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Project Based Learning versus Traditional Learning – Comparing Perpectives of Arab Managers with Chinese Managers

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ABSTRACT

The perspectives on Project Based Learning (PBL), traditional learning and engineering competencies are influenced by national and organizational culture. Based on Hofstede's cultural dimensions theory and grounded in constructivist learning theory, the purpose of this study is to identify the perspectives of Arab and Chinese managers on the effectiveness of PBL versus traditional learning.
Utilizing descriptive and inferential statistics (Wilcoxon and Mann Whitney U test), findings show that Arab managers perceive 13 and Chinese managers 2 competencies to be more effectively developed by PBL, while the difference between PBL and traditional learning is perceived smaller among Chinese managers. A higher desire of avoiding uncertainty among Arab managers, higher achievement orientation among Chinese managers and an influence of educational systems were identified. Higher Education Institutions (HEIs) are advised to consider these findings, in order to compare with their institutions' utilization of PBL versus traditional learning and to prepare engineers for global employment.

Keywords: Project Based Learning, PBL, engineering, competency, industry perspective, Gulf Cooperation Council, GCC, China.

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INTRODUCTION AND BACKGROUND

Various models and approaches related to Problem Based Learning (PBL) have been developed over the past decades (e.g. Savin-Baden, 2007). Anecdotal evidence indicates that Problem-Based Project-Organized Learning (Garcia, Bollain and Del Corral, 2011) is the predominant variant applied in engineering education within the geographic region of the Gulf Cooperation Council (GCC). However, engineering educators and industry representatives within this region prefer to use the shorter label, Project Based Learning, along with the abbreviation PBL.

The goal of students' learning is the development and delivery of a set of complementary and interrelated competencies. Sets of competencies are used as frameworks for exit or employer satisfaction surveys (e.g. Christoforou *et al.*, 2003; Ramadi *et al.*, 2016), and sets of competencies can also be used to analyse the effectiveness of PBL principles in general (Jaeger *et al.*, 2018) or of specific PBL models (Schmidt *et al.*, 2006; Ulseth and Johnson, 2015).

In engineering education, instructors, students and employers are the main stakeholders of the competency development process. Students have a certain level of competency when entering this process (i.e. entry qualification), instructors and educational institutions further develop these competencies (i.e. learning facilitation), before employers receive graduates with an enhanced level of competencies (i.e. programme attributes) and continue to develop these competencies based on their specific needs (i.e. professional development). Individuals of each group of stakeholders experience directly or indirectly this competency development process, and they have distinct perceptions on the utilized learning approaches.

Earlier studies (Rumberger and Thomas, 1993; Vermeulen-Kerstens, 2006) showed that the analysis of career success should use two dimensions to ensure reliable measurements, namely the subjective/intrinsic dimension (i.e. employee perspective) and the objective/extrinsic dimension (i.e. employer perspective). This approach is also applicable to the evaluation of learning approaches such as PBL and its variants. Student evaluations and faculty feedback can provide the subjective dimension, whereas employers can provide the objective dimension.

It could be argued that only instructors and students are able to evaluate learning approaches such as PBL since managers of engineers may not have experienced such approaches. However, this perspective ignores that employers are at the receiving end of the competency development process, and their perspective on employees' performance provides an ultimate evaluation of employees' competencies. Managers and work supervisors with several years of experience and line responsibility for engineers realize

the differences in competency levels among their employees and frequently relate these to different learning approaches and learning environments employees have been previously exposed to. Also, managers and work supervisors are frequently involved in training on the job and professional development and have experience with the effectiveness of different learning approaches. Therefore, managers and supervisors are in a good position to provide important feedback on learning approaches, albeit they may not have experienced these approaches themselves. As is the case with PBL in the GCC region, employers' feedback becomes even more important when educational institutions apply a new learning approach (such as PBL) and the number of graduates who have been exposed to the new approach is not yet large enough, or their duration of employment is currently too short, to draw any reliable conclusion from graduates' evaluations.

The perspective on PBL is influenced by national culture (e.g. Walker *et al.*, 1996) and organizational culture of the educational institution (e.g. Camacho *et al.*, 2018). In a similar manner, the importance of specific engineering competencies has been found to vary across different geographic regions (Lucena *et al.*, 2008) and to be shaped by cultural backgrounds (Jaeger *et al.*, 2019). Therefore, there is a need for region specific research related to engineering competencies (Ramadi *et al.*, 2016) as well as the application of the PBL approach in order to adequately develop engineering competencies within the region at question. This study is contributing to meeting this need regarding the perspectives of PBL within the region of the GCC. The focus is on the perspectives of Arab and Chinese managers of engineers as justified below.

It has been shown before that countries of the GCC region have many particularities in common (Ellaboudy, 2010). Three of the six countries of the GCC region, namely Kuwait, Saudi Arabia and the United Arab Emirates, were included in Hofstede's study of cultural dimensions and the four culture dimensions of the analysis were identical for these countries (Hofstede, 1980, 1984). It is typical for all countries of the GCC region that engineers from diverse cultural backgrounds work for organizations with different organizational cultures and collaborate on projects within the same socio-economic context, i.e. the GCC region.

However, the national cultures in the GCC region are clearly different from the national culture of China in that "uncertainty avoidance", one of the four culture dimensions used by Hofstede when comparing national cultures and indicating the extent to which members of a society feel threatened by ambiguity (Hofstede, 1980; Hofstede-insights, 2019), is in China with 30 much lower than in the GCC region with 80 (Hofstede-insights, 2019). Furthermore, "masculinity", another dimension of Hofstede's country scores and indicating how much a society is driven by competition, achievement and success (Hofstede-insights, 2019), is with 66 in China higher than with 40 in the GCC region.

This means, Chinese culture is more success driven and achievement oriented than GCC culture (Hofstede-insights, 2019).

Chinese organizations and engineers are increasingly involved in engineering activities in the GCC region (Pacheco and March, 2014). In 2020, China is expected to be the biggest market for the oil exporting countries of the GCC region, which in turn draws Chinese companies to the GCC region (EIU, 2014). Ambitious Chinese projects such as the 'one belt, one road' initiative (Qian and Fulton, 2017) contribute further to activities of Chinese companies in the GCC region and beyond. The increasing involvement of Chinese managers of engineers in the GCC region and their involvement in employing engineering graduates from local educational institutions justifies comparing their perspective of PBL with the perspective of their Arab counterparts. The insights will allow conclusions regarding the influence of cultural backgrounds on the perspectives of PBL, which in turn can inform instructors and educational institutions in China and the GCC region when applying PBL *versus* traditional learning at their institutions.

PURPOSE OF STUDY

The purpose of this study is to identify the perspectives of Arab and Chinese managers of engineers in the GCC region on PBL *versus* traditional learning. This means, the intention is to provide the 'objective/extrinsic' dimension (Vermeulen-Kerstens, 2006), of the perspective on PBL *versus* traditional learning and to provide region specific research results which can be used to close the gap between industry's expectations of engineering competencies and satisfaction with these competencies (Ramadi *et al.*, 2016).

Furthermore, the purpose of this study is to utilize a set of engineering competencies for the identification of perspectives on PBL *versus* traditional learning, in order to apply a framework that is equally relevant for the three main stakeholders of the competency development process. For this study, Engineers Australia's sixteen competency elements for Engineering Technologists (EA, 2017) are used, since they are similar to graduate attributes listed by other engineering accrediting bodies such as the student outcomes of ABET (Abet.org, 2014) or the graduation requirements of the China Engineering Education Accreditation Association (Wu, 2015) which are adopted from the graduate attributes of the Washington Accord (IEA, 2013). These competency elements cover all essential skills identified in an earlier study (Nguyen, 1998) as distinct competencies, and a summary of these competency elements is shown in Table 1.

Competency area	Competency element
1. KNOWLEDGE AND SKILLS	1.1. Theory based understanding of the underpinning natural sciences
	1.2. Conceptual understanding of mathematics, numerical analysis, statistics, etc.
	1.3. In depth understanding of specialist knowledge areas
	1.4. Discernment of current knowledge development, such as new methods and materials
	1.5. Knowledge of contextual factors such as business, culture, laws, etc.
	1.6. Understanding of the scope, principles, accountabilities of contemporary engineering
2. ENGINEERING APPLICATION ABILITY	2.1. Application of established engineering methods to problem solving
	2.2. Application of engineering techniques, tools and resources
	2.3. Application of systematic synthesis and design processes
	2.4. Application of systematic approaches to the management of projects
3. PROFESSIONAL AND PERSONAL ATTRIBUTES	3.1. Ethical conduct and professional accountability
	3.2. Effective oral and written communication
	3.3. Creative, innovative and pro-active demeanour
	3.4. Professional use and management of information
	3.5. Orderly management of self and professional conduct
	3.6. Effective team membership and team leadership

Table 1. Competency areas and elements (Source: EA, 2017).

The following sections present the research questions and methodology, results, discussion and conclusions.

RESEARCH QUESTIONS AND METHODOLOGY

Based on the background and purpose of this study as described above, the research questions are composed as follows:

1) What is the contribution of PBL *versus* traditional learning to develop the sixteen competency elements from the perspective of a) Arab managers and b) Chinese managers?
2) Is there a statistically and practically significant difference between the contribution of PBL and traditional learning in developing the sixteen competency elements from the perspective of a) Arab managers and b) Chinese managers?
3) Is there a statistical and practical significant difference between the perspective of Arab managers and the perspective of Chinese managers regarding the development of the sixteen competencies by a) PBL and b) traditional learning?

Questionnaire-based interviews were conducted with Arab and Chinese managers of engineers in Kuwait, a country typical of those found in the GCC region. In order to ensure comparable experience of respondents, only managers with at least five years of

experience as a line manager and active involvement in supervision and leadership of engineers were approached based on personal contacts.

The questionnaire included the sixteen elements of competency shown in Table 1, and the managers were asked to rate them on a 5-point Likert scale regarding their perception of the contribution of PBL in developing these competencies (very little (1) to very much (5)) and regarding their perception of the contribution of traditional learning in developing these competencies (very little (1) to very much (5)).

Prior to rating, the difference between PBL and traditional learning was explained based on a schematic graphic shown on Figure 1. Because of managers' time constraints for interviews and because of different levels of experience with PBL, this simplified and condensed comparison was developed, and it was found applicable. It reduced biased responses resulting from different definitions and backgrounds without neglecting the main characteristics of PBL (Barrows, 1996).

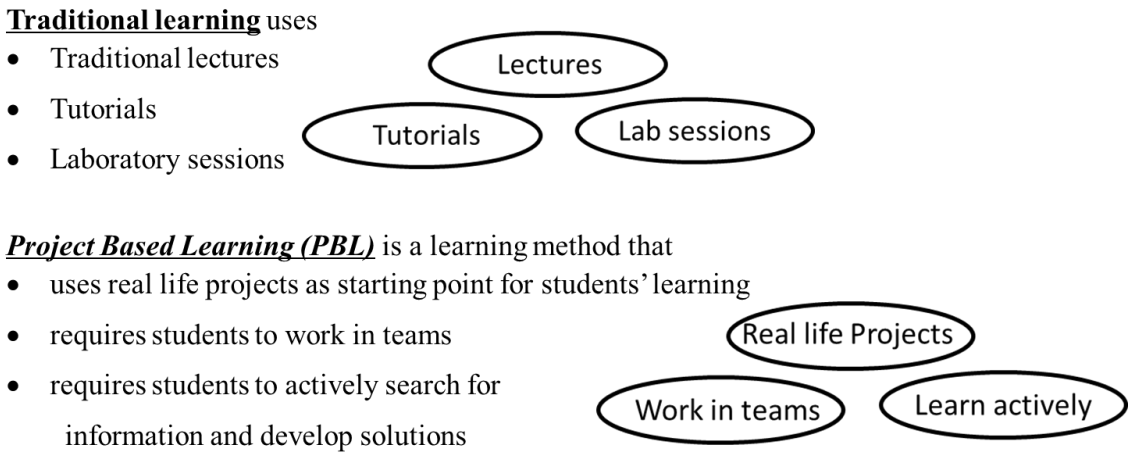

Figure 1. Simplified comparison PBL versus traditional learning.

In addition to respondents' perspectives on PBL and traditional learning, demographic data has been collected and is shown on Table 2.

Variable		Respondents			
		Arab managers		Chinese managers	
		#	%	#	%
Education					
	Bachelor	73	80	29	56
	Master	17	18	23	44
	Ph.D.	2	2	0	0
	Total Education	92	100	52	100
Position					
	Upper management	37	40	26	50
	Lower management	55	60	26	50
	Total Position	92	100	52	100
Industry					
	Petroleum	32	35	0	0
	Construction	40	44	49	94
	Manufacturing	5	5	2	4
	Telecommunication / Electrical	15	16	1	2
	Other	0	0	0	0
	Total Industry	92	100	52	100
Sector					
	Private	35	38	15	29
	Public	57	62	37	71
	Total Sector	92	100	52	100
Size of Organization					
	<10	6	6	1	2
	10-100	30	33	31	60
	>100	56	61	20	38
	Total Size	92	100	52	100
Industrial experience					
	Average number of years	12.7		7.1	

Table 2. Demographic data of respondents.

The collected data is analysed using descriptive statistics to answer research question one, Wilcoxon test to answer research question two and Mann Whitney U test to answer research question three. The Wilcoxon test was chosen since the same group of respondents was evaluating two different aspects, i.e. the contribution of PBL and the contribution of traditional learning; the Mann Whitney U test was appropriate since two different groups of respondents evaluated the same aspects, i.e. contribution of PBL and the contribution of traditional learning (Cohen *et al.*, 2011). Both tests convert collected scores to ranks, before they evaluate if the number of times the score of one aspect is significantly different from the score of the other aspect, and the tests do not require similar sample sizes (e.g. Mann and Whitney, 1947). Since the scores are converted to ranks, the analysis does also not require normal distribution of scores. Following common

practice, the level of significance alpha was set to 0.05. The following sections summarizes the results of the statistical analysis.

RESULTS

The descriptive statistics (Mean, Standard Deviation (SD)) of the perceived contribution to development of competencies by PBL and traditional learning for each of the sixteen competency elements and for both groups of respondents (i.e. Arab managers and Chinese managers) is shown on Table 3. Arab managers perceived *Effective team membership…* (4.6) to be highest developed by PBL and *Conceptual understanding of mathematics…* (3.6) to be lowest developed by PBL, whereas they perceived *Conceptual understanding of mathematics…* (4.0) to be highest developed by traditional learning and *Knowledge of contextual factors…* (2.7) to be lowest developed by traditional learning. Chinese managers perceived *Effective team membership…* and *Creative, innovative and pro-active…* (3.9) to be highest developed by PBL and *Theory based understanding…* (3.2) to be lowest developed by PBL, whereas they perceived *Effective team membership…*, *Ethical conduct…* and *Application of established engineering…* (3.5) to be highest developed by traditional learning and *Knowledge of contextual factors…* and *Theory based understanding…* (3.1) to be lowest developed by traditional learning. The Standard Deviation (SD) of the evaluations by Chinese managers is in general larger than by Arab managers.

Competency Element	Arab managers				Chinese managers			
	PBL		Trad		PBL		Trad	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
1.1. Theory based understanding…	3.7	1.0	3.9	1.0	3.2	1.2	3.1	1.1
1.2. Conceptual understanding of mathematics…	3.6	1.0	4.0	0.9	3.3	1.1	3.2	1.3
1.3. In depth understanding…	4.1	0.9	3.6	0.9	3.8	0.9	3.2	1.1
1.4. Discernment of current knowledge…	4.3	0.8	3.2	1.0	3.6	1.0	3.4	1.1
1.5. Knowledge of contextual factors…	4.1	0.9	2.7	1.1	3.5	1.1	3.1	1.4
1.6. Understanding of accountabilities…	4.2	0.8	3.4	0.9	3.5	1.1	3.3	1.1
2.1. Application of established engineering…	4.4	0.8	3.2	1.0	3.6	1.1	3.5	1.3
2.2. Application of engineering techniques…	4.3	0.8	3.2	1.0	3.5	1.1	3.4	1.4
2.3. Application of systematic design…	4.1	1.0	3.6	1.0	3.4	1.1	3.2	1.2
2.4. Application of systematic management…	4.3	0.8	3.1	1.0	3.4	1.1	3.3	1.1
3.1. Ethical conduct…	4.2	0.9	3.2	1.2	3.6	1.1	3.5	1.1
3.2. Effective oral and written communication…	4.4	0.7	3.4	1.1	3.6	1.2	3.4	1.2
3.3. Creative, innovative and pro-active…	4.2	0.8	3.0	1.1	3.9	1.0	3.4	1.1
3.4. Professional use of information…	4.2	0.7	3.3	1.1	3.7	1.0	3.3	1.1
3.5. Orderly management of self…	4.3	0.7	3.3	1.0	3.6	1.2	3.3	1.3
3.6. Effective team membership…	4.6	0.6	3.2	1.1	3.9	1.1	3.5	1.3

Table 3. Descriptive statistics (Mean, Standard Deviation) of competency elements developed by Project Based Learning (PBL) and traditional learning (Trad).

The difference between development by PBL and by traditional learning, as perceived by Arab managers, is summarized on Table 4. A statistically different contribution to development of competencies was found for all competency elements, except *Theory based understanding…* (p = 0.175). Accordingly, the difference regarding this competency element will be excluded from interpretation in the following discussion section.

Competency Element	**PBL**		**Trad**		**Wilcoxon test**	
	Median	SD	Median	SD	Z	*p*
1.1. Theory based understanding…	4.0	1.0	4.0	1.0	-1.356	0.175
1.2. Conceptual understanding of mathematics…	4.0	1.0	4.0	0.9	-3.142	0.002
1.3. In depth understanding…	4.0	0.9	3.0	0.9	3.557	< .0001
1.4. Discernment of current knowledge…	4.0	0.8	3.0	1.0	6.511	< .0001
1.5. Knowledge of contextual factors…	4.0	0.9	3.0	1.1	3.945	< .0001
1.6. Understanding of accountabilities…	4.0	0.8	3.0	0.9	4.579	< .0001
2.1. Application of established engineering…	5.0	0.8	3.0	1.0	7.607	< .0001
2.2. Application of engineering techniques…	4.5	0.8	3.0	1.0	6.489	< .0001
2.3. Application of systematic design…	4.0	1.0	4.0	1.0	3.242	0.001
2.4. Application of systematic management…	4.0	0.8	3.0	1.0	5.711	< .0001
3.1. Ethical conduct…	4.0	0.9	3.0	1.2	4.161	< .0001
3.2. Effective oral and written communication…	5.0	0.7	3.0	1.1	7.380	< .0001
3.3. Creative, innovative and pro-active…	4.0	0.8	3.0	1.1	4.919	< .0001
3.4. Professional use of information…	4.0	0.7	3.0	1.1	4.330	< .0001
3.5. Orderly management of self…	4.0	0.7	3.0	1.0	5.484	< .0001
3.6. Effective team membership…	5.0	0.6	3.0	1.1	10.838	< .0001

Table 4. Difference between Project Based Learning (PBL) and traditional learning (Trad) – perspective of Arab managers.

The difference between development by PBL and by traditional learning, as perceived by Chinese managers, is summarized on Table 5. Different from the perspective of Arab managers, all differences are statistically in-significant, except *In-depth understanding*... ($p = 0.007$) and *Creative, innovative and pro-active*... ($p = 0.022$).

Competency Element	**PBL**		**Trad**		**Wilcoxon test**	
	Median	SD	Median	SD	Z	*p*
1.1. Theory based understanding…	3.5	1.2	3.0	1.1	0.679	0.497
1.2. Conceptual understanding of mathematics…	3.0	1.1	3.0	1.3	0.283	0.777
1.3. In depth understanding…	4.0	0.9	3.0	1.1	2.711	0.007
1.4. Discernment of current knowledge…	4.0	1.0	3.0	1.1	1.219	0.223
1.5. Knowledge of contextual factors…	4.0	1.1	3.0	1.4	1.557	0.119
1.6. Understanding of accountabilities…	4.0	1.1	3.0	1.1	0.689	0.491
2.1. Application of established engineering…	4.0	1.1	4.0	1.3	0.507	0.612
2.2. Application of engineering techniques…	3.0	1.1	4.0	1.4	-0.111	0.912
2.3. Application of systematic design…	4.0	1.1	3.0	1.2	0.618	0.537
2.4. Application of systematic management…	4.0	1.1	3.0	1.1	0.819	0.413
3.1. Ethical conduct…	4.0	1.1	3.0	1.1	0.728	0.467
3.2. Effective oral and written communication…	4.0	1.2	3.5	1.2	0.579	0.563
3.3. Creative, innovative and pro-active…	4.0	1.0	3.0	1.1	2.295	0.022
3.4. Professional use of information…	4.0	1.0	3.0	1.1	1.612	0.107
3.5. Orderly management of self…	4.0	1.2	4.0	1.3	1.173	0.241
3.6. Effective team membership…	4.0	1.1	4.0	1.3	1.271	0.204

Table 5. Difference between Project Based Learning (PBL) and traditional learning (Trad) – perspective of Chinese managers.

The difference between the perspectives of Arab managers *versus* Chinese managers on the development of competency elements by PBL is shown on Table 6. A statistically significant difference was found for all competencies except *Conceptual understanding of mathematics…* ($p = 0.067$) and *Creative, innovative and pro-active…* ($p = 0.072$).

Competency Element	**Arab**		**Chinese**		**MWU test**		
	Md.	*SD*	*Md.*	*SD*	*U*	*Z*	*p*
1.1. Theory based understanding…	4.0	1.0	3.5	1.2	1826.0	2.352	0.019
1.2. Conceptual understanding...	4.0	1.0	3.0	1.1	1950.5	1.834	0.067
1.3. In depth understanding…	4.0	0.9	4.0	0.9	1893.0	2.073	0.038
1.4. Discernment of current…	4.0	0.8	4.0	1.0	1403.5	4.109	< .0001
1.5. Knowledge of contextual…	4.0	0.9	4.0	1.1	1656.5	3.057	0.002
1.6. Understanding of…	4.0	0.8	4.0	1.1	1468.0	3.841	< .0001
2.1. Application of established...	5.0	0.8	4.0	1.1	1370.0	4.249	< .0001
2.2. Application of engineering...	4.5	0.8	3.0	1.1	1295.0	4.561	< .0001
2.3. Application of systematic…	4.0	1.0	4.0	1.1	1491.0	3.745	< .0001
2.4. Application of systematic…	4.0	0.8	4.0	1.1	1252.0	4.739	< .0001
3.1. Ethical conduct…	4.0	0.9	4.0	1.1	1616.5	3.223	0.001
3.2. Effective oral and written…	5.0	0.7	4.0	1.2	1370.5	4.247	< .0001
3.3. Creative, innovative…	4.0	0.8	4.0	1.0	1959.0	1.799	0.072
3.4. Professional use of…	4.0	0.7	4.0	1.0	1649.5	3.086	0.002
3.5. Orderly management…	4.0	0.7	4.0	1.2	1762.5	2.616	0.009
3.6. Effective team…	5.0	0.6	4.0	1.1	1363.5	4.276	< .0001

Table 6. Difference between Arab and Chinese managers using Mann Whitney U (MWU) test – competency elements developed by Project Based Learning.

In order to facilitate interpretations of the difference between the perspectives of Arab managers and Chinese managers, the competency elements developed by PBL have been ranked based on their Mean value as shown on Table 7. The three competency elements developed most effectively by PBL (i.e. rank one to three) from the Arab managers' perspective are *Effective team membership…*, *Application of established engineering…* and *Effective oral and written communication…*. The same competency elements are on rank 2, 5 and 9 from the Chinese managers' perspective.

The three competency elements developed least effectively by PBL (i.e. rank 14 to 16) are from the Arab managers' perspective *Application of systematic design…*, *Theory based understanding…* and *Conceptual understanding of mathematics…*. The same competency elements are ranked 14, 16 and 15 from the Chinese managers' perspective.

Ran #	Arab managers	Chinese managers
1	3.6. Effective team membership…	3.3. Creative, innovative and pro-active…
2	2.1. Application of established engineering...	3.6. Effective team membership…
3	3.2. Effective oral and written communication…	1.3. In depth understanding…
4	1.4. Discernment of current knowledge…	3.4. Professional use of information…
5	2.2. Application of engineering technique...	2.1. Application of established engineering…
6	2.4. Application of systematic management…	3.5. Orderly management of self…
7	3.5. Orderly management of self…	1.4. Discernment of current knowledge…
8	3.3. Creative, innovative and pro-active…	3.1. Ethical conduct…
9	1.6. Understanding of accountabilities…	3.2. Effective oral and written communication…
10	3.4. Professional use of information…	1.5. Knowledge of contextual factors…
11	3.1. Ethical conduct…	2.2. Application of engineering techniques…
12	1.5. Knowledge of contextual factors…	1.6. Understanding of accountabilities…
13	1.3. In depth understanding…	2.4. Application of systematic management…
14	2.3. Application of systematic design…	2.3. Application of systematic design…
15	1.1. Theory based understanding…	1.2. Conceptual understanding of mathematics…
16	1.2. Conceptual understanding of mathematics...	1.1. Theory based understanding…

Table 7. Ranking of competency elements developed by Project Based Learning (most effectively developed to least effectively developed).

The difference between the perspectives of Arab managers *versus* Chinese managers on the development of competency elements by traditional learning is shown on Table 8. A statistically significant difference was only found for three competency elements, namely *Theory based understanding*… ($p < 0.0001$), *Conceptual understanding of mathematics*… ($p < 0.0001$) and *Creative, innovative and pro-active*… ($p = 0.038$).

Competency Element	**Arab**		**Chinese**		**MWU test**		
	Md.	*SD*	*Md.*	*SD*	*U*	*Z*	*p*
1.1. Theory based understanding…	4.0	1.0	3.0	1.1	1365.0	4.269	< .0001
1.2. Conceptual understanding...	4.0	0.9	3.0	1.3	1455.0	3.895	< .0001
1.3. In depth understanding…	3.0	0.9	3.0	1.1	1981.0	1.707	0.087
1.4. Discernment of current…	3.0	1.0	3.0	1.1	2150.5	-1.002	0.317
1.5. Knowledge of contextual…	3.0	1.1	3.0	1.4	2029.0	-1.508	0.131
1.6. Understanding of…	3.0	0.9	3.0	1.1	2366.5	-0.104	0.920
2.1. Application of established...	3.0	1.0	4.0	1.3	2077.0	-1.308	0.190
2.2. Application of engineering...	3.0	1.0	4.0	1.4	2034.0	-1.487	0.136
2.3. Application of systematic…	4.0	1.0	3.0	1.2	1927.5	1.930	0.054
2.4. Application of systematic…	3.0	1.0	3.0	1.1	2186.5	-0.853	0.395
3.1. Ethical conduct…	3.0	1.2	3.0	1.1	2049.0	-1.425	0.156
3.2. Effective oral and written…	3.0	1.1	3.5	1.2	2093.5	-1.239	0.215
3.3. Creative, innovative…	3.0	1.1	3.0	1.1	1895.0	-2.065	0.038
3.4. Professional use of…	3.0	1.1	3.0	1.1	2312.0	-0.331	0.741
3.5. Orderly management…	3.0	1.0	4.0	1.3	2309.0	-0.343	0.728
3.6. Effective team…	3.0	1.1	4.0	1.3	1948.5	-1.843	0.066

Table 8. Difference between Arab and Chinese managers using Mann Whitney U (MWU) test – competency elements developed by traditional learning.

The competency elements developed by traditional learning have been ranked based on their Mean value as shown on Table 9. The three competency elements developed most effectively by traditional learning (i.e. rank one to three) are from the Arab managers' perspective *Conceptual understanding of mathematics…, Theory based understanding…* and *Application of systematic design….* The same competency elements are on rank 13, 15 and 12 from the Chinese managers' perspective.

The three competency elements developed least effectively by traditional learning (i.e. rank 14 to 16) are from the Arab managers' perspective *Application of systematic management…, Creative, innovative and pro-active… and Knowledge of contextual factors….* The same competency elements are ranked 11, 6 and 16 from the Chinese managers' perspective.

Ran #	Arab managers	Chinese managers
1	1.2. Conceptual understanding of mathematics…	3.6. Effective team membership…
2	1.1. Theory based understanding…	3.1. Ethical conduct…
3	2.3. Application of systematic design…	2.1. Application of established engineering…
4	1.3. In depth understanding…	3.2. Effective oral and written communication…
5	3.2. Effective oral and written communication…	2.2. Application of engineering techniques…
6	1.6. Understanding of accountabilities…	3.3. Creative, innovative and pro-active…
7	3.5. Orderly management of self…	1.4. Discernment of current knowledge…
8	3.4. Professional use of information…	1.6. Understanding of accountabilities…
9	2.1. Application of established engineering…	3.4. Professional use of information…
10	3.1. Ethical conduct…	3.5. Orderly management of self…
11	2.2. Application of engineering techniques…	2.4. Application of systematic management…
12	3.6. Effective team membership…	2.3. Application of systematic design…
13	1.4. Discernment of current knowledge…	1.2. Conceptual understanding of mathematics…
14	2.4. Application of systematic management…	1.3. In depth understanding…
15	3.3. Creative, innovative and pro-active…	1.1. Theory based understanding…
16	1.5. Knowledge of contextual factors…	1.5. Knowledge of contextual factors…

Table 9. Ranking of competency elements developed by traditional learning (most effectively developed to least effectively developed).

The following section summarizes the interpretation and discussion of the presented results.

DISCUSSION

Based on the presented findings, each of the three research questions will be answered and discussed in the following.

The first research question is related to the contribution of PBL *versus* traditional learning to develop the sixteen competency elements from the perspective of a) Arab managers and b) Chinese managers.

The descriptive statistics (Table 3) allow the following interpretations. The Arab managers' difference between the highest and lowest Mean values is larger than the Chinese managers' difference between the highest and lowest Mean values. This means, Chinese managers perceive the development of competency elements by both approaches (i.e. PBL and traditional learning) to be more similar for all competency elements than the Arab managers do. Since the questionnaire was translated into Arabic for the Arab managers and into Chinese for the Chinese managers, an effect of language related differences in understanding the competency elements can be excluded. Furthermore, since all the interviewed managers did not experience PBL during their formal education, and since the difference between PBL and traditional learning was explained in the same

manner to all respondents, varying understanding of the two learning approaches (i.e. PBL and traditional learning) can be excluded too. However, the difference between GCC national culture and Chinese national culture, in particular the difference in "uncertainty avoidance", is reflected in Chinese managers being more comfortable with ambiguity than Arab managers (Hofstede-insights, 2019). This may have reduced the felt need to position themselves more distinct when evaluating the two learning approaches. Furthermore, the difference in "masculinity" (Hofstede-insights, 2019) may have caused a tendency among Chinese managers to evaluate a newer and less familiar learning approach (such as PBL) lower since the focus is more on achievement *versus* the method towards achievement. The latter interpretation is confirmed by the results presented here in that Chinese managers evaluated the development by PBL for all competency elements lower than the Arab managers, whereas they evaluated the development by traditional learning for eight out of 16 competency elements higher than the Arab managers. The differences between the development by PBL *versus* traditional learning for the individual competency elements is covered by research question two and will be covered in the following paragraph.

The second research question is related to the significance of differences between the contribution of PBL and traditional learning in developing the sixteen competency elements from the perspective of a) Arab managers and b) Chinese managers.

The results shown on Table 4 show in conjunction with Table 3 that Arab managers perceive a statistically significant higher development by PBL for all competency elements except *Conceptual understanding of mathematics…* and *In depth understanding….* This means, all elements of the competency areas "engineering application ability" and "professional and personal attributes" (c.f. Table 1) are developed more effectively by PBL. Regarding the competency area "knowledge and skills", three competency elements are perceived to be developed more effectively by PBL (i.e. *Understanding of accountabilities…, Knowledge of contextual factors…, Discernment of current knowledge…*), two competency elements are perceived to be developed more effectively by traditional learning (i.e. *In depth understanding…, Conceptual understanding of mathematics…*) and one competency element did not show a statistically significant difference between the two learning approaches (i.e. *Theory based understanding…*). Arab managers are very much in favour of PBL, which might be related to an unsatisfied learning experience during their own formal education and/or an unsatisfying level of competencies among early career engineers. Anecdotal evidence seems to indicate that both aspects contributed to their perspective on PBL to develop engineering competencies.

The results on Table 5 and Table 3 show that Chinese managers perceive both competency elements *In-depth understanding…* and *Creative, innovative and pro-active…* to be statistically significantly more effectively developed by PBL. They seem to realize potential for students to go more into detail (i.e. *In-depth understanding…*) and to explore creative solutions (i.e. *Creative, innovative and pro-active…*) when learning is based on projects. However, the result means also that only one of six competency elements of the competency area "professional and personal attributes", and only one of six competency elements of the competency area "knowledge and skills" is perceived to be more effectively developed by PBL. In total, 14 out of 16 competency elements are not perceived to be developed more effectively by one of the two learning approaches. In line with the interpretation of the findings related to research question one, the high emphasis of achievement and success might result in a lower emphasis of the way towards success. From the perspective of Chinese managers, either way (i.e. PBL or traditional learning) has potential to develop these 14 out of 16 competency elements. Interestingly, the earlier described low level of "uncertainty avoidance" does not result in more openness towards a newer learning approach (i.e. PBL). This might be related to Chinese managers' being satisfied with the current competency levels among engineers. Also, two further dimensions of Chinese culture, namely high "power distance" (80) and low "individualism" (20) (Hofstede-insights, 2019), may have contributed to the perspective of Chinese managers in that they don't feel authorized to comment on the efficiency of learning approaches on developing competency elements (i.e. high "power distance") and they don't feel comfortable to voice an individual opinion related to this topic (i.e. low "individualism").

The third research question is related to the difference between the perspective of Arab managers and the perspective of Chinese managers regarding the development of the sixteen competencies by a) PBL and b) traditional learning. Regarding the development of competency elements by PBL (i.e. part a) of research question 3), Table 6 shows a statistically significant difference regarding all competency elements except *Conceptual understanding of mathematics…* and *Creative, innovative and pro-active…*, and in conjunction with Table 3 it is found that Arab managers perceive a higher contribution of PBL to developing these 14 competency elements than Chinese managers. However, and as described above, the cultural background may have contributed to a narrower range of Mean values, as well as generally lower Mean values, among Chinese managers. Therefore, it is more conclusive to investigate the difference between Arab managers' and Chinese managers' ranking of competencies based on the perceived contribution of PBL in developing competencies. The interpretation is based on the ranking shown on Table 7 and is given in the following paragraph.

The competency element *In depth understanding…* shows the biggest difference in ranking in that Arab managers ranked it 13 and Chinese managers 3 regarding the effectiveness of PBL in developing this competency. This difference can be explained again with the difference of cultural backgrounds. Although Arab managers were found to be in favour of PBL as shown above, the higher "uncertainty avoidance" of Arab managers (Hofstede-insights, 2019) leads to a lower expectation among Arab managers that in-depth understanding of specialist knowledge can be developed by students' group work based on a real life project, whereas the higher focus on achievements as reflected by the higher "masculinity" of Chinese managers (Hofstede-insights, 2019) leads to a higher expectation among Chinese managers that in-depth understanding can in fact be developed by PBL. These perceptions might be supported by the state of the educational system in the GCC region *versus* China. It has been found that education in the GCC region focusses much on rote-learning (Webb, 2008) and is influenced by students' expectation of spoon-feeding (Randeree, 2006), whereas education in China focusses much on solid theoretical foundations (Li and Guo, 2007). The latter focus enables students better to learn in-depth knowledge in a self-directed manner. In addition, the higher focus on achievement in Chinese culture is also reflected in a high focus on competition and success among Chinese students (Hofstede-insights, 2019).

Similar interpretations seem plausible regarding the two second biggest ranking differences, namely the differences regarding *Creative, innovative and pro-active…* and *Application of systematic management….* The first competency is ranked 8 by Arab managers *versus* 1 by Chinese managers. Cultural background and educational preparation are supporting efficient development of creativity and innovation by the application of PBL in China, whereas Arab managers don't perceive the same efficiency in developing creativity and innovation by PBL in the GCC region. The second competency is ranked by Arab managers 6 and by Chinese managers 13. The higher "uncertainty avoidance" in the GCC region may cause a general higher appreciation of a systematic approach to project management, whereas the higher focus on achievement in China may cause a stronger focus on project outcomes and project success *versus* systematic approaches to project management. This interpretation is supported by a case study involving a Chinese contractor and Arab client of a construction project in the UAE (Ullah Khan, 2014).

Regarding part b) of research question three, namely the differences regarding the development of competencies by traditional learning (c.f. Table 8 and Table 3), and following the above justified reasoning that it is more conclusive to investigate the differences between Arab managers' and Chinese managers' rankings of competencies, the three biggest differences are interpreted as follows. The biggest ranking difference is related to the competency element *Theory based understanding….* For Arab managers it

is on rank 2, whereas for the Chinese managers it is on rank 15. Similar to the previous interpretation, this difference can be explained by the lower focus on achievement as reflected by a lower "masculinity" in the GCC region (Hofstede-insights, 2019) which increases the efficiency of traditional learning in developing understanding based on theories. In addition, and as described above, Arab managers' perception of the educational system in the GCC region necessitates a traditional learning environment for developing this competency. Finally, the higher "uncertainty avoidance" in the GCC region (Hofstede-insights, 2019) may have contributed to this evaluation since Arab managers would expect a lot of uncertainty among students if they would need to develop *Theory based understanding…* based on student self-directed studies within a project and group environment. Arab managers' low satisfaction with their own educational journey and/or satisfaction with this competency among graduates may have had an impact on their perception too. The same interpretation applies to the second biggest difference, namely the difference related to *Conceptual understanding of mathematics…*, which is on rank 1 for the Arab managers and on rank 13 for the Chinese managers.

The third biggest difference, namely the difference related to *Effective team membership…*, which is ranked 12 by Arab managers and 1 by Chinese managers can be interpreted as follows. The lower "masculinity" in GCC culture is more focussed on quality of life and "standing out from the crowd is not admirable" (Hofstede-insights, 2019). This aspect of GCC culture is in line with the aspect of group work when utilizing a PBL approach and Arab managers did not see that effective team membership is effectively developed by traditional learning. In addition, the higher level of "uncertainty avoidance" in GCC culture (Hofstede-insights, 2019) contributes to appreciating teamwork since it has potential to identify and avoid uncertainties. Although both cultures share similarities regarding "power distance" and "individualism", a higher emphasis on hierarchy in Chinese organizational cultures when comparing with Arab organizational cultures (Jaeger *et al.*, 2017) points towards a stronger emphasis on uniformity and structure in social interactions such as teamwork. Uniform and structured group norms can be more effectively developed by traditional learning since group norms in PBL are likely to develop differently in each student group dependent on social interaction, personalities and experiences in each group. Of course, the size of society, history, tradition and education have an impact on the perception of managers too. Like Chinese managers' perception on the development of *Ethical conduct…* (rank 2, Table 9), *Effective team membership…* is seen by Chinese managers' to be developed very effectively by traditional learning environments.

In summary, national culture and organizational culture of Arab managers and Chinese managers have a strong impact on their perspectives of the effectivity of PBL and traditional learning in developing engineering competencies. Since managers of engineers

are at the receiving end of the engineering competency development process, engineering programs of Higher Education Institutions (HEIs) in both regions (i.e. GCC and China) may want to compare their utilization of PBL and traditional learning with the perspectives of managers of engineers from their region. However, if HEIs aim at developing "global engineers", i.e. engineers who are well prepared for work in a cross-cultural context, they are advised of comparing their learning approaches with the perspectives of managers of engineers from different cultures. The perspectives of managers from the GCC region and from China were presented in this study.

Before concluding this study, its limitations as well as recommendations for future investigations of this topic are summarized.

LIMITATIONS AND FUTURE STUDIES

The chosen methodology of semi-structured questionnaire-based interviews, as well as using respondents' native language for questionnaires and conducting interviews and a common definition of key concepts (i.e. PBL and traditional learning), contributed to a robust construct validity. Respondents reflected a high-level seriousness during the interviews and maturation effects resulting from respondents' familiarization with questions were controlled. At the same time and as noted earlier (e.g. Jaeger *et al.*, 2017), these advantages may also have potential to lead to a distortion of responses.

External validity of results can be assumed for the perspectives of the managers of engineers who were interviewed here. The scope of this study was limited to two learning approaches (i.e. PBL and traditional learning), one specific set of competency elements (EA, 2017), two cultural backgrounds (i.e. GCC and China) and one organizational perspective (i.e. managers of engineers).

Comparison of results with perspectives of managers of engineers from other cultural backgrounds was not within the scope of this study since it would require a comparable framework in order to be conclusive. However, future studies could fill this gap.

Future studies could also investigate the influence of other independent variables on the perspective on PBL *versus* traditional learning in developing engineering competencies, such as gender, educational background, duration of cross-cultural experience and duration of management experience. However, this would require the availability of an adequate number of responses for each answer category of these variables in order to ensure reliable comparisons.

CONCLUSION

This study aimed at identifying the perspectives of Arab and Chinese managers on the effectiveness of PBL *versus* traditional learning in developing engineering competencies. In general, it was found that Chinese managers perceive the effect of PBL *versus* traditional learning on developing competencies less different than Arab managers. Chinese managers evaluated the effect of PBL lower than their Arab counterparts, which might be related to the higher achievement orientation of Chinese culture, leading to a lower focus on the method towards achievement (i.e. PBL).

Arab managers perceive higher development by PBL for all competencies except *Conceptual understanding of mathematics…* and *In depth understanding…*, whereas Chinese managers perceive only two competencies to be more effectively developed by PBL *versus* traditional learning, namely *In-depth understanding…* and *Creative, innovative and pro-active….*

Comparing the perspectives of Arab managers with Chinese managers, the difference of national culture backgrounds, specifically, the higher "uncertainty avoidance" of Arab managers and the higher achievement orientation of Chinese managers, have been identified to cause Arab managers to perceive the development by PBL to be lower regarding *In-depth understanding of specialist knowledge*, lower regarding *Creative, innovative and pro-active demeanour* and higher regarding *Application of systematic management of projects*. At the same time, Arab managers perceive the development by traditional learning to be higher regarding *Theory based understanding…,* higher regarding *Conceptual understanding of mathematics...* and lower regarding *Effective team membership….* In addition, an influence of the educational systems in China and GCC region, as well as a higher pronounced hierarchy culture in Chinese organizations, were identified as reasons for the different perspectives on PBL *versus* traditional learning.

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