Romanian Higher Education: Modelling Evolution Tendencies

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Abstract
After communist regime downfall (in 1989, December) the Romania Educational System was continuous changed. In 1995 was adopted Law of Education, and each university develops respecting the law, and personal management strategies taking into account the national educational necessities. Starting from the data regarding the number of students from higher education from 1992 to 2005 the aim of the present research is to develop and analyze a mathematical model useful in prediction of students' number for a given year (in our case is 2008). The higher education was analyzed after geographical clusterization of the forty-two Romanian counties. Eight clusters included into analysis: Central, Capital, West, South, South West, South East, North West, and North East (called developing regions). In order to analyze the trends of Romanian higher education a mathematical model has been developed. The model integrates the following parameters: (1) the mean annual variation ratio (as absolute and relative values), (2) the increasing mean annual ratio (as absolute and relative values), (3) the number of students estimation for 1989 (as absolute value), (4) the numbers of students prediction for 2008, (5) the correlation coefficient, (6) the linear trend, (7) the number of students estimation for 1989 and (8) for 2008 obtained by the model. The mathematical model has been integrated into an online program and is available at:
http://vl.academicdirect.ro/applied_statistics/management&policy/education/romania/e_regions/.
The above-described parameters were computed for each item, cluster, and globally. The obtained results regarding the evolutions and predictions are analyzed and discussed. The plan of future development is highlighted.

Keywords: Higher Education, Mathematical Model, Romania Regions

Introduction

Major changes were made after 1989 in Romania. In educational field, in terms of legislation, it is enough to mention that during 1995 to 2004 a series of regulations were adopted in order to transform the educational system. Thus, Education Law (L, no. 84) was adopted on July 24, 1995. Since then, a series of changes had been made: Urgency Prescript (UP) no. 36/1997, L 151/1999, UP 30/2000 repealed by L 113/2002, UPs 130/2000, 206/2000, 295/2000, 2/2001, 32/2001, Ls 98/2001, 159/2001, UP 123/2001, L 713/2001, UPs 184/2001, Ls 345/2002, 520/2002, 268/2003, 267/2004 and 354/2004.

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Starting prom the main premise of learning to share the knowledge and formations was necessary to decentralized the education in order to create the competition arena which to lead later to an efficient educational system.

In terms of responsible institutions for public education management at national level, together with Education, Research and Youth Ministry (in his actual naming from April 3, 2007), are a series of Governmental agencies, such as National Council of Funding of Higher Education, National University Research Council, and National Council for Learning Reform.

During the period from 1992 to 2005, very a small number of private institutions of higher education exist in Romania (just few). Also in terms of size are smaller than public higher education institutions.

Statistical analysis of data during this period was made using of time series (Jäntschi and Diudea, 2003), regression analysis (Jäntschi and Bolboaca, 2007), and correlation (Bolboaca and Jäntschi, 2006). An online application, part now from a long series of such type of applications started with this one (Jäntschi, 2002) was made in order to analyzed the data.

The present study are focused on public higher education institutions, in terms of evolution of number of institutions, number of faculties, number of teaching staff, number of students, and number of graduated and aim is to identify the common facts related to developing of these.

Methodology

Material

The present study uses the reported data on higher education institutions by National Institute of Statistics during 1992-2004 years. In addition, it uses the splitting into developing regions of Romania's territory made by same institute. More, another series of data (at this time representing converted units, so-called student-equivalent are available from CNFIS, a Romanian agency responsible with funding of higher education institution during the last five years), recorded during 1995 to 2006 were used for comparisons. Flowing figure depict developing regions:

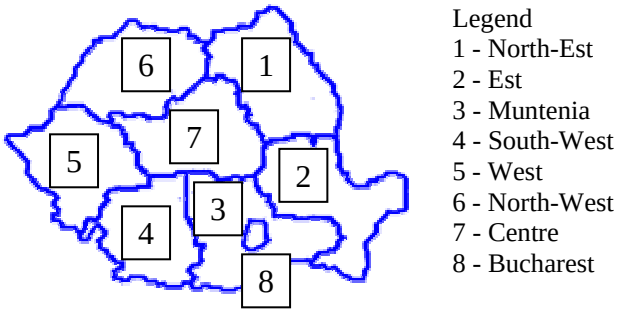


Figure 1. Romania's territory by developing regions

The evolution of four numerical characteristics (institutions, faculties, teaching staff, students, graduated) during 1992-2004 period were summarized and presented in table 1.

Table 1. Romanian Institutions, Faculties, Teaching staff, Students, Graduated during 1992-2004

	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
1	56	62	63	63	95	102	106	111	121	126	126	125	122
2	257	261	262	262	437	485	516	556	632	696	729	742	754
3	17315	18123	19130	20452	22611	23477	24427	26013	26977	27959	28674	29619	30137
4	215226	235669	250087	255162	336141	354488	360590	407720	452621	533152	582221	596297	620785
5	25927	29901	33366	34240	47837	57360	80991	67799	63622	67940	76230	93467	103402

1 = Institutions, 2 = Faculties, 3 = Teaching staff, 4 = Students, 5 = Graduated students

Mathematical Model

Let $a_1, \ldots, a_n$ be a time period, where a_i is a calendaristic or university year, and n is number of years from the considered period (A). Let $b_1, \ldots, b_n$ be a time series, where b_i is the value of the considered characteristic (B) corresponding to the time moment a_i. Let $M(\cdot)$ be the average operator. Thus, $M(B)$ is the average of the B characteristic:

$$M(B) = \Sigma b_i/n \quad (1)$$

Analogue,

$$M(A) = \Sigma a_i/n,\ M(AB) = \Sigma a_i b_i/n,\ M(A^2) = \Sigma a_i^2/n, \text{ so on} \quad (2)$$

There were calculated the following parameters:

- Averaged Annual Variation (in absolute units), *AAVA*, and Averaged Annual Variation (in relative units), *AAVR*:

$$AAVA(B) = \Sigma|b_{i+1}-b_i|/(n-1),\ AAVR(B) = AAVA(B)\cdot 100/M(B) \quad (3)$$

- Averaged Annual Growing (in absolute units), *AAGA*, and Averaged Annual Growing (in relative units), *AAGR*:

$$AAGA(B) = (b_n-b_1)/(n-1),\ AAGR(B) = AAGA(B)\cdot 100/M(B) \quad (4)$$

Using (4), backward (*BF*) and forward (*FF*) forecasting at one given year can be done using formulas:

$$BF(B,A,year) = \begin{cases} b_1\left(1+AAGR(B)\right)^{year-a_1}, & AAGR(B) \neq -1 \\ b_1\left(1-AAGR(B)\right)^{a_1-year}, & \text{otherwise} \end{cases} \quad (5)$$

$$FF(B,A,year) = \begin{cases} b_n\left(1+AAGR(B)\right)^{year-a_n}, & AAGR(B) \neq -1 \\ b_n\left(1-AAGR(B)\right)^{a_n-year}, & \text{otherwise} \end{cases} \quad (6)$$

Linear regression and correlation between *B* and *A* (time correlation analysis) is also a good tool for analysis. Following formulas were used:

$$r(A,B) = cov(A,B)/disp(A)\cdot disp(B),$$
$$cov(A,B) = M(AB)-M(A)\cdot M(B),\ disp(A) = (M(A^2)-M^2(A))^{1/2} \quad (7)$$

where r = the correlation coefficient; cov(A,B) = the covariance of *A* with *B*, and disp(A) = the dispersion of *A*.

Trend, expressed in both absolute and relative units:

$$Trend(B,A) = cov(A,B)/disp^2(A),\ TR(B,A) = 100\cdot Trend(B,A)/M(B) \quad (8)$$

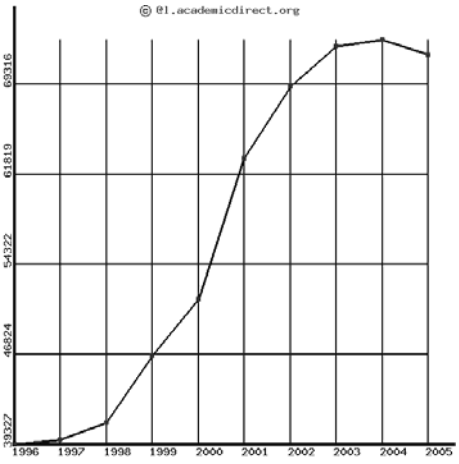
The estimation based on trend (relation 7) it served for estimation at 1989 and 2008 years with formula:

$$Estimation(B,A,year) = b_i + Trend(B,A)\cdot(year-a_i), \text{ true for any i from 1 to n} \quad (9)$$

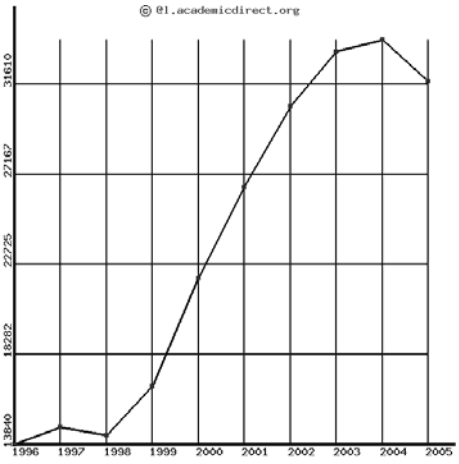
The estimation can be done for both backward (*BE*) and forward (*FE*).

Findings

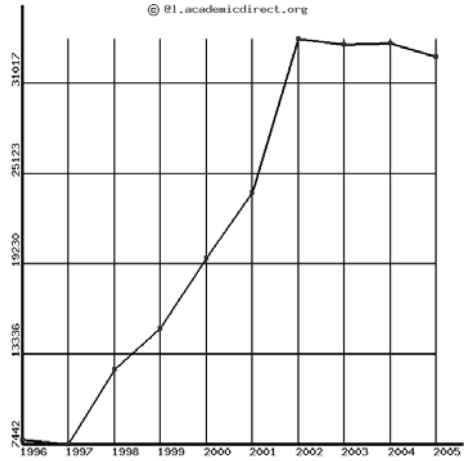
The numbers of students from higher educations institutions by developing regions are presented in figures 1-8.



1 - North-East



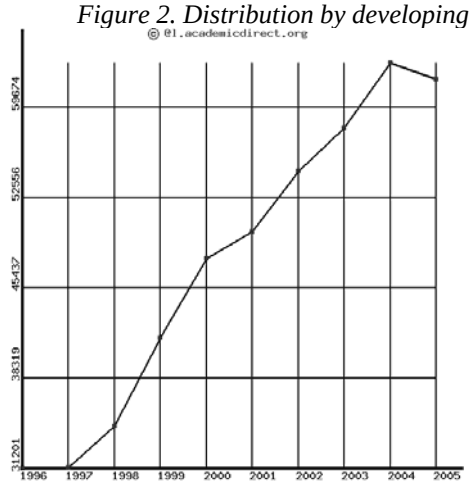
2 - Est



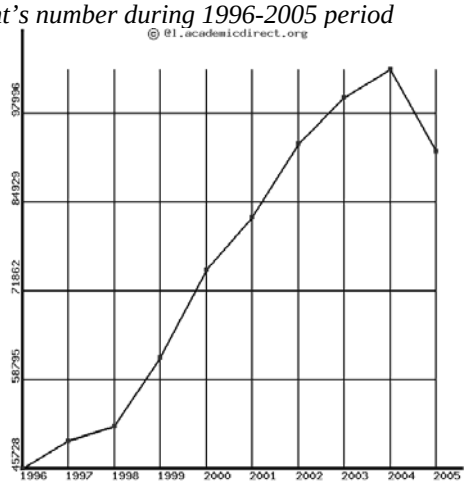
3 - Muntenia

4 - South-West

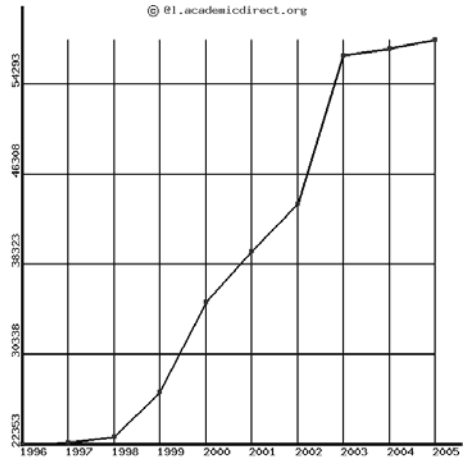
Figure 2. Distribution by developing regions of student's number during 1996-2005 period



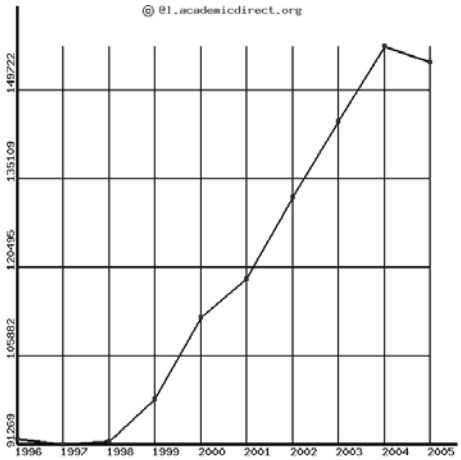
5 - West



6 - North-West



7 - Centre



8 - Bucharest

Figure 2. Distribution by developing regions of student's number during 1996-2005 period - continued

Table 1 contained the numerical parameters described by equations (1-9) for chose characteristics (number of institutions, faculties, teaching staff, students, and graduated).

Table 1. Results from student's number by growing regions in Romania considering years from 1996 to 2005

Region	Parameters								
	AAVR	AAGR	BF(1989)	FF(2008)	r	Trend	TR	BE(1989)	FE(2008)
1 - North-Est	6.8	6.4	25547	86413	0.96	4616	8	3716	91428
2 - Est	10.7	8.4	7872	40482	0.95	2643	11	0	43575
3 - Muntenia	14.2	12.6	3370	46820	0.96	3490	16	0	48181
4 - South-West	8.1	8.1	9645	46220	0.97	2694	10	0	47619
5 - West	7.8	7.2	19178	76282	0.99	3997	8	1445	77385
6 - North-West	10.4	6.9	28756	112809	0.95	6963	9	0	128033
7 - Centre	10.4	10.4	11216	78328	0.97	4800	12	0	74559
8 - Bucharest	6.4	5.8	62066	182853	0.97	8435	7	22312	182570

AAVR = Averaged Annual Variation in relative units (%)
AAGR = Averaged Annual Growing in relative units (%)
BF(1989) =Backward Forecasting at 1989 year (from AAGR) in absolute units
FF(1989) = Forward Forecasting at 2008 year (from AAGR) in absolute units
r = Correlation coefficient between selected characteristic and years (time correlation coefficient)
Trend = Linear regression coefficient of selected characteristic by years, in absolute units
TR = Relative measure of Trend (Trend divided by average), in relative units (%)
BE(1989) = Backward Estimation at 1989 year (from Trend), in absolute units
FE(2008) = Forward Estimation at 2008 year (from Trend), in absolute units

The parameters described by equations (1-9) for chose characteristics (number of institutions, faculties, teaching staff, students, and graduated) are presented in table 2 and 3.

Table 2. Descriptive data for 1992-2004 period related to higher education institutes in Romania

	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
1	56	62	63	63	95	102	106	111	121	126	126	125	122
2	257	261	262	262	437	485	516	556	632	696	729	742	754
3	17315	18123	19130	20452	22611	23477	24427	26013	26977	27959	28674	29619	30137
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1 = Institutions, 2 = Faculties, 3 = Teaching staff, 4= Students, 5= Graduated

Table 3. Parameters described by equations (1-9) values for number of institutions, faculties, teaching staff, students, and graduated considering years from 1992 to 2004

Parameter	Institutions	Faculties	Teaching staff	Students	Graduated
AAVR	6.3	8.2	4.4	8.4	15.5
AAGR	5.6	8.2	4.4	8.4	10.7
BF(1989)	50	220	15883	182997	21145
FF(2008)	160	1117	37396	931251	172143
r	0.94	0.98	0.99	0.98	0.94
Trend	6.7	50	1134	36732	6029
TR	7	10	5	9	10
BE(1989)	45	110	15153	106158	11930
FE(2008)	172	1052	36697	804062	126477

AAVR = Averaged Annual Variation in relative units (%)
AAGR = Averaged Annual Growing in relative units (%)
BF(1989) =Backward Forecasting at 1989 year (from AAGR) in absolute units
FF(1989) = Forward Forecasting at 2008 year (from AAGR) in absolute units
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BE(1989) = Backward Estimation at 1989 year (from Trend), in absolute units
FE(2008) = Forward Estimation at 2008 year (from Trend), in absolute units

Discussion

Are surprisingly the estimates of 0 to 1989 year when Trend (Eq.8) are used for prediction in table 1. This can have more than one possible explanation. A possible explanation is based on moving of preferences of learning from less expensive trainings to much expensive ones, which has as effect increasing (more than linear) of "student-equivalent" rate. In terms of effects on our analysis, trend become higher, putting the prediction at 1989 year at level of 0. Another explanation could be, because data are obtained from reports from universities, which are related to funds, so by increasing of the student-equivalent value of a university the funds also increases.

The lowest growing rate (see table 1) is recorded on Capital City (Bucharest, 5.8%). Thus, it can be says that the students are reoriented to another University centres. The biggest rate is near Bucharest (Muntenia, 12.6%) which comes to prove the previous sentence, being more facile to learn near to your home city than far from this. Note that, other regions do not benefit so much from this movement. The next region in terms of growing rate, Centre (10.4%), is also near to Bucharest.

Analyzing the data from table 3, are remarkable the growing and variation rate of number of graduated, which are over two times more than growing rate of teaching staff number. Despite its lowest growing rate, the number of teaching staff had biggest time correlation - is the most stable parameter - which is in one way the expected result, considering that during this period, the legislation related to employing in Romania favourites the employed, so the movement is not spectacular at all.

Conclusion

Both growing rate and linear trend shown that public higher education institutions from Romania were in a process of large expansion in the last decade.

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6.5 Attributes of effective economic instructors: a case study at Economic Education Department, Yogyakarta State University.
Losina Purnastuti

6.6 Pendidikan percukaian sebagai satu subjek di dalam sistem pendidikan negara: perspektif bakal guru.
Mohamad Ali Roshidi Ahmad & Mohd Asri Mohd Noor

6.7 Hubungan status sosio ekonomi ibu bapa dengan kefahaman konsep moral.
Mohamad Khairi Othman & Mohd Yahaya Mohd Hussin

6.8 Peran nilai moral dan nasionalisme dalam pendidikan di Indonesia.
Mudji Hartono

6.9 The accounting curriculum: a process to create effective leadership in job market.
Norizan Saad & Kamisan Gadar

6.10 Proses penerapan nilai murni guru perakaunan dalam melaksanakan pengajaran prinsip perakaunan.
Noor Lela Ahmad, Nor Aishah Buang & Norasmah Othman

6.11 Metode *problem solving* dalam pembelajaran mata kuliah pranata sosial.
Puji Lestari

6.12 Perbandingan pembelajaran koperatif dan tardisional terhadap prestasi dan konsep kendiri akademik dalam pendidikan perakaunan.
Rafiduraida Abdul Rahman & Norimah Rambeli

6.13 Persepsi pelajar terhadap kemahiran yang penting dalam kursus perakaunan.
Rohaila Yusof, Norasmah Othman & Faridah Karim

6.14 Asas pengetahuan dan pembangunan kemahiran dalam pendidikan perakaunan.
Shariffah Intan Syed Salleh & Syed Ismail Syed Mohamad

6.15 Pembelajaran ilmu pengetahuan sosial pasca berbagai bencana alam di Indonesia.
Suhadi Purwantara

6.16 Implementasi model pembelajaran *students teams achievement divisions* dalam mata kuliah strategi pembelajaran ekonomi.
Suwarno

6.17 Kesesuaian kurikulum perakaunan dengan kehendak tenagakerja: pandangan di kalangan pelajar dan pensyarah UPSI.
Syed Ismail Syed Mohammad, Syariffah Intan Syed Salleh, Fidlizan Muhammad & Khalid Ismail

6.18 Pengintegrasian konsep dan nilai pengelolaan air dan sanitasi lingkungan dalam pembelajaran IPS.
Yos Sudarso & Ucu Rahayu

6.19 Hubungan pendidikan percukaian dengan tahap kefahaman dan kebolehan pengisian borang cukai nyata pendapatan (Borang B): satu kajian kes di Tg. Malim.
Zuriadah Ismail, Mohd Shuhairy Mohd Noor & Mohd Nazri Hamzah

6.20 A study on factors that caused stress to the part-time master of accountancy students at UiTM.
Faridah Jaafar, Julianti Samsudin & Shanusi Ahmad

TRACK 7: INCORPORATING BUSINESS & ENTREPRENEURSHIP IN EDUCATION

7.1 Faktor-faktor pendukung keberhasilan berwiraswasta wanita menikah.
Aliyah Rasyid Baswedan

7.2 Kesediaan pelajar keusahawanan dalam membangunkan perniagaan sendiri.
Amal Hayati, Hariyaty Ab Wahid, & Norsamsinar Samsudin

7.3 Apprentice to businessmen in Indonesian history and culture tourism service.
Harianti

7.4 Orientasi pembelajaran melalui pengalaman dalam pendidikan keusahawanan.
Hariyaty Ab Wahid, Norsamsinar Samsuddin & Juliana Osman

7.5 Faktor-faktor pendorong usahawan wanita di daerah Kinta.
Loo Kam Lim & Kamisan Gadar

7.6 An attitude approach to the prediction of entrepreneurship on students in institution of higher learning.
Mohd Noor Mohd Shariff & Nordin Yusoff

7.7 Incorporating entrepreneurship in education.
Nasim Raza

7.8 Pemikiran keusahawanan dalam pengurusan pusat sumber sekolah (PSS): satu kajian tinjauan dikalangan guru media di daerah Kuala Selangor.
Noraini Mohamed Noh & Hariyaty Ab Wahid

7.9 Entrepreneurship: optimising contribution of vocational education in Indonesia.

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7.10 Pelaksanaan dan kesan program siswa bistari terhadap inspirasi keusahawanan sebagai kerjaya pilihan: kajian kes di Universiti Teknologi Mara Johor.
Sharul Effendy Janudin & Ros Hasri Ahmad

7.11 Entrepreneurs Marketing Knowledge And Its Contribution Towards Companies Growth: The Malaysian Perspective.

Ahmad Mahmood

TRACK 8: TECHNOLOGY INTEGRATION IN BUSINESS EDUCATION

8.1 E-learning application in higher learning institutions in Malaysia: a Study of online live tutorial at Unitar Kota Bharu, Kelantan.
Abdul Manaf Bohari, Azham Hussain, Fazillah Mohd Kamal & Wan Marhaini Wan Omar

8.2 Model keupayaan dan gaya kognitif melalui animasi grafik dalam mata pelajaran teknikal.
Ahmad Rizal Madar, Norhanisha Yusof, Saifullizam Puteh & Yahya Bunta

8.3 Faktor-faktor keberkesanan penggunaan pendidikan dalam talian di Institut Pendidikan Tinggi.
Nurazariah Abidin

8.4 Multimedia Instructional design: an insight on the theory and practical applications.
Riaza Mohd Rias & Halimah Badioze Zaman

8.5 Why we need to use ITIL for better IT and business infrastructure management in Malaysia.
Shamsul Arrieya Ariffin

8.6 The implementation of e-learning preparation model by students of economic and cooperation-ut in archipelago areas.
Suhartono, Djahrudin & Sri Sumiyati

8.7 Development of tutorial kids for social sciences with multimedia for learning support services in distance learning.
Sri Sumiyati S

8.8 Process of business instructional within distance learning system.
Suripto, Rhini Fatmasari & Kusnadi

8.9 Optimum usage of technology in social sciences education.
Wia Z Nuzia

8.10. Online instructional clinic for professionalism teacher.
Sri Sumiyati, Suhartono & Djahrudin

8.11. A study on the on-line self-supervision system for improving teacher's instruction specialties.
Shin-cheon, Kang

8.12 A true experience in managing an e-learning program at UiTM
Syed Jamal Abdul Nasir Syed Mohamad, Rosmin Talib & Aini Faridah

TRACK 9: BUSINESS EDUCATION CURRICULUM DEVELOPMENT & REFORM

9.1 Pengembangan model pembelajaran keterampilan kewirausahaan berbaris social budaya bagi perempuan nelayan.
H. Anwar Hafid

9.2 Developing strategic management model of the Iranian higher education institutions.
Abdolrahim Navehebrahim & Mohammed Qahremani

9.3 Impact of African growth and opportunity act on sub-Saharan economic and political development.
Enoch K. Beraho

9.4 Subjek elektif kursus kejuruteraan elektrik: kajian keperluan dan keberkesanan di bidang kerjaya.
Saifullizam Puteh, Wan Norhidayah Wan Mohamed Noor & Ahamad Rizal Madar

9.5 The needs to re-engineer the entrepreneurship course activities.
Shamsul Arrieya Ariffin

9.6 Optimalisasi penerapan metode inkuiri dalam pembelajaran mata kuliah sejarah asia tenggara baru di program studi ilmu sejarah FIS UNY.
Terry Irenewaty

TRACK 10: ORGANIZATIONAL CHANGE & STRATEGIC MANAGEMENT

10.1 Towards pay for performance practice: transformational tool during Ut-Bhp.
Amalia Kusuma Wardini

10.2 Romanian higher education: modeling evolution tendencies.
Carmen E. Stoenoiu, Ioan Abrudan, Lorentz Jäntschi, & Sorana D. Bolboacă

10.3 Research policy via funding allocation analysis.
Lorentz Jäntschi, Carmen E. Stoenoiu, & Sorana D. Bolboacă

10.4 Halangan sebagai suatu alat konstruktif untuk pengurusan perubahan.
Muhammad Khairuddin Lim & Norsamsinar Samsuddin

10.5 Gaya Kepimpinan apresiatif pengetua wanita dan impaknya terhadap prestasi akademik, sikap pelajar dan sikap guru:satu kerangka konseptual kajian.
Nazirmuddin Ahmad & Hasani Mohd Dali

10.6 Gelagat pengurusan usahawan perusahaan kecil dan sederhana dan hubungannya dengan ciri-ciri keusahawanan.
Norsamsinar Samsudin, Muhammad Khairuddin Lim, & Mohd Taib Ariffin

10.7 Keadilan distributive bertindak sebagai moderator dalam perhubungan antara jenis faedah kerja dan prestasi kerja.
Clara Ong Guat Leng, Azman Ismail, Chong Siaw Joon, & Sheilla Lim Omar Lim

10.8. Impak imbasan persekitaran perancangan sumber manusia terhadap prestasi organisasi.
Sopian Bujang & Nek Kamal Yeop Yunus

10.9. Pembangunan "safety aptitude system" dalam meningkatkan keberkesanan modul latihan keselamatan pekerja.
Muhammad Nubli Abdul Wahab & Hafizoah Kassim

10.10. Sistem Pendidikan dan Pasaran Buruh: Faedah antara Jantina
Zulkifly Osman & Ishak Yussof

TRACK 11: QUALITY MANAGEMENT IN BUSINESS & EDUCATION

11.1 Pensyarah IPTS: hubungan antara kepuasan kerja, gaya kepimpinan dan tekanan kerja.
Hawa Rahmat, Mohd Rahimi Yusoff & Hazalizah Hamzah

11.2 Amalan prinsip-prinsip pengurusan berkualiti di sekolah menengah harian di daerah hilir Perak: satu perbandingan.
Munirah Abd Hamid & Kamarul Bahari Yaakub

11.3 Kualiti, kesedaran dan penerimaan perkhidmatan perbankan elektronik di Kalangan kakitangan akademik politeknik.
Suzyanty Mohd Shokory, Mohd. Nazir Md. Zabit & Nek Kamal Yeop Yunus

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