



Improving of Cognitive and Meta-Cognitive Skills of the Students in View of the Educational Practices in the Gulf Region

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ABSTRACT

This article investigates how educational practices (either teaching practices or internal structure of the current academic systems) in the gulf, deal with different aspects of cognitive and meta-cognitive skills among the students. In the introduction part, the importance and dimensions of cognitive and meta-cognitive skills were discussed in relation with some relevant subjects. Then, we further elaborate on current educational practices worldwide and its effect on common perception towards science. Finally, we discuss local perspectives to give another view of improving cognitive and meta-cognitive skills among the students.

Keywords: Learning Strategies; Learner Autonomy; Attitudes towards Learning; Problem Based Learning; Creativity Training; Cognitive Domain.

INTRODUCTION

One could easily claim that no skillful scientist, inventor, expert, physician, even a banker or social worker acquired his or her cognitive, meta-cognitive, academic, and work skills solely through an extensive instruction, study of written materials, or through the mere observation of other skilled individuals. Generally speaking, schools and universities often provide information about scientific facts and laws with less concentration on the connection between theory and practice. A diligent student, who has learned all of the required facts and principles, should be involved in practical training in order to know how to put theoretical knowledge in efficient and effective use (Larkin, 1981; Huddle et al., 2000). In this article, we are going to concentrate on educational practices in view of cognitive and meta-cognitive skills of the students; as this is directly related to teaching practices either in the general or higher educational programs.

Cognitive skills is a wide subject that ranges from very simple skills (e.g. paying

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attention, ability to know the color and the shape of objects, understanding what is heard of simple words and instructions, differentiating among voices, understanding the meaning of the basic expected words for a given age) to more complicated ones (e.g. understanding of complex real life situation, analysis of scientific phenomenon, problem solving in view of learnt facts and principles, critical and creative thinking). One, easily, may notice that cognitive skills could be considered as the essential “tools” of academic as well as work success. One important question one can raise at this point is: How the text books and teaching methodologies used in school and university levels knowingly address such skills? Another similar and important question could be asked related to meta-cognitive skills; knowledge one has about his/her own cognitive processes (Flavell, 1979), or as commonly said, thinking about thinking. Meta-cognition is related to self-monitoring, self-assessment, regulating learning and self-management and developmental planning cognitive issues (Pintrich & Groot, 1990; Schraw, 1998). Studying meta-cognitive skills is vital for academic success of the students and even for life long career success (Flavell, 1979, Pintrich & Groot, 1990; Schraw, 1998).

According to Perry’s (1979) model of intellectual development, freshmen students are usually dualistic in thinking. i.e. they see the world in dualistic fashion involving the opposites of right-wrong, good-bad, truth is absolute, and uncertainty can only be temporary (Finster, 1989). This black and white thinking changes with experience to a more complicated, contextual view of reality (relativism)(Finster, 1991). Unfortunately, most school and university teaching practices provide the opportunity to strengthen the dualist perspectives of students by specifying exactly what methodology of solving problems or laboratory data they are supposed to collect to verify the truth that has already been explained and discussed by the instructor (Finster, 1991). This kind of traditional teaching leaves no room for hypotheses, trials, errors, or individual responsibility, and precludes the student’s involvement in a decision-making process, which could be considered as an important training of cognitive and meta-cognitive skills and in scientific research and development. To overcome such problems, many methods have been developed and implemented. For example, in a guided inquiry approach, students may design the experiment through teacher-led discussions and certain practical efforts (Ricci & Ditzler, 1991; Palincsar et al., 1998; Hanson & Wolfskill, 2000). Cooperative and active learning (Yager et al., 1985; Johnson et al., 1991) and problem-solving teaching (Gallet, 1998) could be useful methodologies for different cognitive and meta-cognitive skills development. However, a focused teaching or learning practices based on the mentioned strategies to train the students about certain skill remains a different issue, as this could be related to the curricula itself and even how each topic is approached.

In this report, we will investigate the educational practices in the gulf region, especially, in Saudi Arabia from international perspective. However, there will be little emphasize on the international perspective due to the nature of this article. Also we will present our own effort in this regard. The flow of the article will be as follows:

- International Perspective
- Local Perspective: Saudi Arabia in particular and Gulf region including the authors’ perspective

The focus of each perspective will be on the current practices and efforts to overcome the problem of traditional teaching. Moreover, we will discuss how this is related to implementation of new methodologies in the class rooms and its effect on training of cognitive and meta-cognitive skills of the students to increase their academic and probably non-academic performance.

International Perspective

In the last two decades, science fields became less appealing to university students in different parts of the world, including the USA, Europe (Commission of European Communities, 2001:24), and Australia (Dekkers & DeLaeter, 2001; Lyons, 2004). Students' attitude and perception of science in general, may have contributed to this situation (Ramsden, 1998; Osborne et al., 2003). The learning environment and the way we teach science may have contributed tremendously to this perception (Ann, Timothy & Laubach, 2001; McWilliam et al., 2008). Student's characterization of school science as "boring or irrelevant" was reported in many countries as a common perception towards school science (Lyons, 2006; McWilliam et al., 2008). Another common perception of the school science as a "difficult" and "it is important but not for me", was also reported by many researchers in the literature (Kelly, 1988; Osborne et al., 1998; Thornton, 1999). Also, cognitive challenge (Osborne & Collins, 2001) and the unfamiliar terminology and concepts of most science courses contributed partly to these perceptions (Hanrahan, 2003). But we cannot ignore the frustration associated with passive learning, memorization, or the irrelevance of the context to the daily life of students (Lyons, 2006; McWilliam et al., 2008).

To solve such problem, the American Association for the Advancement of Science (AAAS) (1993) and the National Research Council (NRC) (1996) emphasized the importance of shifting towards student centered pedagogy. We need to build enthusiasm in our students to appreciate what they study. We need to motivate students and try to change their attitude toward science and science learning. Different studies have been conducted such as attitude towards learning, which is related to cognitive styles to accelerate cognitive processes (Brown & Holtzman, 1969; Kolb, 1981, Honey & Mumford, 1992; Entwistle, 1998) motivational aspects and learning strategies (Ryan, 1982; Vallerand & Bissonnette, 1992; Schunk & Meece, 1992; Apter, 2001; Pintrich, 2003). Introducing technological projects as learning tools (Zucker et al., 2008); using visual and spatial modes in the communication of scientific ideas (Ramadas, 2009); and bringing engineering design to teach some difficult science concept (Apedoe et al., 2008). All these studies aims, in one way or another, towards increasing cognitive or meta-cognitive skills among the students far from the traditional teaching methodologies. However, how fast these findings are implemented in daily life teaching practices remains a very open question to be investigated.

Local Perspective: Saudi Arabia and the Gulf Region and Our Own Perspective (in School and University Levels).

We believe that various problems associated with science education in the gulf region are similar, in principle, to the problems encountered in the international perspective. To help shedding some light on this issue we design a short questionnaire to probe the spectrum of student's interest in studying science in one of the respected universities in the gulf region. The number of students surveyed was 84 distributed among freshmen students who are taking introductory 101 courses. The analyses of the results are summarized in Table 1 below.

Table 1. The “spectrum” of students’ interest in studying science (n=84)

Students who have the desire and they like to study any of 101 courses	
101 – Course(s)	% of students
Math (only)	27%
Chem (only)	19%
Phys (only)	8%
None of the courses	31%
Math & Chem	5%
Math & Phys	5%
Chem & Phys	2%
All of the courses	3%
The most difficult freshman 101 course (math, phys, chem)	
Phys	70%
Chem	12%
Math	5%
None	13%

Interestingly, and in common agreement with international difficulties mentioned above in the international perspective, 24% of the students who said that Physics is difficult, did not take the Physics 101 course yet. Also, 100 % of the students who did not take physics yet, said that Physics is difficult. This puts more pressure on education specialist, education policy makers, ministry of education and ministry of higher education and even the privet sector to seriously address problems related to science education. In this regards, we found (Jalil et al., 2008) that university students were skeptical about whether the curricula design and teaching methodologies of higher education actually promote self-efficacy towards invention. The study including students with high grade point average (GPA), they expressed negative opinions about curricula design and teaching methodologies followed by their instructors. We believe this is a quality issue that is clear enough to the university students, and should be discussed loudly.

Fairly recently, several quality systems were initiated in different gulf countries to promote excellence in higher education to meet local and international challenges. For example (Al-Atiqi & Alharbi, 2009), Privet Universities Council in Kuwait was formed 2001, Oman accreditation council was formed 1999, and the National Commission for Academic Accreditation and Assessment was established in 2004. The need for quality assurance system in education may have been resulted from the old practice in education that resulted in the student’s characterization of science as “boring or irrelevant” as mentioned above.

Unfortunately, even recent quality systems, does not consider clearly and effectively the issue of cognitive and metacognitive development of the university students and how is it related to the people development and the wealth of the country. For example, if we examine the Privet Universities Council of Kuwait, we find five performance indicators (ibid) were considered as indicators of good quality of higher education:

1. Effectiveness (e.g. grade distribution, class per faculty, scientific quotation).
2. Productivity (e.g. output per academic staff, graduates, research)
3. Efficiency (e.g. resources utilization, students’ change of specialization, students under probation)
4. Internal structure (e.g. faculty per assistant and/or admin, faculty ranks, area per student)
5. Growth and renewal (new faculty per total, foreign students, part-time staff)

The same analogy could be seen in standards of quality assurance systems in Saudi Arabia (Darandari et al., 2009), where one easily notice that development of cognitive

skills and meta-cognitive skills or the related strategies among the students less pronounced compared to the other quality issues. Moreover, if it is mentioned in the specifications of the sub-standards in the system, there is no assessment methodology that shows how one can measure such skills among the students. In fairness of the people in charge of the system, we have to recognize that the quality assurance system is very young in Saudi Arabia, and it needs a lot of work from the team responsible of such system before having tangible results among university students. As everyone may know, such systems are dynamic ones, people in charge may add, omit, modify and evaluate success indicators that may contribute in producing high quality academic systems and hence quality graduates.

It is not secret that education needs more reforms in each country of the region. For states such as the UAE, a viable economic future is a race against time that can only be won with an integrated triangle consisting of educational policies, state actions, and maximization of economic opportunities. The key to the UAE's future depends on continued development and maintenance of a knowledge-based economy and continual reappraisal of the fundamental and traditional relationship between work, learning, and education (Vandewalle, 2000).

King Fahd University of Petroleum and Minerals (Dhahran Saudi Arabia) undertook faculty development initiative that aims at development through "enriched academic opportunities". The University established Teaching and Learning Centre to provide such experience to promote excellence in student learning inside and outside the classroom. The center offers voluntary service that fosters continuous academic development by arranges workshops, mini-courses, seminars, consulting services to all faculties and graduate teaching assistants. For evaluation, the center provides peer consultation and class-visits that provides constructive feedback for faculty members on their teaching skills and techniques. The hope is that the improved faculty skills will funnel through and help improve the quality of teaching and the student's level of achievement.

Several departments have adaptive complementary supportive efforts by enhancing student learning. The Physics Department offered introductory physics labs that are based on engaging the students in all aspect of the experiment. The instructor rule is to supervise and overall manage the experiments. At the end of each lab session the instructor administers comprehensive quiz that is designed to gauge the achievement of the students. In a survey conducted on 109 students participated in this program, 76% of the students feels that they became more of achiever, and are able to do experiments on their own. Moreover, 83% of the responded students reported that the lab improved their team work skills.

Attitude Towards Science Learning Can Be Changed

Our research on some characteristics of Noble Laureates (Jalil & Boujettif, 2005) indicated that, as students, they preferred to carry out experiments first then draw up their conclusions, which is far more thought-provoking; requiring the person to draw on qualities such as initiative, ingenuity and resourcefulness. This result was found to be in agreement with a recent study (Jalil, 2006) where university student's benefited more when left to experiment first and draw up conclusions on their own. Positive changes in students' attitude (e.g. enjoyment, persistence, sense of being achievers) were observed. The study was performed on freshman chemistry students taking the laboratory associated with the course. We followed two different approaches. In Approach I, each experiment was explained and demonstrated to the students before they are allowed to perform the required experiment.

The expected results were also discussed. In Approach II, the students started the

experiments themselves at the beginning of the laboratory session with minimal help from the instructor. Surveys related to understanding, enjoyment, achievement, and the difficulties of conducting the experiment were then carried out. While 54% of the students reported increased understanding using Approach II, only 32% reported similarly following Approach I. However, 78% of the students said they felt better about themselves and their achievements using Approach II and 76% claimed they became more self-dependent and conducting experiments alone became routine or almost routine.

We also found that above average students (with grades more than or equal to the average+1.5 of the standard deviation of the class) preferred to do the experiments first, while only 17% of students with low grades (grades less than or equal the average-1.5 of the standard deviation of the class) preferred this approach.

These results encouraged us to attempt to influence the students' attitudes towards science learning at an earlier stage of their schooling life. The research of Gibson and Chase (2002) also suggests that attitudes towards science develops at early stage in a child's education and is difficult to change once they reach middle school.

Our recent results (Jalil et al., 2009), where we employed a hands-on experimental approach based on stimulating very high cognitive levels in teaching several science topics, involving students from grades 1 to 4. As a means of improving attitude towards learning science, increasing the students' understanding and achievement, and increasing their self-confidence of being inventors. In this active learning approach, students were left to conduct the experiment/task themselves without any explanation from the teacher and left to draw their own conclusions. This is considered a high level training of using complex cognitive skills of the students. This was done in contrast to the traditional methodology, where teachers explain and demonstrate the experiment to students before they conduct the experiment/task themselves. This type of training (which we don't like to call it teaching) has a clear effect when we have studied (Jalil et. al., 2008) the self-efficacy towards invention, which could be considered as a significant "precursor" to innovative solutions among university and school aged students.

At the university level, it has been found that the mean self efficacy-towards invention was the highest in students from the university preparatory years (2.75/10) whilst being lowest amongst students at senior levels (1.85/10). The students (including students with high grade point average) were skeptical about whether the curricula design and teaching methodologies of higher education, actually promote self-efficacy towards invention. The students also expressed negative opinions about both constructs. Also, it has been found that the correlation between the CGPA with any of the constructs looked at, was not significant for the 392 university students in this study ($\alpha=0.05$).

Regarding the school aged students, 32% of the third grade (G3) and fourth grade (G4) students exhibited self-efficacy toward innovation. This percentage roughly doubled (to 63%) after their participation in a one month training program which took students through a highly student-centered approach learning. The program aimed at promoting high cognitive levels to obtain more innovative and creative products. This is also can be considered as a training of meta-cognitive practices where continuous monitoring of each thought and step of action should be considered and even properly planned to obtain certain results or products in a given time with certain specifications.

Working Memory: Always Present, But an Absent Issue in Academic Systems

Working memory is where we "think" as we learn. A notion that emerges as a synthesis from several threads in the research literatures of cognition, motivation, and connectionism. It is that motivation in learning, the process whereby working memory resource allocation is instigated and sustained (Baddeley, 1992; Brooks & Shell, 2006).

Working memory in students' centered learning methodologies and engagement of higher cognitive skills of the brains is expected to be activated much more readily as compared to the traditional approach, throughout the learning process. This requires greater attention and conscious awareness on the part of the students. Such involvement of the working memory may produce scientific learnt models (Haruno et al., 1999; Haruno et al., 2001; Vandervert, 2003; Wolpert et al., 2003) for a given scientific phenomena in a faster time and the conscious awareness of the students may be considered as training of the active memory itself (Baddeley & Logie, 1999). It is worth to note at this point, the modeling of cognitive processes, which needs kind of "repetitive processes" via constructivist approach are most efficiently modeled (constructed) in the cerebellum; not just rote repetition (Jalil, 2007). Many researchers showed the strength of the constructivist approach in gaining concept and the interactions of these concepts with one's experience (ref. in Jalil, 2007). However, our view does not propose that there are no other disadvantages to constructivist approach in learning. But the potential significance of constructivism has already extended beyond research; into the classroom where creativity could be the first place to be taught. Such high involvement of working memories is expected to increase the efficiency of the learnt models and the subsequent feed back to the motor areas of the cerebral cortex. This is translated to students experiencing less pressure and more relaxation when dealing with challenging problems. Our recent studies shows (Jalil et al., 2009) students build their own scientific models in our approach rather than "transferring" other people's (the teacher who is instructing 'his own model') scientific models into their heads as in the traditional approaches of teaching science.

To conclude we believe that the constructivist approach associate with high activation of the working memory via awareness of careful training of high level cognitive and meta-cognitive skills may contribute in faster formation of learnt models (Jalil, 2007). Furthermore; because the components of working memory contain the attributes of conscious awareness, it is argued that the patterns of the cerebellar models learned in working memory provide the experiential basis for scientific discovery (Vandervert, 2003); which is a vital factor for nations' development.

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