a number of students can not communicate in class. They find it difficult to ask questions or to answer them, and find themselves in both a linguistic and psychological dilemma (see Kocakulah, Ustunluoglu & Kocakulah, 2005). Therefore, this highlights the need to develop some strategies that might minimize these problems.

In our earlier exploratory study, we identified factors that can contribute to the motivational level of this class of students (see Yushau, Omar, Al-Attas & Al-Absi, 2009). The contributions of these factors are at varying degrees, and also depend on the class of students (that is high performing, average, or weak). It was also found that there is a strong indirect correlation between students and the English language. In particular, the results indicate that low performing students are not in synch with the teacher, which is perhaps due to a language problem. This calls for a need to find a way to at least minimize this language difficulty that might reduce students' emotional problems, failure rates, as well as increase their confidence.

It was also found that both the average and low performing students are correlated with friends, and these students are willing to seek advice or assistance that can lead them to a better understanding of mathematics and improve their performance in the subject. On the other hand, the high performing students, though not correlated with friends, were willing to share their understanding with others.

As a result, a follow up to this exploratory study was designed whereby some aspects of the findings in Yushau et. al. (2009) were implemented in the classroom with the aim of motivating students to improve their understanding and performance in mathematics. This paper presents both qualitative and quantitative findings of a one semester classroom experiment conducted using some motivational approaches.

LITERATURE REVIEW

Academic motivation is concerned with what makes students desire to seek knowledge and engage in learning-related activities, and believe that school is important (Brown, 2009). It is the type of motivation that helps students to succeed in school and make them develop positive attitudes toward learning. This has attracted a lot of researchers' attention, and consequently many conceptual perspectives have been developed in order to have a clear understanding of the construct. However, according to Steven, Karau & Ramayah (2007) and Komarraju (2008), the attention of psychologists and educators is now more toward a socio-cognitive model. This model suggests that students are motivated in multiple ways, and that motivation is influenced by both intrinsic (cognitive) and extrinsic (social and cultural) factors (see Steven, Karau & Ramayah, 2007).

As a result, substantial research on cultural differences in academic motivation has considered primarily ethnic and racial differences in U.S., Japan, China, Korea, Turkey and Malaysia (Steven, Karau & Ramayah, 2007). The findings in all these point to a complex relationship between culture and academic motivation. This tends to reiterate the fact that academic motivation cannot be understood unless through the lenses of the social fabric in which it is embedded (Laversy, 1999). As a result, "there has been a huge focus over the years as to why certain ethnic groups outperform others academically." (Laversy, 1999).

One reason why motivation has attracted a lot of attention, especially in mathematics, might not be unconnected with the fact that many research findings have linked motivation to students' achievement (Renchler, 1992; Tella, 2007; Moen & Doyle, 1977; Pintrich, 2000; Weiner, 1985). Motivated students devote more time, effort and resources to learn and to solve problems, and hence perform better than their less motivated peers (Chiu, 2000).

Consequently, the question of how to motivate students and develop their interest in the mathematics classroom has become a leading concern for mathematics teachers and educators (Ricks, 2009). One approach that has been used and has shown to increase students' motivation is through *group-work* (Chiu, 2000; Morton & Oates, 1998; Oates, 1999). Engaging students with meaningful mathematics activities has a tendency to improve students' motivation (Teaching & Learning Laboratory, 2010). In particular, group-work gives students the opportunity to explain ideas to one another using an informal language which is readily understood by their peers and at the apprentice-level (Morton & Oates, 1998). This is more so for bilingual students who are learning mathematics in their second language. *Grouping* improves students' interaction in

classrooms, reading of textbooks, and minimizes the difficulty in following teachers' lectures (Morton & Oates, 1998). It also gives students who are deficient in the language of instruction an opportunity to participate in the discourse, and possibly develop their confidence in their mathematical competence, and to increase their enjoyment of mathematics (Barnes, 1998; 1999). Invariably, this increases their motivational level. Studies have shown that students enjoy working with each other and being part of a bigger group (Latu, 2004).

Another approach that has the potential of improving student motivation is academic *advising*. Bloom (2005) defines academic advising as "a collaborative partnership centered on teaching students how to identify and achieve their personal, educational, career, and life goals by purposefully designing, optimizing, and integrating their classroom and extracurricular experiences." The role of an academic advising program to the development of students' entire career has clearly evolved over the years. Now, advisers not only assist students with their course schedules and academic goals but also help them make the most of their entire college experience (Marsh, 2008). Through one-on-one partnerships, academic advisors challenge students to determine meaningful career and life goals by encouraging them to reflect upon their educational experiences, problems and achievements (Marsh, 2008). Research on college students suggests that activities like advising could increase students' involvement in their college experiences and motivation (Frost, 1991). This indicates that advisers have the capacity to increase meaningful contact with students and to encourage them to persist in a college program (Frost, 1991). In particular, studies have shown that academic advising can smooth the path of students who are in stages of transition, and can make them understand factors affecting their early college life, career, educational goals, and hence make them better equipped to select educational programs, choose courses, and schedule classes (Tinto, 1987).

Although a lot of studies have been done on student motivation, it is only recently that researchers' interests have moved toward the university level (Lavery, 1999; Tinto, 1987; Vallerand & O'Connor, 1989; Kleinginna & Jr., and Kleinginna, 1981). Similarly, previous studies (example see Yushau, Omar, Al-Attas & Al-Absi, 2009; Steven, Karau & Ramayah, 2007) have examined university students' motivation as a function of ethnicity and culture but in general not much is known about Arab students, especially at the transition (preparatory year) university level.

METHODOLOGY

Participants

Around one hundred and twenty students of the preparatory year cohort of King Fahd University of Petroleum & Minerals (KFUPM) students were involved in the study. These are predominantly Arab students who were fresh from high school, and were undergoing a compulsory one-year preparatory program. Two instructors were involved in the teaching of the six sections of students who participated in the experiments. Other sections with comparable initial performance levels were observed to provide control for the experiments.

The Classroom Experiment

The strategies developed and used in addition to the normal classroom teaching included:

- Group-work only.
- Academic advising only.
- Group work and advising.

Each instructor taught three sections, one section each was randomly assigned to grouping only, advising only, and for both grouping and advising.

Group Work Only

The grouping took place only once a week, while the other three contact hours were normal teaching. Here, students were placed in groups of five or six. Each group consisted of high performing students (With grades B and above in Math 001), average students (with grades C or C+ in Math 001), and low performing students (with grades D or D+ in Math 001). It was assumed that the combination and dynamics of the groups would increase interactions among students. Group leadership was rotated among students on weekly basis. A set of well prepared questions was given to the students to be solved collaboratively. The questions were generally the summary of the topics students completed in the previous week. The number of questions varied from three to five depending on the difficulty. But generally the questions were multi-conceptual, in which students were expected to discuss and come out with the summary of the final solution. The group leader was expected to summarize and hand over the group work to the teacher at the end of the class. During these activities, the teachers' role was to go around and monitor students' progress, and in case there was lack of agreement on some concepts or procedures, the teacher could intervene by providing hints. It should be noted that though language of instruction in the normal class is officially English, during group-work, the students were free to use any language to communicate. This gave them an opportunity to freely discuss issues at a greater length with no language restriction.

Academic Advising Only

Students in the preparatory year are in their late teens and are generally indecisive. This calls for a closer look at them and a need to advise them appropriately. While the university has a counseling center, the students at the preparatory year level do not seem to be fully aware of it. In particular, they lack advice on how to study mathematics. Therefore, the advising strategy used here is to cater to that. This involves following closely the progress of each student, and advising him appropriately on a one to one basis. The aim was to keep track of students in terms of their academic progress, highlight their weaknesses and strengths, and advise them appropriately. The advising, however, took place during office hours only. So this necessitated creating extra office hours for students' benefits.

Advising and Grouping

In the third class of the experimental group, the participants were exposed to both academic advising and group work, as discussed earlier.

Data Collection

Data for this study was collected both qualitatively and quantitatively. The qualitative data was based on the classroom observation, formal and informal interviews. Classroom observations were done throughout the experimental period, while the interviews were conducted at the end of the term. The aim of the interview was to seek students' impression on the teaching experiments. Seventeen students were interviewed. Seven (grouping only) and two (advising only), the remaining eight (grouping and advising). The quantitative data was based on the students' performance in the course.

RESULTS AND DISCUSSIONS

Qualitative Results

From the interviews conducted with some participants in the experiment it appears that the students enjoyed their group activities. *Grouping* appears to have encouraged the high performing students to explain their understanding to others, as this would require them to reorganize their thoughts and consequently consolidate their understanding more deeply. As for the average students, working in groups seems to have helped them to verify their understanding of some concepts that they were unclear to them, and build their confidence. For the low performing students, the approach gave them opportunity to

freely interact with fellow students in a small group rather than in a formal classroom setting. Furthermore, since there was no restriction on the language of communication in the groups, students reported that it was easier to ask questions and pinpoint their areas of difficulties. The group work process engaged all members to actively participate in some group activities. In this study, the *group work* certainly increased the class interaction. As noted earlier, the language of instruction in class is English, but students at the prep year are generally weak in English. So, the group work gives them a good opportunity to discuss mathematics. The instructors can hear them arguing seriously in Arabic, with occasional interspersing of some English terminology. This kind of interaction was not usually available in class. It is interesting to note that, contrary to our assumptions that the high performing students would be leading the academic discussion in the group, many times, low or average performing students actively lead the group to a more successful result. This shows the dynamics of group work. One major problem faced by the group work was the reluctance of some students to actively participate in the discussion. This was minimized when a grade was assigned for participation, and group leadership was made on rotational basis. From the interview conducted with some students who participated in the experiment it appears that the students enjoyed their group activities. However, no details could be narrated here because contrary to our plan, we did not get enough students to participate in the interview. Nevertheless, from the comments of the available students, we can reasonably conclude that the experiment was successful.

The participants in the *advising only* group were briefed at the beginning of the semester on the special office hours time for the teachers for those looking for academic advising. It was not made compulsory for all the students to attend, but all students who were performing below expectation were told to see the teacher on an individual basis. Since the meeting was one on one, the students generally felt free to discuss their problems with the teacher. The problems reported by the students were academic, social and psychological. The academic problems in most cases were due to lack of a clear understanding of some basic concepts from high school. These deficiencies continue to accompany the students and make it difficult for them to follow arguments in all related topics. Some other problems are operational. For example, some had difficulty in doing some basic arithmetic operations (working with fractions and rational expressions).

As reported in Yushau, Omar, Al-Attas & Al-Absi (2009) and Achoui (2004), family is on top of the list of all motivating factors at KFUPM. No doubt, students tend to get distracted with a simple family problem that sometimes has no direct relationship with them. Many times, students report the reason of their lack of concentration and performance is due to family problem. “I have problems in my family” is the common phrase. Some will open up more and some will leave it at that level. We try to make them

understand that the result of their lack of motivation will lead them to failure, and the implication of their failure extends to the family (Steven, Karau & Ramayah, 2007). This makes them see the bigger picture of their actions. As for the psychological aspects, most of these students are away from their family for the first time in their life. So they feel somewhat homesick. On the other hand, the students were carefully selected, and all of them have excellent academic records in their high school. However, at the Prep Year, they usually find things to be relatively tougher and the demand for hard work is greater. Hence, they seemed to start questioning their self-confidence. This usually happens, especially after a first quiz (test) when they get low marks. They will usually tell the instructor that this is the first time in their life they are getting these low marks. So this coupled with the academic pressure creates some psychological tensions in some students. Here, students are made to understand that many other students have made it, so they have an equal opportunity to make it. But the secret is hard work. In general, *advising* gives the teacher some opportunities to know exactly what the students' problems (academic, social or psychological) are, and to advise them appropriately.

Quantitative Results

We classified students as top and low performing students on the basis of their performance on their first exam. That is, students who scored in the top 33% and the lowest 33% on the first major exam were categorized into these categories. We refer to this as the *initial course* performance. Then on the basis of this, we identified control groups similar in performance to the treatment groups we discussed earlier. Also, we did the same classifications of students on the total percentage of the course. We refer to this as *overall* performance. In this section, we describe the effectiveness of the treatments on the basis of these performance groups.

In Table 1 below, we provide the effects of the treatment and the control at the initial and overall levels as well as the difference in the effects across these levels. In addition, we report the difference in percentages of low performing students from the experimental and the control groups. Furthermore, *p*-values for the significance of the differences and Cohen's effect sizes are also reported.

The effectiveness of treatments can be seen in the decrease in percentage of low performing students from the control to the treatment group. From Table 1, none of the treatments has statistically significant differences between the treatment group and control at the start of the study. Neither is there any practical difference. For the whole course as well, there were no statistically significant differences between treatment groups and their controls. However, *grouping only* appears to have some practical difference. *Grouping* appears to increase the percentage of low performing students from

control to the treatment group by about 5.47%. We further looked at the difference in percentage of students classified as low performing at the beginning of the semester and at the end. Although the percentages decrease for all but one group, the maximum decrease appears to be at most 3.57%. For the *grouping* treatment, surprisingly, the percentage of low performing students increases. One possible explanation is that when grouping was done, low performing students were not as willing to cooperate with their peers and thus did not benefit from the group activities. Another is that the discussions could be unfocused or off-topic. Thus, their performances were worse off than at the beginning of the semester.

Table 1. Percentage of Low Performing Students in the MATH002 Course

	TREAT	*n*	Group	*n*	Control	Difference	*P*-value	Effect size
Initial	Advising	57	31.58%	59	33.90%	-2.32%	0.7900	-0.049
	Grouping	58	29.31%	114	33.33%	-4.02%	0.5885	-0.085
	Both	60	36.67%	56	35.71%	0.96%	0.9144	0.020
Overall	Advising	57	28.07%	59	32.20%	-4.13%	0.6275	-0.088
	Grouping	58	37.93%	114	32.46%	5.47%	0.4794	0.117
	Both	60	35.00%	56	32.14%	2.86%	0.7443	0.061
Overall - Initial	Advising	57	-3.51%	59	-1.70%	-1.81%		
	Grouping	58	8.62%	114	-0.87%	9.49%		
	Both	60	-1.67%	56	-3.57%	1.90%		

In Table 2, we provide descriptive statistics for the differences of the top performing students in the MATH002 overall course performance.

Table 2. Percentage of Top Performing Students in the MATH002 Course

TREAT	*n*	Group	*n*	Control	Difference	*P*-value	Effect size
Advising	57	49.12%	59	44.07%	5.05%	0.5852	0.102
Grouping	58	32.76%	114	41.23%	-8.47%	0.2711	-0.172
Both	60	30.00%	56	21.43%	8.57%	0.2880	0.209

However, the effectiveness of treatments can be seen in the increase in percentage of top performing students from the control to the treatment group.

In Table 2, no differences are statistically significant but the effect sizes suggests small to medium sized practical differences. Grouping decreases the percentage of top performing students between control and treatment groups. In addition, grouping alone has a negative effect on top performing students. Advising and both (advising plus grouping) increases the percentage of top performing students. This is a positive impact

on top performing students. The only treatment that does not help is the grouping only treatment which reduces the percentage by around 8.47%. A plausible explanation is that these types of students are not gaining much from the group discussion, except for those who enjoy sharing their experiences.

Table 3 provides descriptive statistics for the differences of the average performing students in the MATH002 overall course performance. Because the average of performing students could move downwards or upwards more easily than the other two groups of students, we must interpret the results of this table while simultaneously keeping the results of the previous tables in mind.

Table 3. Percentage of Medium Performing Students in the MATH002 Course

TREAT	*n*	Group	*n*	Control	Difference	*P*-value	Effect size
Advising	57	22.81%	59	23.73%	-0.92%	0.9067	-0.022
Grouping	58	29.31%	114	26.31%	3.00%	0.6795	0.068
Both	60	35.00%	56	46.43%	-11.43%	0.2078	-0.229

Again, none of the percentage differences were statistically significant. Also, it appeared that both the advising only and the grouping only treatment are not beneficial to the medium performing students. From the effect sizes, the medium performing students are affected by the combined advising-grouping treatment. There are fewer students classified as average in the combined treatment compared to the control group. And because we know from Table 2 that more (around 30%) students were classified as top performing at the end of the semester, most of the average students benefited from this combined treatment by being classified as top performing.

CONCLUSION

This paper presents the results of a study conducted with the aim of motivating Arab students at the preparatory year level of a university to improve their motivation in learning mathematics. The study was a natural continuation of an early exploratory study that investigated the motivational factors of this class of students. Based on the findings in our early exploratory study, *grouping* and *academic advising* were used with the aim of improving students' motivation in learning mathematics. Although the students' performance did not show any statistically significant difference between the experimental and control groups, qualitative and quantitative data collected indicate that the participants in the experiment, especially weak ones, have in one way or the other

benefited from the teaching approach.

From the *qualitative* data collected, the class interaction between students has increased substantially for the participants in the grouping. This gives them the opportunity to learn from each other with no language restriction. Students generally like the atmosphere. The high performing students benefited by teaching others. The average students learned to verify their understanding and develop their confidence. Similarly, the low performing students found a platform to discuss and find solutions to their difficulties.

From the *quantitative* results, the top performing students appeared to find benefits from treatments with advising components such as advising only and grouping with advising. They appear to do poorly when grouping only was the treatment compared to their respective control groups. But they appear to benefit the most when advising was combined with grouping. One explanation is that top students benefit by both the giving and receiving ends of the knowledge imparting continuum and not from just one mode. They can easily benefit by the peer mentoring roles in the *group work* by stimulating themselves with fresh activities and by the student role in understanding and capitalizing on their strengths and weaknesses in the *advising* sessions. In short, *grouping only* did not benefit the top performing students. But when combined with *advising*, *grouping* appears the best treatment for top performing students. This conclusion also holds true for the average performing students.

On the other hand, it appears that low performing students have benefited from *advising* as compared to the control group. However, for the poor students, *grouping only* appears detrimental to their performance. The percentages of low performing students increased from the control to the treatment groups whenever the group work was performed. This may be because low performing students tend to not participate well and benefit from group work as they have a tendency to hide in the crowd. In short, the phenomenon of hiding within the crowd is accentuated with *group work* for most of the poor students.

Although statistical analysis did not show any significant difference between treatment and their control groups for the whole course, the teachers who participated in the experiment have gained more experience and a better approach to motivate students to learn mathematics. Students, on the other hand, have learned to work together and appreciate group work, and appear to be better informed about their problem of lack of motivation, and hopefully have gained experience on how to minimize these problems towards better learning of mathematics.

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