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Hard and Soft Skills Self-Assessment Relationship with Satisfaction of Graduates

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***Abstract*—Soft skills such as communication, teamwork, problem-solving, and leadership are important for any workplace and are increasingly sought by employers. Hard skills on the other hand represent scientific and professional knowledge required to properly perform the job. This paper presents the results of a survey of bachelor's degree graduates of Business Administration and Management programs of Mongolian University of Science and Technology conducted in May 2023. In the survey, graduates were asked to assess their knowledge and skills they have obtained during their bachelor's degree studies, university facilities, extracurricular activities, and subsequent career growth. The knowledge and skills acquired by the graduates were grouped into two groups by factor analysis: soft and hard skills. University facility indicators are also grouped into two factors: the first one includes physical facilities and student services, and the second is teaching and organization. Graduates' self-assessment of soft skills is higher than that of hard skills, but it was found that hard skills have a greater influence on satisfaction ratings. Hard skills were found to be more related to teaching and management. The amount of the salary at the time of the survey and the graduation date, are found to have no statistically insignificant relationship with graduates' satisfaction level. These results may indicate that the soft skills acquired by the program are useful for performing tasks as part of a team, but it is the hard skills and other soft skills not included in the model such as leadership that lead to promotion at the managerial level.**

Keywords—survey, CDIO, program outcomes, factor analysis, regression analysis

I. INTRODUCTION

Mongolian University of Science and Technology (MUST) regularly conducts graduates' satisfaction surveys. University graduates' satisfaction is influenced by experience as a university student, perception of the quality of academic teaching as well as the quality of physical facilities, curriculum content, interaction with teachers and classmates, academic success, professional employment, and income received. A study in Chile (where like in Mongolian universities offer primarily undergraduate professional degrees, rather than providing a liberal education that does not prepare for a specific profession) on factors that affect post-graduation satisfaction that graduates' satisfaction with their degree program is a joint function of family background, program quality, and university image, but not salary once graduated [1]. Other factors include the university's prestige [2], degree of social capital and self-confidence derived from his/her family [3].

Before 2023 the university business administration program has defined program outcomes in the following 4 focus areas:

1. Professional traits and attitude
2. Professional knowledge
3. Professional skills
4. Professional practice

In the 2018 and 2021 surveys when graduates were asked to self-assess their acquired knowledge and skills, "personal attitude" was ranked first, followed by "skills to use information technology", next by "professional skills", and the lowest rating was for "knowledge of foreign languages"(Fig.1).

The independent sample T-test results confirmed that the 2021 assessment rates of outcomes during the pandemic were statistically significantly higher than those of 2018 before the pandemic. Graduates assess their knowledge and skills obtained during the COVID pandemic higher, but their satisfaction level is lower, which may be attributed to more effort put into studies during difficult times.

The 2023 graduate satisfaction survey differs from previous surveys. It evaluated graduates' knowledge, skills, and attitudes according to the CDIO (Conceive, Design, Implement, Operate) approach, with 4 groups totaling 19 learning outcomes.

The CDIO initiative envisions an education that stresses the fundamentals set in the context of Conceiving-Designing-Implementing-Operating products, processes, and systems [4].

The CDIO Syllabus is compared with modern models of leadership and entrepreneurship, and extensions to the Syllabus are proposed in 2009. The proposed outcome is an

extended version of the Syllabus, called the CDIO Syllabus, Version 2.0 [5].

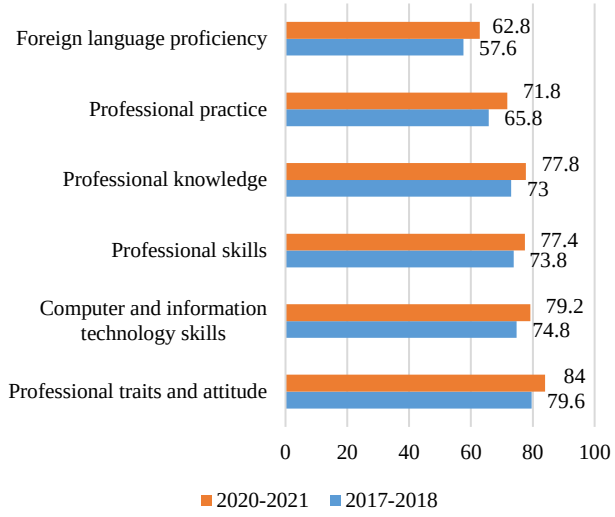

Fig. 1. Graduates' evaluation of program outcomes

By extending or modifying the definitions of products, processes, and systems the CDIO approach can be adapted beyond engineering fields in business and management programs. CDIO adaptation in non-engineering programs such as Diploma in Music and Audio Technology of Singapore Polytechnic and International Business of Vietnam National University led to improvement of design skills and generic skills, strengthened connections to the working life, and enhanced educational quality, both in terms of continuous improvement and in terms of meeting international accreditation requirements [6].

TABLE I. CDIO LEARNING OUTCOMES

#	**Learning outcome**
A.	BUSINESS KNOWLEDGE AND REASONING
A.1	Knowledge of underlying sciences (mathematics, economics, etc.)
A.2	Core business fundamental knowledge (organizational management, statistics, production management, basic marketing, business communication, business law)
A.3	Advanced business knowledge (finance, marketing, human resources, information systems, etc.)
B.	PERSONAL AND PROFESSIONAL SKILLS AND ATTRIBUTES
B.1	Business reasoning and problem-solving
B.2	Experimentation and knowledge discovery
B.3	System thinking
B.4	Personal skills and attitudes (initiative and willingness to take risks, perseverance and flexibility, creative thinking, critical thinking, time management, etc)
B.5	Professional skills and attitudes (professional ethics, integrity, responsibility, and accountability; professional behavior, proactively planning, etc.)
C.	INTERPERSONAL SKILLS: TEAMWORK AND COMMUNICATION
C.1	Teamwork
C.2	Communications
C.3	Communications in foreign languages
D.	CONCEIVING, DESIGNING, IMPLEMENTING, OPERATING IN THE ENTERPRISE AND THE SOCIETAL CONTEXT
D.1	External and societal context
D.2	Enterprise and business context
D.3	Conceiving and engineering business systems
D.4	Designing
D.5	Implementing
D.6	Operating
D.7	Leadership
D.8	Entrepreunership

Compared to previous generations, more college students now rate themselves as above average in their abilities in both traditional "hard" and "soft" skill areas [7].

Hard skills refer to the graduate's specific knowledge and technical skills necessary to perform professional work, while soft skills refer to the interpersonal and communication skills necessary to navigate at the workplace. Success in the workplace requires graduates to possess soft skills. In 2023 Forbes magazine identified soft skills that companies value the most as following [8].

1. Communication
2. Leadership
3. Teamwork
4. Creativity
5. Time management
6. Adaptability
7. Problem-solving
8. Work ethic
9. Critical thinking
10. Conflict management
11. Emotional intelligence

From CDIO learning outcomes B4, B5, C1, C2, C3, D1, D2 represent soft skills.

The World Economic Forum's Future of Jobs 2023 report finds analytical thinking, creative thinking, and AI and big data will top in-demand skills by 2027. Leadership and social influence and curiosity and lifelong learning are among other skills expected to see growing demand [9].

Integration of topics such as entrepreneurship and leadership within CDIO-based engineering education is a challenging task for teachers, program leaders and coordinators [10]. For business and management programs which have a greater focus on soft skills compared to engineering programs, this integration might be easier. While prominent leaders may not be created by a leadership course, students do gain understanding and skills [11]. University-based leadership programs adopt a multimethod approach, inclusion of traditional academic methods (e.g., seminars, lectures) with experiential methods (e.g., community service, internship, field experience) to the delivery [12].

II. GENERAL INFORMATION ABOUT RESPONDENTS

A total of 299 graduates who graduated between 2000 and 2023 participated in the survey conducted between May 9-27, 2023.

TABLE II. RESPONDENT'S MAJOR

#	**Major**	**Number**	**Percent**
1	Financial management	59	19.7
2	Information systems management	53	17.7
3	Humana resources management	40	13.4
4	International business management	33	11.0
5	Marketing management	31	10.4
6	Light industry management	25	8.4
7	Tourism management	23	7.7
8	Small and medium enterprises management	23	7.7
9	Information communication management	10	3.3

10	Public management	1	0.3
11	Production and marketing management	1	0.3
	Total	299	100.0

The majority of the participants or 207 were female (69.2%), 92 (30.8%) were male. A total of 277 graduates who disclosed their salary information, are earning between 630,000 and 20,000,000 ₮, an average of 2.4 million ₮.

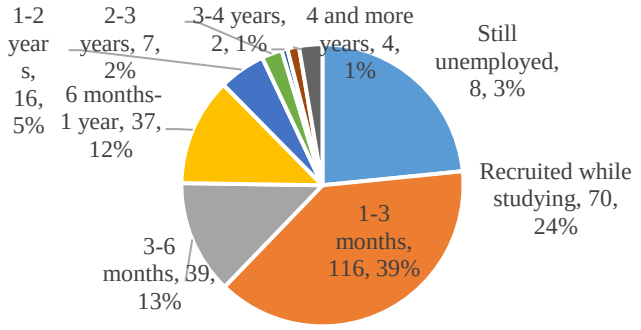

Fig. 2. Time required for finding the first full-time job

23.4% of graduates were recruited while studying, 38.8% within 1-3 months after graduation, 13% within 3-6 months, 12.4% within 6 months to 1 year, in total, 87.6% were employed within 1 year after graduation, while 3% were still unemployed (Fig.2). Nearly 1 in 3 (30.4%) graduates had experience of starting their own business alone or together with a partner.

III. Self-assessment of Knowledge and Skills Obtained Through The Program

Among the total 20 knowledge and skills, 19 by CDIO approach and the additional "information technology skills", soft skills such as C1, B4, B5, and C2 have the highest ratings, while communications in foreign languages, knowledge of underlying sciences, experimentation and knowledge creation, implementing skills were rated with the lowest points (Table III).

TABLE III. Graduates' Self-Assessment of Knowledge, Skills, and Attitude Acquired through the Program

#	Program learning outcome	Average rating	Standard deviation
1	C1. Teamwork	4.25	0.75
2	B4. Personal skills and attitudes (initiative and willingness to take risks, perseverance and flexibility, creative thinking, critical thinking, time management, etc)	4.20	0.82
3	B5. Professional skills and attitudes (professional ethics, integrity, responsibility, and accountability; professional behavior, proactively planning, etc.)	4.12	0.83
4	C2. Communications	4.10	0.88
5	A2. Core business fundamental knowledge	4.05	0.76
6	D1. External and societal context	4.02	0.79
7	Information technology skills	3.99	0.92
8	D2. Enterprise and business context	3.99	0.84
9	A3. Advanced business knowledge (finance, marketing, human resources, information systems, etc.)	3.95	0.85
10	D7. Leadership	3.93	0.87
11	B1. Business reasoning and problem-solving	3.89	0.82
12	D6. Operating	3.86	0.87
13	B3. System thinking	3.83	0.91
14	D4. Designing	3.83	0.91
15	D3. Conceiving and engineering business systems	3.79	0.93
16	D8. Entrepreunership	3.79	0.88
17	D5. Implementing	3.70	0.93
18	B2. Experimentation and knowledge discovery	3.66	0.98
19	A1. Knowledge of underlying sciences (mathematics, economics, etc.)	3.64	0.83
20	C3. Communications in foreign languages	3.27	0.95

From these 20 program learning outcomes 12 were grouped into 2 groups by factor analysis. The following 8 outcomes are left ungrouped and need further analysis as they might indicate knowledge and skills that are insufficiently covered within the program.

1. B2. Experimentation and knowledge discovery
2. B3. System thinking
3. D2. Enterprise and business context
4. D3. Conceiving and engineering business systems,
5. D4. Designing
6. D6. Operating
7. D7. Leadership
8. D8. Entrepreneurship

TABLE IY. Program Learning Outcomes Factor Analysis

#	Program learning outcome	Factor	
		1	2
1	C1. Teamwork	0.805	
2	B4. Personal skills and attitudes (initiative and willingness to take risks, perseverance and flexibility, creative thinking, critical thinking, time management, etc)	0.804	
3	C2. Communications	0.773	
4	B5. Professional skills and attitudes (professional ethics, integrity, responsibility, and accountability; professional behavior, proactively planning, etc.)	0.759	
5	D1. External and societal context	0.718	
6	A1. Knowledge of underlying sciences (mathematics, economics, etc.)		0.773
7	A3. Advanced business knowledge (finance, marketing, human resources, information systems, etc.)		0.744
8	A2. Core business fundamental knowledge (organizational management, statistics, production management, basic marketing, business communication, business law)		0.724
9	B1. Business reasoning and problem-solving		0.676
10	D5. Implementing		0.662
11	C3. Communications in foreign languages		0.639
12	Information technology skills		0.553

Note: KMO measure of sampling adequacy=0.945, Barlett's test of sphericity: Approx. Chi-square=4135.277, df=120, Sig.=0.000
Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization. Rotation converged in 3 iterations.

Learning outcomes grouped into factor #1 are considered as "soft skills", and those grouped into factor #2 are considered as "hard skills".

IY. GRADUATES' SATISFACTION

The average satisfaction rating of business administration and management program graduates is 4.29 on a scale of 1-5. On the other hand, graduates' evaluation of how much the education obtained at MUST assist to their work career was evaluated as 3.78 points.

When evaluating the school's activities with a total of 16 indicators, "Teachers' knowledge, teaching methods, and skills" were evaluated with the highest score of 4.11, and the activities of the Alumni Association with the lowest score of 2.54 (Table V).

TABLE Y. GRADUATES' ASSESSMENT OF THE UNIVERSITY PERFORMANCE

#	Performance indicator	Average	Standard deviation
1	Knowledge, teaching methods, and skills of the faculty	4.11	0.81
2	Professional competitions, events, olympiads, academic conferences, etc. organized among students beside the classroom training.	3.61	1.06
3	Art and sports competitions and other cultural events organized among students	3.52	1
4	School administration and organization	3.43	1.01
5	Student affairs service	3.41	1.06
6	Library services, availability, and facilities	3.27	1.16
7	Computer labs facilities and availability, supply of technology and software	3.14	1.17
8	Career development support	3.09	1.22
9	Dormitory	3.03	1.09
10	School cafeteria	2.85	1.17
11	Internet connection	2.83	1.27
12	Student clubs activities	2.83	1.17
13	School's internal environment comfortableness (classrooms, corridors, halls, sport hall, etc.)	2.81	1.22
14	Student council activities	2.74	1.16
15	School's external environment comfortableness	2.71	1.22
16	Alumni activities	2.54	1.18

The 16 university performance indicators were grouped in two factor by factor analysis (Table VI). Factor 1 consists of 11 performance indicators and can be referred as "physical facilities and service", factor 2 consists of 5 indicators that can be referred as "teaching and management".

TABLE YI. FACTOR ANALYSIS OF THE UNIVERSITY PERFORMANCE

#	Performance indicators	Factor 1	Factor 2
1	School's internal environment comfortableness (classrooms, corridors, halls, sport hall, etc.)	0.863	
2	School's external environment comfortableness	0.845	
3	Alumni activities	0.798	
4	School cafeteria	0.790	
5	Internet connection	0.784	
6	Student council activities	0.777	
7	Dormitory	0.770	
8	Student clubs activities	0.753	
9	Computer labs facilities and availability, supply of technology and software	0.660	
10	Career development support	0.624	
11	Library services, availability, and facilities	0.600	
12	Knowledge, teaching methods, and skills of the faculty		0.836
13	Professional competitions, events, olympiads, academic conferences, etc. organized among students beside classroom training		0.741
14	Student affairs service		0.739
15	School administration and organization		0.726
16	Professional competitions, events, olympiads, academic conferences, etc. organized among students beside the classroom training.		0.697

Note: KMO measure of sampling adequacy=0.945, Barlett's test of sphericity: Approx. Chi-square=4135.277, df=120, Sig.=0.000
Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization. Rotation converged in 3 iterations.

Y. RELATIONSHIP BETWEEN GRADUATES' SATISFACTION AND SELF-ASSESSMENT OF SOFT AND HARD SKILLS

The relationship between graduates' satisfaction and hard and soft skills, "school environment comfortableness and service", "management and teaching", and career growth was estimated by regression analysis. Although the regression model is statistically significant as a whole, the influence of residual factors not included in the model is high (Table VII).

TABLE YII. REGRESSION ANALYSIS BETWEEN GRADUATES' SATISFACTION AND HARD AND SOFT SKILLS

ANOVA[a]						
Model		*Sum of Squares*	*df*	*Mean Square*	*F*	*Sig.*
1	regression	77.333	5	15.467	43.603	.000[b]
	residual	103.931	293	.355		
	total	181.264	298			
a. Dependent variable: Assess your satisfaction level as a graduate from MUST School of Business Administration and Humanities						
b. Predictors: (Constant), career growth, soft skills, hard skills, physical facilities and service, management and teaching						

When the hard skills self-assessment level increased by 1 point graduates' satisfaction increased by 0.350 points, which has the highest statistically significant coefficient. The second highest coefficient is for management and teaching (0.270), followed by soft skills (0.184) in third, and career growth (0.123) in fourth place. The physical facilities and service which had relatively lower ratings found to be statistically insignificant to the graduates' satisfaction level (Table VIII).

TABLE YIII. REGRESSION ANALYSIS RESULTS BETWEEN GRADUATES' SATISFACTION AND HARD AND SOFT SKILLS

Independent variables	Unstandardized B		Standardized Coefficients Beta.	t	Sig.
	B	*Std. Error*	*Beta*		
(Constant)	3.861	0.168		22.994	0.000

Soft skills	0.143	0.041	0.184	3.497	0.001
Hard skills	0.273	0.041	0.350	6.623	0.000
Physical facilities and service	0.042	0.035	0.054	1.194	0.233
Management and teaching	0.211	0.044	0.270	4.773	0.000
Career growth	0.112	0.043	0.123	2.597	0.010

Note: Dependent variable нь Assess your satisfaction level as a graduate from MUST School of Business Administration and Humanities

Regression analysis revealed that the salary of the graduates did not affect the satisfaction rating, while career growth had a positive effect.

In addition to the self-assessment of satisfaction, the analysis also considered the assessment of the usefulness of the education received at the MUST in the graduates' work career. The explanatory power of the regression model increased, and the influence of the remaining factors, that are not included in the model represented by a constant is reduced compared to the previous model (Table IX).

TABLE IX. REGRESSION ANALYSIS RESULTS BETWEEN GRADUATES' WORK CAREER AND HARD AND SOFT SKILLS

ANOVA[a]						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	regression	112.827	5	22.565	38.306	.000[b]
	residual	172.604	293	.589		
	total	285.431	298			
a. Dependent variable: How much the education obtained at MUST assist to your work career?						
b. Predictors: (Constant), career growth, soft skills, hard skills, physical facilities and service, management and teaching						

As the career progresses, the perceived usefulness of the education will increase, and hard skills will be seen as more useful in work careers than soft skills (Table X).

TABLE X. RESULTS OF REGRESSION ANALYSIS BETWEEN PERCEIVED CAREER GROWTH AND HARD AND SOFT SKILLS SELF-ASSESSMENT

	Unstandardized B		***Standardized Coefficients***		
Model	***B***	***Std. Error***	***Beta***	***t***	***Sig.***
(Constant)	2.530	.216		11.692	.000
Soft skills	.183	.053	.187	3.463	.001
Hard skills	.189	.053	.193	3.561	.000
Physical facilities and service	.108	.046	.110	2.364	.019
Management and teaching	.232	.057	.237	4.077	.000
Career growth	.329	.056	.286	5.899	.000

Note: The dependent variable is the evaluation of the usefulness of the education received at the MUST in the career

Table XI shows the results of the correlation analysis within four factored variables.

TABLE XI. CORRELATION BETWEEN PREDICTORS

Predictors	**Soft skills**	**Hard skills**	**Physical facilities and service**	**Management and teaching**
Soft skills	1	.000	.055	.453**
Hard skills	.000	1	.173**	.419**
Physical facilities and service	.055	.173**	1	.000
Management and teaching	.453**	.419**	.000	1

*Note: ** statistically significant correlation at 0.01 level (2-tailed Pearson Correlation).*

Soft skills had a higher correlation with management and teaching, while hard skills had a higher correlation with physical facilities and services.

CONCLUSION

From 2022 business administration and management programs of MUST are being reformed to follow the CDIO approach in defining program learning outcomes. As the process of program adjustment is ongoing graduates' satisfaction survey is conducted to use the results in program learning outcomes redefinition. In the satisfaction survey obtained from the graduates, 12 of the total 20 program learning outcomes were grouped into soft and hard skills by factor analysis.

Soft skills consist of the following 5 learning outcomes:

1) C1. Teamwork
2) B4. Personal skills and attitudes (initiative and willingness to take risks, perseverance and flexibility, creative thinking, critical thinking, time management, etc)
3) C2. Communications
4) B5. Professional skills and attitudes (professional ethics, integrity, responsibility, and accountability; professional behavior, proactively planning, etc.)
5) D1. External and societal context

Hard skills, in turn, consist of the following 7 learning outcomes:

1) A1. Knowledge of underlying sciences (mathematics, economics, etc.)
2) A3. Advanced business knowledge (finance, marketing, human resources, information systems, etc.)
3) A2. Core business fundamental knowledge (organizational management, statistics, production management, basic marketing, business communication, business law)
4) B1. Business reasoning and problem-solving
5) D5. Implementing
6) C3. Communications in foreign languages
7) Information technology skills

Although graduates rated their soft skills more optimistically than hard skills, the effect of hard skills on satisfaction was found to be greater. Interestingly, salary and graduation time had no significant relationship with graduates' satisfaction.

Graduates have relatively higher evaluations for faculty and extracurricular activities, while relatively lower evaluations for school external and internal environment and alumni activities. Soft skills were found to have a higher correlation with management and teaching, while hard skills had a higher correlation with physical facilities and services.

The higher impact of hard skills assessment level on graduates' satisfaction may have the following reasons. First, it may indicate that graduates value their hard skills more than their soft skills. Second, the soft skills acquired at the MUST are not the type of soft skills that are required at the workplace, particularly for career growth. Third, the results may imply that the acquired soft skills are useful for performing tasks as

part of a team, but it is the hard skills and other skills not included in the model that lead to promotion at the managerial level.

Finally, it might be necessary to develop the curriculum by focusing on teaching the skills, that are dropped by the the factor analysis and left ungrouped. These 8 outcomes are mainly CDIO 4th level outcomes and are:

1) B2. Experimentation and knowledge discovery
2) B3. System thinking
3) D2 Enterprise and business context
4) D3. Conceiving and engineering business systems
5) D4. Designing
6) D6. Operating
7) D7 Leadership
8) D8. Entrepreneurship

Some of these outcomes are covered by master degree programs at MUST. However, leadership and experimentation and knowledge discovery (curiosity and lifelong learning) are needed to be taught and nurtured in business administration programs at bachelor's degree level.

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