Cross-Cultural Learning Motivations for Engineering Students

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Benchmarking and Analyzing Learning Motivations for Engineering Students from Peru, United States and Russia

Background

Globalization and knowledge based economy of this contemporary world fosters interest in the mobility component of professional education. Labor and academic mobility increases especially in engineering. Altbach, et al. outline the trends in global higher education and define globalization as "the reality shaped by an increasingly integrated world economy, new information and communications technology (ICT), the emergence of an international knowledge network, the role of the English language, and other forces beyond the control of academic institutions"[1]. Universities are attempting to respond to globalization by promoting international mobility programs for students and faculty, sending students to study abroad, organizing professors' exchange or e-learning practices, setting up branch campuses overseas, and establishing joint academic and research programs. A unique approach to introducing students to the global environment is the international senior capstone project introduced at the Purdue Polytechnic Institute and is fully described elsewhere[12]. This new approach to increase the awareness in engineering students of the challenges of global teams has already resulted in multi-national teams involving students from Peru, Germany, Poland, and the Netherlands and coming in the near future, teams including Denmark, Russia, Australia and Dubai. This mixing of students from different nationalities stimulated this interest in learning motivation so that project topics for these team can be selected that would appeal to a mixed nationality team.

Motivation

Motivation is a crosscutting element of personality. Motivation reflects the level of identity, group characteristics and specifics of the learning situation. Learning motivation is one of the most thoroughly studied topics in personality and educational psychology. Being a link between individuals and their social and historic context, learning motivation is an indicator of social and cultural influences on personality and is influenced by personal characteristics, by the peculiarities of engineering pedagogy, and by the students' mentality, culture and value system. This influence is especially important for international students as different cultures develop various learning strategies and values that form the basis of the student's motivation to acquire an engineering degree. Learning motivation greatly influences the efficiency of the training process. More than that, many researchers[2, 3, 4] consider motivation to be no less than, and even more important than, cognitive capabilities for personal development and professional success.

Motivational psychology is a vast field of psychological and educational studies. Researchers are interested in this subject because motivation is one of the clue components of any type of activity that determines its efficiency. Kovalev called motivation "the core of the personality psychology"[5]. It is essential to study the motivational process within a specific social and cultural context. Motivation can be considered dynamically and statically. It is a process characteristic that may be reflected on the level of relatively stable personality traits[8]. Therefore social situation, especially continuous and repeated ones, may influence personality through common motivations and motivational strategies. Personality is a product and an actor of

socialization and self-realization. Therefore the individual motivational sphere is developed through the perception of sociocultural experience and its interpretation by personal internal environment.

Bibliographical analysis shows that nowadays there is no one unified theory of human motivation. It is a complex and multi-dimensional concept determined by a variety of external and internal factors. External determinants are characteristic for the milieu, and internal factors include those that are common for animals and for human beings, and specifically human motivators. However educational activity is poly-motivated, i.e. it may be determined by a few wide, generalized and significant motives. It cannot be limited only to cognition and to cognitive motives. This complexity and ambiguousness of the concept itself results in various research approaches in the study of learning motivation.

This study has accepted and is based on Deci and Ryan's self-determination theory which considers human motivation to be a continuum of the three fundamental attitudes: extrinsic and intrinsic motivation and amotivation[2, 9]. Intrinsic motivation refers to doing something because it is inherently interesting or enjoyable, while extrinsic motivation refers to doing something because it leads to a separable outcome[9]. Amotivation represents the nonregulated pole of the continuum, characterized by the individual's perception of lack of control over events, incompetence and absence of purpose[10].

Assessing Learning Motivation

There exist several survey tools which evaluate learning motivation. The Academic Motivation Scale (AMS-C 28) (College version)[11] was selected as the tool most appropriate for the international dimension of this study and was consistent with the self-determination concept.[11] This scale was originally developed and written in French and later translated to English and its efficacy was thoroughly evaluated by Vallerand et al.[11]. This survey reflexes the three self-determination attitudes with seven subscales aligning with the prime attitudes:
- three subscales for intrinsic motivation-- to know, to accomplish and to experience stimulation;
- three subscales for extrinsic motivation—to be identified; to be introjected and to be externally regulated; and
- one subscale for amotivation.

The survey contains 28 statement of motivation assessed on a 7-point scale with four statements linked to each of the seven subscales.

Populations of the Study

306 students took part in this study:
- 86 engineering students from Purdue Polytechnic Institute (81 male and 5 female, aged 18 - 23) from the mid-west United States,
- 85 engineering students from Kazan National Research Technological University, (39 male and 46 female, aged 17 - 25) from Kazan, Tartarstan in central Russia.
- 135 students from Universidad de Ingeniería y Tecnología (106 male and 29 female, aged 18 - 23) from Lima, Peru.

An interesting observation already begins in examining the demographics of the respondents: the US survey is predominantly male with 94.19% of the respondents. In Peru, 78.52% of the participants were male students and finally, in the Russian survey more than a half (54.12%) of the sample consisted of female students. These figures correspond to the general trends in the national engineering education systems in each nationality. Unlike many western countries, Russian universities are characterized by a large proportion of girls who choose to study engineering[6]. Thus conclusions from this survey relative to learning motivation might be significantly influenced not only by national cultural influences but also by differences stemming from gender.

This survey was administered to three different nationality and had to deal with the differences in language. The survey was translated into Spanish for the Peruvian students and into Russian for the Russian students. Two effects are possible: respondents replying a non-native language and second, respondents replying to a translated survey. This study does not attempt to thoroughly assess these influences but recognizes them as uncontrolled influences. While no exhaustive evaluation was made for this paper, the survey was administered to Russian students in both English and a translated Russian version and no differences were found between the two sets of survey.

 Due to an oversight, the survey in Peru was given to the students using a 1-5 scale. In the USA and in Russia the original AMS C28 1-7 scale was used. Thus the answers were ranked in numerical order from highest response to lowest response (see Table 2) and these rankings were used to compare and interpret the results.

Survey Results and discussion

In Table 1, the combined survey results are shown for the US, Russian and Peruvian engineering students. The students were asked to indicate to what extent the listed factors correspond to reasons why they are going to the university.

Motivation factors	USA		Russia		Peru	
	Mean	Rank	Mean	Rank	Mean	Rank
1. Because with only a high school degree I would not find a high-paying job later on.	5.7	5	5.54	4	3.84	14
2. Because I experience pleasure and satisfaction while learning new things.	5.2	9	5.13	6	4.3	2
3. Because I think that a college education will help me better prepare for the career I have chosen.	5.88	3	5.11	7	4.25	3
4. For the intense feelings I experience when I am communicating my own ideas to others.	3.26	21	2.29	24	3.6	20
5. Honestly, I don't know; I really feel that I am wasting my time in school.	2.02	26	1.82	26	1.44	26
6. For the pleasure I experience while surpassing myself in my studies.	3.9	20	4.32	18	4.11	7

7. To prove to myself that I am capable of completing my college degree.	4.74	14	4.38	16	3.71	17
8. In order to obtain a more prestigious job later on.	6.01	2	5.87	2	3.99	10
9. For the pleasure I experience when I discover new things never seen before.	4.94	12	4.79	12	4.24	4.5
10. Because eventually it will enable me to enter the job market in a field that I like.	6.05	1	5.2	5	4.10	8
11. For the pleasure that I experience when I read interesting authors.	2.76	23	3.21	22	3.42	21
12. I once had good reasons for going to college; however, now I wonder whether I should continue.	2.15	25	1.88	25	1.74	25
13. For the pleasure that I experience while I am surpassing myself in one of my personal accomplishments.	4.38	17	4.84	11	4.18	6
14. Because of the fact that when I succeed in college I feel important.	4.47	15	4.35	17	3.69	18.5
15. Because I want to have "the good life" later on.	5.52	6	5.99	1	4.05	9
16. For the pleasure that I experience in broadening my knowledge about subjects which appeal to me.	5.12	11	4.58	14	4.24	4.5
17. Because this will help me make a better choice regarding my career orientation.	5.17	10	5.09	8	3.75	15.5
18. For the pleasure that I experience when I feel completely absorbed by what certain authors have written.	2.69	24	3.15	23	3.30	22
19. I can't see why I go to college and frankly, I couldn't care less.	1.8	28	1.51	28	1.35	27
20. For the satisfaction I feel when I am in the process of accomplishing difficult academic activities.	4.24	19	3.94	21	3.75	15.5
21. To show myself that I am an intelligent person.	4.45	16	4.07	19	3.28	23
22. In order to have a better salary later on.	5.72	4	5.82	3	3.69	18.5
23. Because my studies allow me to continue to learn about many things that interest me.	5.24	8	4.89	10	4.33	1
24. Because I believe that a few additional years of education will improve my competence as a worker.	5.5	7	4.91	9	3.98	11
25. For the "high" feeling that I experience while reading about various interesting subjects.	3.0	22	4.02	20	3.21	24
26. I don't know; I can't understand what I am doing in school.	1.84	27	1.6	27	1.3	28

| 27. Because college allows me to experience a personal satisfaction in my quest for excellence in my studies. | 4.29 | 18 | 4.42 | 15 | 3.87 | 13 |
| 28. Because I want to show myself that I can succeed in my studies. | 4.9 | 13 | 4.59 | 13 | 3.96 | 12 |

Table 1. Cross-cultural diversity of academic motivation factors.

	USA	Russia	Peru
Peru	$r_s = 0.707, p \geq 0.01$		
USA		$r_s = 0.952, p \geq 0.01$	
Russia			$r_s = 0.717, p \geq 0.01$

Table 2. Spearman's rank correlation coefficient between national samples.

The data in the three studied samples shown in table 1 was been first evaluated using the Spearman's rank correlation coefficient, a nonparametric measure of statistical dependence between two variables. As it can be seen from Table 2, the null hypothesis in all the three comparisons are declined and the relationship between the ranks are statistically significant. Therefore it may assume that there are no great cross-cultural differences in learning motivation, which is good news for the international mobility programs organizers. Learning motivation can be considered as a universal meta-cultural system. In Table 1 it is shown that such factors as "Because I want to have "the good life" later on ", "Because I think that a college education will help me better prepare for the career I have chosen", "Because eventually it will enable me to enter the job market in a field that I like" are in the upper part of the ranked assessment scale in all the three national groups, while such amotivational items as "Honestly, I don't know; I really feel that I am wasting my time in school" and "I don't know; I can't understand what I am doing in school" are scored very poorly and of little influence.

However, from Table 2, it is also evident that the studied population was not homogeneous and there are a few differences worth being analyzed:

1. The most important motivational factor for the Peru students and ranked 1st is "Because my studies allow me to continue to learn about many things that interest me"(#23). In the US and Russian group this motive is not so significant (8th and 10th ranks correspondently). Another 'purely academic' motive "Because I experience pleasure and satisfaction while learning new things"(#2), also very significant for the Peru group (2nd rank) is less important for the US (9th rank) and Russian (6th rank) students. The same pattern is seen with the item "For the pleasure that I experience in broadening my knowledge about subjects which appeal to me"(#16): 4.5th rank in Peru, 11th rank in the USA and 14th rank in Russia. Most of the questions regarding pleasure and satisfaction rated much higher for the Peruvian students.
2. As to the Russian sample, they pay much attention to the future prestige and give high rank to the factor "Because I want to have "the good life" later on" (1st rank), while North and South Americans pay less attention to it (6th rank in the USA and 9th rank in Peru).
3. It is also interesting to observe that Peruvian students do not make close connection between their studies and their salaries in the future: the motive "In order to have a better salary later on", rather important for the US and Russian future engineers (4th and 3rd rank correspondently), is not significant for them (only 18.5th rank).

4. The most important factor for the US students "Because eventually it will enable me to enter the job market in a field that I like" is also on the top of the Peruvian and Russian ranked rows but much higher—1st versus 5th for the Russians and 8th for the Peruvians g.

A more generalized picture is observed when the motivational constructs in the three national groups are compared (Table 3).

Motivation	USA		Russia		Peru	
	Mean	Rank	Mean	Rank	Mean	Rank
Intrinsic motivation - to know	5.13	3	4.85	3	4.28	1
Intrinsic motivation – towards accomplishment	4.20	5	4.38	4	3.98	3
Intrinsic motivation – to experience stimulation	2.92	6	3.34	6	3.38	6
Extrinsic motivation - identified	5.65	2	5.08	2	4.01	2
Extrinsic motivation - introjected	4.64	4	4.35	5	3.66	5
Extrinsic motivation – external regulation	5.74	1	5.81	1	3.89	4
Amotivation	1.95	7	1.70	7	1.45	7

Table 3. Cross-cultural analysis of academic motivation.

1. It is good to know that all the examined population is motivated to study engineering: low ranks of amotivation demonstrates that the students are aware of their motives and understand the reasons they attend classes.
2. Peruvians show stronger intrinsic motivation (to know), while Russian and US students are mainly driven by extrinsic motivation (external regulation: high salary, prestigious position, and 'good life'). In other words future engineers from Peru study engineering mainly because they want to acquire new knowledge in the sphere (direct learning motivation, determined by subjective factors). Their future colleagues from the USA and from Russia are mostly motivated by social factors (indirect learning motivation, determined by objective factors). Interpreting these results should take into consideration that intrinsic motivation has traditionally been undersood as leading to high-quality learning and creativity. On the other hand self-determination theory proposes that there are varied types of extrinsic motivation, some of which represent impoverished forms of motivation and some of which represent active agentic states[9].

More profound understanding of academic motivation in the studied national groups can be obtained by inter-correlational analysis (Pearson linear correlation coefficient).Pearson analysis reveals very close interrelation between motivational items in all the three samples, especially in the Peruvian group (see Table 4). This means that motivational sphere is very integrated. On the other hand, the fact that all the motivational factors are inter-related may indicate that there are no strong independent motives that drive academic activity. It is not surprising that the amotivational attitude has negative correlations with all the other constructs: the stronger amotivation is the less motivated a person becomes.

Motivation	Quantity of significant correlations (p≥0.05, p≥0.01)					
	USA		Russia		Peru	
	Positive	Negative	Positive	Negative	Positive	Negative
Intrinsic motivation - to know	60	12	66	8	85	16
Intrinsic motivation – towards accomplishment	62	11	70	3	86	16
Intrinsic motivation – to experience stimulation	35	2	71	1	76	12
Extrinsic motivation - identified	50	8	67	9	85	15
Extrinsic motivation - introjected	62	9	59	1	85	10
Extrinsic motivation – external regulation	28	1	44	3	77	9
Amotivation	6	45	6	25	6	81
Total	**303**	**88**	**383**	**50**	**500**	**159**

Table 4. Number of positive and negative relations between motivational factors in the US, Russian and Peruvian sample groups from Pearson linear analysis.

The factor "Because eventually it will enable me to enter the job market in a field that I like" (# 10 see Table 1) was ranked 1st in the US sample group. It has positive connections with 8 other motives (Figure 1). As it is seen from Table 1, all of the factors, except for #27 are on the top 10 of the ranked row. Thus these factors form a systemically important backbone synergy that provides the basis for academic motivation of the examined group. Therefore US engineering students that took part in this study are motivated to study if they understand the future marketability of the acquired competences and their applicability in obtaining a good and
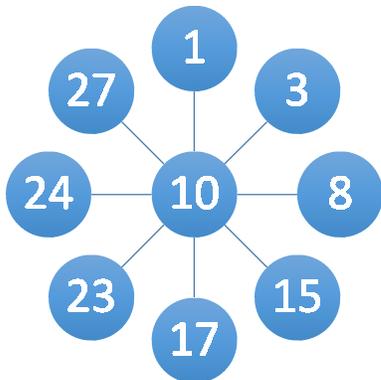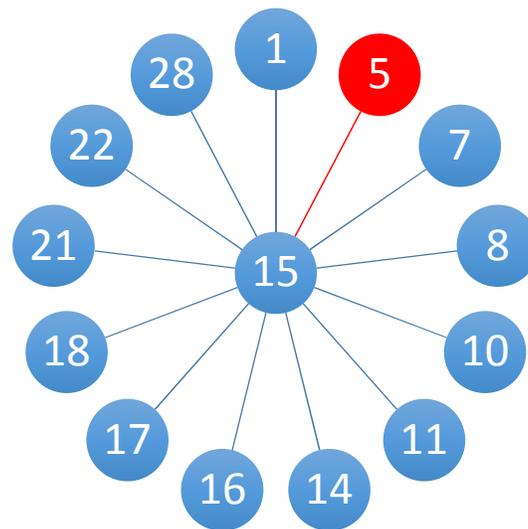

MOTIVATIONAL FACTORS:
10 - Because eventually it will enable me to enter the job market in a field that I like
1 - Because with only a high school degree I would not find a high-paying job later on,
3 - Because I think that a college education will help me better prepare for the career I have chosen,
8 - In order to obtain a more prestigious job later on,
15 - Because I want to have "the good life" later on,
17 - Because this will help me make a better choice regarding my career orientation,
23 - Because my studies allow me to continue to learn about many things that interest me,
24 - Because I believe that a few additional years of education will improve my competence as a worker,
27 - Because college allows me to experience a personal satisfaction in my quest for excellence in my studies.

Figure 1. The most significant motivational factor's correlation pleiade for the US sample group.

interesting job. There is also one motive dealing with self-confidence (#27) and one cognitive factor (#23).

The most significant motivational factor (1st rank) for the Russian sample, shown in figure 2, was "Because I want to have "the good life" later on" (#15). It has 12 positive correlations and one negative connection (in the Figure 2 positive correlations are marked blue and negative relation is red). As it is seen from Figure 2, the backbone motivational synergy for the Russian sample is less definite than in the American group. In the given pleiade not only are high-ranked motives revealed, but also those that have lower value (see Table 1). This fact may indicate that the examined sample was not fully conscious about the factors that influence them most of all. This motivational construct consists of three strong motivations:

MOTIVATIONAL FACTORS:
15 - Because I want to have "the good life" later on, 1- Because with only a high school d
I would not find a high-paying job later on,
7 - To prove to myself that I am capable of completing my college degree,
8 - In order to obtain a more prestigious job later on,
10 - Because eventually it will enable me to enter the job market in a field that I like,
11 - For the pleasure that I experience when I read interesting authors,
14 - Because of the fact that when I succeed in college I feel important,
16 - For the pleasure that I experience in broadening my knowledge about subjects which appeal to me,
17 - Because this will help me make a better choice regarding my career orientation,
18 - For the pleasure that I experience when I feel completely absorbed by what certain authors have written,
21 - To show myself that I am an intelligent person,
22 - In order to have a better salary later on",
28 - Because I want to show myself that I can succeed in my studies
5 - Honestly, I don't know; I really feel that I am wasting my time in school.

Figure 2. The most significant motivational factor's correlation pleiade for the Russian sample group.

- like in the US group, it includes extrinsic motivation that determines the strive for a good well-paid job and marketability,
- a set of motives dealing with self-confidence (# 7, 14, 21, 28) and finally,
- cognition interest (#11, 16, 18).

Peruvian sample showed interrelation of all the motivational factors and therefore it was impossible to define any correlation pleiades. It means that the whole complex of variables drives academic activity in this group. However descriptive statistics showed that, unlike the US and Russian group, students in Peru laid more emphasis on cognitive intrinsic motivation than on the desire to acquire a marketable job in the future.

Gender specific learning motivations in the cross-cultural context

Motivation	Male students					
	USA		Russia		Peru	
	Mean	Rank	Mean	Rank	Mean	Rank
Intrinsic motivation - to know	5.09	3	4.7	3	4.32	1
Intrinsic motivation – towards accomplishment	4.15	5	4.26	5	3.99	3
Intrinsic motivation – to experience stimulation	2.88	6	3.22	6	3.40	6
Extrinsic motivation - identified	5.63	2	4.97	2	4.03	2
Extrinsic motivation - introjected	4.6	4	4.31	4	3.7	5
Extrinsic motivation – external regulation	5.71	1	5.79	1	3.89	4
Amotivation	1,99	7	2.01	7	1.45	7

Table 5. Cross-cultural analysis of academic motivation of male students.

Motivation	Female students					
	USA		Russia		Peru	
	Mean	Rank	Mean	Rank	Mean	Rank
Intrinsic motivation - to know	5,65	3	4.97	3	4.14	1
Intrinsic motivation – towards accomplishment	5.00	5	4.48	4	3.94	3
Intrinsic motivation – to experience stimulation	3,65	6	3.45	6	3.33	6
Extrinsic motivation - identified	5,95	2	5.16	2	3.95	2
Extrinsic motivation - introjected	5.35	4	4.38	5	3.5	5
Extrinsic motivation – external regulation	6.15	1	5,82	1	3.88	4
Amotivation	1.35	7	1.44	7	1.48	7

Table 6. Cross-cultural analysis of academic motivation of female students

In this portion of the paper the analysis turns to differences between national cultures in male and female samples: USA, Peruvian and Russian. In tables 5 and 6, the data for male and female academic motivation for each nationality is presented. In this section, the discussion centers on responses that are significantly different than the other responses. Like in the previous part, rank analysis was made. There are no significant rank differences between male and female samples within one national group. T-Student correlation also showed no gender differences.

Comparison of ranks showed that U.S. and Russian students, both male and female, have the same hierarchy of academic motivation. In the female sample there is a slight difference in rank between intrinsic motivation – towards accomplishment and extrinsic motivation – introjected. American students put accomplishment in 5th place and Russians in 4th place and the mean in the American group is higher than in the Russian group. However the trend is not firmly established due to the small number of U.S. female participants.

The Peruvian sample (both male and female) showed the same peculiarities as described in the previous part of the article: this group is more driven by cognitive intrinsic motivation in their academic activities, while their US and Russian peers are motivated externally (prestige, marketability and economical aspects).

Conclusions and Suggested Approaches

The study has shown that there are no crucial differences between the US, Russian and Peruvian academic motivation that is very promising in the context of student mobility programs and training the global engineers. However it revealed some cultural peculiarities that can be useful for improving the educational process in the international teams.

1) For US and Russian engineering students to be motivated for the extra effort required in international projects, they need to understand how the international experience is applicable to the acquired knowledge and their marketability of a job
2) Peruvian engineering students are driven mainly by cognitive interest. This intrinsic interest is consistent with a high importance placed on projects having societal impact.
3) Russian students consider academic success as a way to raise self-attitude and prestige within their society.

The revealed characteristics should be taken into account by the faculty working in the international student teams and by administrative staff engaged in organizing mobility and e-learning programs.

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