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The Dramatic Drop in Mathematics and Physics Students in High Schools: Consequences and Causes for Concern

Abstract

Applicants for the technology and engineering fields of the universities are, in fact, graduates of the field of mathematics and physics in high schools. Recently, the officials have symbolically declared the red alarm for the dramatic reduction in the students in the field of mathematics and physics in high schools. That is, surveys indicate that students have become increasingly less likely to pursue the field of mathematics and physics during the last two decades, leading to fewer applicants for engineering and technology fields of higher-level education. This would in turn inflict irreparable damages to the country's industry, production, employment, development, and technology shortly, and on the other hand, the perceived decrease in competition among applicants in this field has arguably caused a drop in the scientific level of candidates applying for the engineering fields. The findings of the current research indicate that this downturn in the application is directly related to the perceived career future of that field, mediated through the attitude of the families and individuals regarding the direction of life.

Keywords: Dramatic Drop, Consequences, Causes, Concern

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Introduction

The integrity of the industry is pivotal to the establishment and sustainability of economic growth in the world, and many advanced countries attribute the realization of sustainable growth and development to the optimal industrialization of their nation (Ebrahim Braz, 2016).

The workforce constitutes a large portion of the current world's population. International Labor Organization reported in 2018 that the global workforce is made up of 3.5 billion people. Improving the quality of human resources is one of the most significant drivers of improving labor productivity. The sustainable growth of production can be attributed to the increased productivity of the labor force, itself highly assumed to be achievable by heightening the quality of the workforce. Human health in general and the labor force, in particular, is considered a type of capital; Because health leads to more productivity and production and creates more income and prosperity. Improving the quality of the workforce can be achieved by raising the level of health and hygiene of the workforce. Desirable health levels facilitate optimal working conditions and increase the current and prospective expertise of the workforce, as a healthier workforce will contribute more to the development of production and economic growth.

As such, the alarming drop in the number of mathematics-physics students in high schools and its destructive effects on the industrial prospects of the country necessitates profound studies performed thereon.

Applicants for engineering, physics, and mathematical sciences in universities are graduates of mathematics and physics in high schools. In the last two decades, according to the statistics of applicants for the National University Entrance Exam from 2005 to 2020, the number of applicants in the fields of mathematics-physics, humanities, and experimental sciences were 342185, 518807, and 428654, respectively, in 2006, while the same figures were 194823, 355580, and 883662, respectively, in 2020, indicating a significant increase in the number of applicants for experimental sciences, while a significant decrease in mathematics-physics applicants.

The following table shows the statistics of the applicants for the National University Entrance Exam from 2005 to 2020, which depicts the decreasing trend of mathematics-physics applicants (Maralani, 2020).

Methods

This study sought to examine the reasons behind the significant drop in the applicants of mathematics-physics fields in the National University Entrance Exam, for which two separate sets of questionnaires were administered to high-school students of mathematics-physics and experimental sciences.

The questionnaires covered three main grounds for choosing a particular field to pursue in high school, namely (1) career prospects, (2) interest, and (3) qualification scores.

The questionnaires were administered to various high schools from varying regions of Tabriz, the findings from which revealed that almost 80% of students studying experimental sciences had career prospects in mind why choosing their field, while 20% did it on pure interest grounds. Moreover, no student reported having been forced to choose the field out of not meeting the qualification scores requirements.

On the other hand, almost no student of mathematics-physics fields cited career prospects as their motivation for choosing this field, as 60% of such students reported to have been forced into this field, given that did not meet the qualification score for selecting the experimental sciences field. Ultimately, 40% of mathematics-physics students reportedly selected the field out of pure interest.

Given that the results revealed a major difference in reported career prospects in the two groups of students, the research selected the aforementioned grounds as the main research focus.

Career prospects in terms of monthly income and welfare

Technology and engineering fields

Graduates from the technology and engineering field are often introduced into the workforce as industrial laborers, for which the government has set a minimum monthly basic wage of 36,700,000 rials (approx. USD 150). Nevertheless, the poverty threshold for the same year was a monthly income of 10 million tomans (approx. USD 400). Since the former figure simply does not allow for ends to meet, laborers are often left with no choice but to fill the income gap with more work hours or seek a second job. Various work-related accidents can be attributed to low wages, as such workers seek more working hours or second, part-time, jobs that make them work 15-18 hours per day instead of the standard 8 hours a day, hence becoming less focused when working with various devices. Damari et al. (2020) reported that Iranian workers have higher-than-average working hours and score low on parameters representing household social involvement and emotional support, a natural result of which would be the less tendency of their children to adopt technology and engineering fields as their career pathway.

Medical sciences

Iranian physicians are paid 800,000 rials for every appointment, and they can visit 10 patients minimum in a day, amassing a daily income of 8,000,000 rials (approx. USD 32). Considering 26 working days every month, the average monthly income for a typical physician, before accounting for operations and shift bonuses, would be 200 million rials (approx. USD 800), which is more than 5 times that of an engineer.

The authors decided that the working environment of any labor can be studied from 5 perspectives, namely (1) Job burnout, (2) Job insecurity, (3) Organizational justice in the workplace, (4) Violence in the workplace, and (5) Safety and health issues.

The research population for this study was the workers of the Iran Tractor Manufacturing Company

Job burnout

The descriptive statistics of mean, standard deviation, skewness, kurtosis, minimum and maximum were calculated for the variable of job burnout. Scores ranged between 1 and 5. The results are given in Table 1. The mean for the variable of job burnout is 3.75, with respective minimum and maximum of 1.89 and 5.0.

Table 1: Descriptive statistics for the variable of Job burnout

Variable	Frequency	Mean	SD	Skewness	Kurtosis	Min	Max
Job burnout	281	3.75	0.73	-0.65	-0.32	1.89	5.00

Job insecurity

Job insecurity can be broadly defined as employees' fear of losing their job and becoming unemployed or demoted. In this research, both aspects of qualitative job insecurity and quantitative job insecurity were examined.

Some works have inherent features that lead to occupational stress and anxiety, and hence insecurity for many employees (Kali et al. 2016: 199). In line with the current recession in the industry, the feeling of job insecurity has significantly improved for the employees of the industry sector. Among the various types of stresses that people may experience, occupational stress stands out in terms of significance and effects. Occupational stress can be defined as the accumulation of stressors and relevant work-related situations that most people consider them straining stress. That is, stress is a state in which work-related issues affect people's physical and mental health, one of the effects of which would be the perceived reduction of communication skills. Communication skills represent the set of potential and actual abilities of people that they can use to achieve acceptable and informative behavior through reaching a level of emotional relationship. Communication is the process of exchanging information, thoughts, and feelings through verbal and non-verbal interactions between people. They allow interpersonal connection and convey semantic intents. Lack of communication skills leads to feelings of loneliness, social anxiety, depression, low self-esteem, and career and academic failure. Many researchers, e.g., Faber, argue that communication skills are adaptive and hence can moderate job stress.

The damages inflicted upon the industrial sector by occupational stress have significant implications for various strata of society and are deemed extremely costly for the individuals suffering therefrom, the institutions and production units where people work, and ultimately, for the national economy. Statistics indicated that stress and the corresponding complications lead to the loss of hundreds of working days every year, and on average, one million people refuse to attend the workplace every day owing to disorders attributed to stress ailments. Notwithstanding the differences in personal mentality, resilience, and perceived strength, individuals may face stress-related complications that encompass mental, physical, and behavioral ones. Several occupational factors, including temperature-related disturbances, management and

organization, and noise, are shown to be involved in the occupational stress of workers.

The descriptive statistics of mean, standard deviation, skewness, kurtosis, minimum and maximum were calculated for the variable of job insecurity and its components. Scores ranged between 1 and 5. The results are given in Table 2. The mean for the variable of job insecurity was 3.51, with respective minimum and maximum of 1.60 and 5.0. Furthermore, the mean for the qualitative dimension was 3.47, while the mean for the quantitative dimension was 3.53

Table 2: Descriptive statistics for the variable of Job insecurity and its components

Variable	Frequency	Mean	SD	Skewness	Kurtosis	Min	Max
Job insecurity	281	3.51	0.77	-0.34	-0.79	1.60	5.00
Qualitative dimension of job insecurity	281	3.47	0.78	0.09	-0.52	1.50	5.00
Quantitative dimension of job insecurity	281	3.53	0.90	-0.44	-0.98	1.33	5.00

Organizational justice

The descriptive statistics of mean, standard deviation, skewness, kurtosis, minimum and maximum were calculated for the variable of organizational justice and its components. Scores ranged between 1 and 5. The results are given in Table 3. The mean for the variable of organizational justice was 2.85, with respective minimum and maximum of 1.05 and 4.80. Furthermore, the calculated means for each component were 2.63 for distributive justice, 3.03 for procedural justice, and 2.84 for interactive justice.

Table 3: Descriptive statistics for the variable of organizational justice and its components

Variable	Frequency	Mean	SD	Skewness	Kurtosis	Min	Max
Organizational justice	281	2.85	0.88	0.52	-0.02	1.05	4.80
Distributive justice	281	2.63	110	0.50	-0.67	1.00	5.00
Procedural justice	281	3.03	0.94	0.14	-0.38	1.00	5.00
Interactive justice	281	2.84	0.90	0.47	-0.15	1.00	4.78

Violence in the workplace

According to the definition of the International Labor Organization, “violence and harassment” refers to a range of unacceptable behaviors and practices, or threats at the working environment, whether a single occurrence or repeated that aim or result in physical, psychological, sexual or economic harm. Hence, this act has become a global concern with ever-increasing implications and varying levels of significance. Therefore, evidence from international studies suggests that violence in the world of work is associated with higher risks of negative mental health consequences, such as psychological suffering, anxiety, sleep disorders, chronic fatigue, depression, adjustment disorder and even work-related suicide, and physical complications such as muscle and skeletal pains, cardiovascular diseases and type 2 diabetes. Furthermore, violence and harassment can be attributed to increased risk for a variety of social and economic complications in the workplace, including absenteeism attitude, long nonappearances out of illness, reduced productivity, and increased unemployment.

The findings of the current study revealed that the national prevalence of violence in the workplace is higher than that of the global estimate. Moreover, the findings reflect a wide variability in the rates of violence in various provinces of the country. For example, personal harassment and violence (with a national average of 3.9%) varied between 1.2% for Tehran province and 8.1% for Kermanshah province. This finding is in line with the results of international studies depicting significant geographic differences in the prevalence of violence and harassment in the world of work. For instance, the prevalence of workplace violence in Scandinavian countries is lower compared to that of European and American countries. This variation can be attributed to cultural, economic, climatic, or managerial differences. Nevertheless, more studies are required to examine the correlation between the cultural, economic, and social indicators of the country's provinces, and violence in the workplace. Studying these differences can provide valuable insights for determining priorities and designing intervention programs for policymakers and managers in the field of work and health.

Safety and health issues of workers and engineers

Standard work is safe and healthy and seeks to maintain freedom and human dignity. The commitment to protect workers against work-related illness and injury is one of the main concerns of the International Labor Organization (ILO).

The modern-era take on the issue of health in the workplace emphasizes that the workplace should be an opportunity for reducing the risk factors of physical and mental illness, hence shouldering employers with social, as well as legal, responsibilities and duties in this regard. Reducing health- and safety-related costs requires carefully-devised comprehensive plans that are developed with the collaboration of stakeholders and approved by decision-making authorities.

One of the most serious challenges that societies should address in the upcoming century is maintaining health and quality of life. Merely attending to the health of individuals is

not sufficient to solve health problems in workplaces. The economic costs of occupational health and safety problems reflect heavily on the competitiveness of governments and organizations. As such, every organization must seek to establish, maintain and improve the health of its workforce, in addition to maintaining values, to facilitate the development and growth of technology and production. People spend more than a third of their lives in work environments, and hence, ensuring the safety and health of working environments is of natural significance to economic development and optimization of costs.

Inferential findings

The normality of the distribution of variables

Kolmogorov-Smirnov test was used to examine the normality of the distribution of variables, the null hypothesis being that the distribution is normal. If the significance level of the test is greater than 0.05, the null hypothesis is confirmed and it is concluded that the distribution of the research variable is normal.

Since the significance levels were all greater than 0.05, all research variables have a normal distribution.

Table 4: The results of the Kolmogorov-Smirnov on the normality of the distribution of variables

Variable	Frequency	z-value	Sig. level
Job burnout	281	1.297	0.077
Job insecurity	281	1.275	0.081
Qualitative dimension of job insecurity	281	1.318	0.068
Quantitative dimension of job insecurity	281	1.308	0.071
Organizational justice	281	1.24	0.097
Distributive justice	281	1.308	0.071
Procedural justice	281	1.287	0.079
Interactive justice	281	1.361	0.083

Table 5: Results of Least Significant Difference (LSD) post hoc test for pairwise comparisons of job burnout and activity sector

Variable	Activity sector (I)	Activity sector (J)	Mean difference (I-J)	Error	Sig. level
Job burnout	Machine shop	Assembly and calibration workshop	0.33	0.09	0.001
		Administration offices	0.82	0.10	0.001
	Assembly and calibration workshop	Machine shop	-0.33	0.09	0.001
		Administration offices	0.49	0.10	0.001
	Administration offices	Machine shop	-0.82	0.10	0.001
		Assembly and calibration workshop	-0.49	0.10	0.001

Conclusion:

The public perception of the career prospects of technical-engineering graduates compared to those graduates of experimental fields (medicine) has tilted the most talented high school students towards the latter, the effects of which have been exacerbated by family members who are now more conscious of the social and economic status of their studying child. This tilt has led to varying levels of intense competition among the applicants of experimental sciences while fashioning a substantial gap in competitiveness among the technical-engineering applicants. In the long run, this would lead to the diminishing of the competent engineering type, and hence an irreversible blow to the production and industrial technology and development of the country. The active involvement of various international organizations such as the World Health Organization (WHO) and the International Labor Organization (ILO) in issues related to the world of work, a rather prominent of which is healthcare, clearly depicts the multifaceted nature of this realm. Brazil, which is the fifth largest country in the world, has taken some preliminary, yet profound, steps towards the comprehensive welfare of its human resources by forming a unified health system.

Since 2007, Australia has sought to devise and implement the standards of human occupational hazards, largely based on those of the World Labor Organization. International workplace standards are maintained at sustainably high levels in Western European countries. Likewise, Japan has been very successful in promoting safe working conditions along with industrial developments, in line with their so-called Kaizen attitude. The International Labor Organization has requirements such as ergonomic and works risk factors to protect workers against physical and mental illnesses and injuries caused by hazards and accidents in the world of work. These standards have historically impacted the laws and regulations of governments. One such standard pertains to the occupational health service contracts and their proposals covering musculoskeletal injuries, violence, stress, harassment, and biological, chemical, and physical hazards.

Such contracts are of utmost significance to the prevention, diagnosis, treatment, and care of the receiving-end population, and the battle against discrimination. The very first step to assess the health of the workers according to the International Labor Organization is periodical medical tests, followed by biological tests, the deployment of a registration and warning system for monitoring the likelihood of fatalities and injuries owing to occupational accidents and diseases, piloting epidemiological research to monitor occupational illnesses, and finally maintaining the confidentiality of workers' health data. There are also previously established laws in government decrees that must be implemented. Chapter 4 of the 1990 Labor Law emphasizes the protection of human and material resources. In article 92 thereof, the provision of medical records for employees and periodical examinations has been established. Article 93 addresses the formation of technical protection and occupational health committee. The sixth chapter of the same law discusses the formation of labor and employer associations and organizations. The General Policies on Land Development of 2011 acknowledges the requirement for improving the indicators of human development with an emphasis on the promotion of health. The General Health Policies of 2014 maintain the vision for improving health indicators to achieve first place in the region of Southwest Asia. Paragraph 6 of the General Population Policy Document of 2014 has dutifully discussed the provision of health and prevention of social harm and disease. Moreover, the 2010 General Policies of Reforming the Consumption Pattern cites the empowerment of the workforce in all support programs as a major goal, while the General Policies of the Administrative System of 2010 have similarly prioritized human dignity and valuing human and social capital. For the sake of achieving the aforementioned milestones, the government should give more material and spiritual value to technical and engineering professionals by taking the necessary measures and by adopting protective laws .The government should also seek more facilities for engineers regarding welfare, emotional needs, and working hours.

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Reference

1. (ILO) and World Health Organization (WHO) in the Protection and Promotion of Occupational Health and Safety. Dynamics of Public Administration. 2013; 30(2): .72-702
2. Forastieri V. Improving health in the workplace: ILO's framework for action. (Geneva): International Labour Organization (ILO); 2014. P. 4.
3. Kühn S. 1 Global employment and social trends. World Employment and Social Outlook. 2020; 2020(1): 1.
4. Cox T. Workplace health promotion. An International Journal of Work, Health & Organisations. 1997; 11(1):
5. Kawakami T, Kogi K. Ergonomics support for local initiative in improving safety and health at work:
6. Azadmarzabadi E, Niknafs S. Models of opposing against job stress among military staff. J Payavard Salamat. 2016;10(4):299-310. [Persian]
7. Behzad Damari, Iraj Esmaeeli, Alireza Noroozi, Ebrahim Sadeghifar. The National Workplace Violence Survey among Industrial Workers in the Islamic Republic of Iran. Iran Occupational Health. 2020 (30 Dec);17:83
8. Braz, E. (2016). The position and role of industry in the economic development of Iran
9. Davarzani M, Naemi AM. The effect of training of communication skills with a religious approach on professional ethics and procrastination in employees of Sabzevar university of medical sciences. J Sabzevar Univ Med Sci. 2018;25(2):143-50. [Persian]
10. Emad SE, Abbaszadeh M. Studying the relationship between communicative skills and work-related stress among journalists working in Tehran press club. Communic Res. 2015;84(4):97-115. DOI: 10.22082/CR.2016.18819
11. Forastieri V. Improving health in the workplace: ILO's framework for action. (Geneva): International Labour Organization (ILO); 2014. p. 4.
12. Ghazavi Z, Feshangchi S, Alavi M, Keshvari M. Effect of a family-oriented communication skills training program on depression, anxiety, and stress in older adults: a randomized clinical trial. Nurs Midwifery Stud. 2016;5(1):e28550. PMID: 27331053 DOI: 10.17795/nmsjournal28550
13. Guay S, Goncalves J, Jarvis J. A systematic review of exposure to physical violence across occupational domains according to victims' sex. Aggress Violent Behav 2015; 25: 133-41.doi: 10.1016/j.avb.2015.07.013
14. Gutberlet J, Baeder A, Pontuschka N, Felipone S, dos Santos T. Participatory research revealing the work and occupational health hazards of cooperative recyclers in Brazil. International journal of environmental research and public health. 2013; 10(10): 4607-27.
15. Hajihasani M. Job stress in Shahrekord University staff: predictive role of emotional intelligence and

self-differentiation. Occup Hyg Health Promot J. 2018;2(2):10311. [Persian]
16. Hamidi Y, Fayazi N, Soltanian A, Heidari G, Ahmadpanah M, Nazari N, et al. Relationship between occupational stress and the performance of health care units in Hamadan Health Center, Iran. J Occup Hyg Eng. 2017;4(3):26-32. DOI: 10.21859/johe.4.3.26
17. International Labour Organization experiences in industrially developing countries. Ergonomics. 2005; 48(5): 581-90.
18. Jebedar Maralani, P. (2020). The significant decrease in engineering applicants and its consequences. *Iranian Engineering Education Quarterly*, 22nd year, number 87.
19. Kawakami T, Kogi K. Ergonomics support for local initiative in improving safety and health at work: International Labour Organization experiences in industrially developing countries. Ergonomics. 2005; 48(5): 581-90.
20. Macdonald W, Driscoll T, Stuckey R, Oakman J. Occupational health and safety in Australia. Industrial health. 20. 9-172: (3) 50; 12.
21. Matsuda S. A Review of the French Occupational Health System-From the Viewpoint of International Comparison between France and Japan-. Asian Pacific Journal of Disease Management. 2014; 6(2): 45-9.
22. Mohammadfam I, Zokaei HR, Nava S. Assessment of the costs of fatal occupational accidents in Tehran FEYZ. 2007; 11(1): 61-6. [Persian
23. Organization WH. Joint WHO/ILO policy guidelines on improving health worker access to prevention, treatment, and care services for HIV and TB. 2010.
24. Schütte S, Chastang J-F, Parent-Thirion A, Vermeylen G, Niedhammer I. Association between sociodemographic, psychosocial, material and occupational factors and self-reported health among workers in Europe. Journal of Public Health. 201 204-194: (2) 36; 3.
25. Sparling PB. Worksite health promotion: principles, resources, and challenges. Prev Chronic Dis 2009; 7(1). http://www.cdc.gov/pcd/issues/2010/jan/09_0048.htm
26. Stebbing J, Powles T. Stress in the workplace amongst medical professionals. J Postgrad Med. 2007;53(2):83-4.
27. World Health Organization. Burden of disease from environmental noise: Quantification of healthy life years lost in Europe. Geneva: World Health Organization, Regional Office for Europe; 2011.
28. Zamanian Z, Azad P, Ghaderi F, Bahrami S, Kouhnavard B. Investigate the relationship between the rate of sound and local lighting with occupational stress among dentists in the city of Shiraz. J Health. 2016;7(1):87-94. [Persian]