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Physical and Mathematical sciences

Физико-Математические науки

Use of Resolving Equation to Define the Lower Critical Reynolds Number

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Abstract

Although the issue of streams with non-crossing trajectories of particle motions ranging from chaotic, random with irregular current lines, has been given a lot of attention, it still remains unresolved. The study features a relevant issue for hydromechanics, which is precise values determination of the Lower Critical Reynolds Number. It is suggested to put forward an updated approach to the use of energetic analysis for analytical calculation of the Reynolds Resolving Equation. The assessment of transition to mean motion from pulsation to the direction of laminar flows was fulfilled.

Keywords: turbulence energy; resolving equation; the Lower Critical Reynolds Number.

Introduction

The study features an illustration of researched steady direct motion of incompressible viscous fluid in the direction X caused by the pressure between two parallel walls ($y=\pm b_o$.). On the walls, the conditions for the adhesion and the equality to zero of the derivatives of velocity for all coordinates are created. Conditions are created for the pulsating motion of periodicity of a perturbation for the coordinate x with the period λ and the condition of the symmetry of the turbulent stress.

Definition

As a result of integration of the energy equation for Reynolds relative molar motion [3] the discriminating equation that defines the energy transition of the relative molar motion to the energy of the mean molar motion and heat has following form:

$$-\nu\int_{-b_o}^{b_o}\left[\ell^4\left(\alpha^2+\beta^2\right)+2\ell^2\left(\dot{\alpha}^2+\dot{\beta}^2\right)+\ddot{\alpha}^2+\ddot{\beta}^2\right]dy=\ell\int_{-b_o}^{b_o}\frac{d\bar{V}}{dy}\left(\alpha\dot{\beta}-\beta\dot{\alpha}\right)dy, \qquad (1)$$

where α,β, dots over symbols denote derivatives for y, $\ell = 2\pi/\lambda$,— the wave number of pulsations, - ν kinematics coefficient of viscosity. Included in the formula (1) the derivative of the mean velocity $\bar{V}$ in the direction across the flow, $\frac{d\bar{V}}{dy}$.in contrast to Reynolds [3] is determined not from the Poiseuille law for laminar flows, but from the turbulent profile of velocity distribution [4]

$$\frac{U_{max} - \bar{V}}{V_*} = 2,5 \ln b_o / y$$

Integrating by parts the right side of the discriminating equation (1) and taking into account the conditions of the symmetry of pulsation we obtain the discriminating equation in the following form:

$$\frac{5V_* b_o}{\nu} = \frac{E_2}{E_1}. \qquad (2)$$

where E_1 - the transition energy of the mean molar motion in heat is defined by the equation :

$$E_1 = \frac{1}{2b_o} \int_{-b_o}^{b_o} \frac{dy}{y^2} \int_{-b_o}^{y} \ell\left(\beta\dot{\alpha} - \alpha\dot{\beta}\right)dy, \qquad (3)$$

E_2 - the energy of transition from mean molar motion to the relative molar is defined by the equation:

$$E_2 = \int_{-b_o}^{b_o} \left[\ell^4\left(\alpha^2 + \beta^2\right) + 2\ell^2\left(\dot{\alpha}^2 + \dot{\beta}^2\right) + \ddot{\alpha}^2 + \ddot{\beta}^2\right]dy. \qquad (4)$$

In accordance with the boundary conditions the amplitudes of the pulsations can be written as fallowing:

$$\alpha = a \cdot \sin p + a \cdot \sin 3p, \qquad \beta = a \cdot \sin 2p + \frac{a}{2} \cdot \sin 4p,$$

where $p = \frac{\pi y}{2b_o}$.

Result

As a result of integration of the equations (3) and (4) we obtain:

$$E_1 = \frac{\pi a^2 L}{16 b_o^3}\left[3\mathrm{Si}\left(\frac{\pi}{2}\right) + 3\mathrm{Si}\left(\frac{3\pi}{2}\right) - \mathrm{Si}\left(\frac{5\pi}{2}\right) - \mathrm{Si}\left(\frac{7\pi}{2}\right)\right], \qquad (5)$$

$$E_2 = \frac{a^2}{b_o^3}\left(\frac{\pi}{2}\right)^4 \left[3,25L^4 + 36L^2 + 162\right]. \qquad (6)$$

where $L = \frac{2b_o}{\pi}\ell$.

After substitution in the discriminating equation (2) of expressions (5), (6) and known from [4] relations of transition from dynamic velocity V_* to mean velocity $\bar{V}$ we obtain:

$$\mathrm{Re} = \frac{2b_o \bar{V}}{\nu} = \frac{37,4\left(L^4 + 11L^2 + 50\right)}{L}.$$

Conclusion

The minimum of the expression (7) is determined by the value L_{min}=1,62, of which gives Re_{min}=2000. This means that for the reverse flow transition from turbulent to laminar the discriminating equation, defining the low value of the critical Reynolds number is expressed through the pulsation frequency and the dimension of a stream near the wall surface. Similar calculations can be made for other types of flow.

References:

1. Liepmann H.W. (1979) The Rise and Fall of Ideas in Turbulence *Amer. Sci.* 67, 2. 221—228.

2. Jackson D., Launder B. (2007) Osborne Reynolds and the publication of his papers on turbulent flow. *Annual. Review of Fluid Mechanics*. 39. 19–35.

3 . Reynolds O. (1895) On the dynamical theory of incompressible viscous fluids and the determination of the criterion. *Philosophical Transactions of the Royal Society of London*. A. 186, 123-164.

4. Nigmatulin R.I., Solovyev A.A. (2012) Fundamentals of fluid mechanics. Moscow: Littera, 400 p. (in Russian)

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Biological sciences

Биологические науки

Environmental Impact Assessment of Coal Mining: Indian Scenario

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Abstract

Coal mining is a development activity, which is bound to damage the natural ecosystem by all its activities direct and ancillary, starting from land acquisition to coal beneficiation and use of the products. This is so because environmental degradation has affected especially the common property resources such as land and water on which depend the subsistence and well-being of the local community. The study area being the foremost coal producing region of the country also ranked high in the record of environmentally degraded region. Huge areas in the Raniganj and Jharia coalfield in India have become ruined due to abandoned and active mine surface and underground mines. In open cast mines, waste resources are usually stacked as huge dumps in the surroundings. These, coupled with coal dumps, cause noteworthy visual impact. Large vicinity of forest, farming land, and pasture land has been transformed into colliery colonies or into uncultivated land due to rapid expansion of the coal mines. As a result, land use pattern has been changed considerably over last three decades. This study is pursued to assess the impact of coal mining activities on local community and environment.

Keywords: environmental degradation; health hazards; mine fire; pollution; agriculture.

Introduction

Environmental Impact Assessment (EIA) is a concept that evolved in search for ways to render development and protection of the environment. In order to predict and assess the impacts associated with a proposed action, it is essential to explain the environmental setting in which the proposed action takes place. This gives the baseline information against which prediction and assessment can be made. The study tries to mention about the environment which has been degraded by coal mining. Now a day's environmental assessment is widely used to study the impact which is still continuing in the particular region by particular activity. Increasing demand for environmental quality, protection of greenery, clear air and water, minimization of noise congestion and open space for active outdoor recreation have all taken with key importance. An impact can be defined as any change in physical, chemical, biological, cultural and socio-economic environmental system that can be attributed to human activities.

Raniganj and Jharia coal mining region plays an important role in India's overall development. This region has well developed transport and communication and rich in mineral resources. This famous coal bearing region has got very well scope for large industrial development along with other developments of agriculture, livestock, forest, water and other minerals. An integrated approach is very necessary for sustainable development in this region.

It is thus clear that coal mining leads to environmental damage, while economic development and self-reliance call for the increased mining activities of the available mineral resources. Though there is no alternative to the site of mining operations, options as to the location and technology of processing, adaptation of eco-friendly coal mining process and aforestation in the mining site etc can really minimize the damage to the environment.

Methodology

The methodology of the present study includes collection of research material over the field study and observation methods. The present study is based on both Primary and Secondary data. Primary data are collected from a structured interview schedule with the officers and workers of Coal India Ltd, W.B, India and secondary data are collected from CMPDI (Coal Mining Planning And Design Institute) records, journals of IICM (Indian Institute of Coal Management) and books and research paper related to coal mines. The field study was conducted from the Coal India Headquarters in 2012.

Results and discussions

Environment of underground mine working in India has been extremely dangerous because of the constricted geometry, darkness around, suffocating mine atmosphere, heat and humidity. Working under poor light in the past caused miners mustangs, is practically unknown now because of the improved lighting. Heat humidity and thermal stress often extreme under deep mines have been responsible for poor efficiency of the miners.

Air conditioning of the atmosphere in some of the deep underground mines have been realized in the interest of good organization. In this exercise, optimization of the man, machines, and environment system- physical environment in terms of heat, humidity, air movement, illumination noise, vibration, toxic agent, dust and fumes are to be looked into.

The environment of underground mines have been a subject of serious concern to the mine operators because of the liberation of methane with coal cutting, heat and humidity and generation of fumes with the blasting of coal (Wathern, 1988). The opening of the coal seams with interconnecting galleries, coursing for intake and return air, creation of air draught and deployment of auxiliary or forcing fans are some of the conventional means adopted to improve the environment of underground. The suppression of dust or suspended participate matter is trued by water spraying from the loading or transfer points. In the subsequent years water infusion in the seams and water jet mounting on the cutting edges is tried to minimize dust menace during cutting of the coal.

The auto oxidation of the coal; a slow process is aggravated when large surface area of the fine coal particles come in come in contact of air. The oxidation of pyrite adds a new dimension to the problem and being an exothermic process causes spontaneous heating and fire underground under favorable conditions. The heating process generates SO_2, CO, CO_2 and higher hydrocarbons (Boliga, 2010). These gases reaching to the atmosphere through cracks and fissures make the underground atmosphere unsuitable for the miners and also pollute the surface atmosphere around the up cast channels. Similarly the blasting underground generates NO_x and other gases in addition to fine particulate matter. The atmosphere underground was affected by a number of mining activities like cutting, blasting, loading and transport and preparation to beneficiation on the surface. The factors responsible for generating and adding different pollutants in the atmosphere underground are shown in the following chart. The most damaging constituent among them were the suspended particulate, impurity attributed to be due to handling, transport and preparation of coal and the methane released from the coal seams.

Some of the pollutants are the natural product of the coal formation while a number of them are produced during the mining operation, preparation and handling. The underground mining technology has been developed in different parts of the world to improve the mine environment and to minimize hazards associated with different activities. Main activities of the underground

mining, their impact over the surface workers, overlying formation and the surface and common remedial measures are summarized in the following table.

Table 1: Environmental problems of underground coal mining in India

Operation	Impact	Remedial Measures
Excavation	Methane Explosion	Effective ventilation Drainage
Drilling/ Cutting	Coal explosion Noise pollution	Dust extractor / Water infusion Earmuffs
Blasting	Fumes and vibration	Improvement in explosive and detonator
Loading	Dust pollution Noise pollution	Water infusion, Séquence control
Transport	Noise pollution	Earmuffs, improved Maintenance Water spry
Ground	Dust pollution Roof and side fall Opening of join/fissures	Effective support system Reinforcement Remote operation of m/
Movement subsidence	Land degradation Damage of surface Features Lowering or water table	Mining with harmless geometry/ Stowing, and reclamation.

Sources: CMPDI, Survey Report, 2013

Underground dust hazard in coalmining areas

The atmosphere of underground is under severe constraint because of the limited geometry of opening, number of simultaneous mining activities, liberation of gases from the coal seams and reaction of air with freshly exposed coal surface and pyrites. Rise in temperature by 1° C/ 22m depth cover made the atmosphere hot while the seepage of water from the roof and walls increases the humidity when the dust particles get segregated.

The dust particles causing harmful effect are divided into inert and proliferate groups. The inert particles-line stone, and smoke soot do not impair lung function unless excessive deposition over years. Proliferate group of dust includes free or crystalline silica and coal dust. The silicosis giving rise to difficulty in breathing, reduction of chest expansion and susceptibility to tuberculosis is because of the silica dust. Coal dust causes focal emphysema and results in marked disability in advance stage. The disturbance in the lung function in the early stage of fibrosis results in reduction in breathing or ventilator capacity and impairment of the process of gas exchange. In either case, the change in function is associated with bronchitis or emphysema.

The dust concentration underground varies with the operation and location, quality of coal and natural moisture content of the mine environment. Typical findings for an Indian mine is summarized in the following table covering different operational sites (CMRS* Annual Report-2012). All the measurements are taken with MRE 113, a Gravimetric Dust Sampler. The dust concentration was high in case of dry, soft coal with high ash content. The dust particles size under suspension varied from 1.5 micron to below 10 microns being most crucial and responsible for pneumoconiosis amongst miners.

* CMRS- Coal Mining Research Standard

Table 2: Dust concentration during different mining operations in India

Operations	Dust concentration mg/m³ of air
Tub loading	1.93-2.85
Drilling	3.00-10.27
S D Loading*	5.00-6.25
Under cutting	8.00
Transfer points	2.73-2.86
Blasting	10.00-20.00

Sources: CMRS Annual Report, 2012-2013

For every ton of coal mined underground, about 100 gm irrespirable dust is produced, out of which about 1-10% is air borne including 5 and 1 micron particles in the ratio of 1:40. The irrespirable dust generation in high rank coal seams or seams with higher ash content is proportionately more. The dust generation with the blunt cutting bits is also higher when the cutting is more under compression.

Table 3: Irrespirable dust composition from underground mines in India

Operations	Sulfur %	Ash %	Free Silica %
Under cutting	0.49 (0.15-1.05)	20.94 (1.95-57.05)	5.46 (1.56-13.32)
Drilling	0.56 (0.27-1.12)	15.70 (11.64-20.63)	4.05 (2.67-7.71)
Blasting	0.41 (0.31-0.70)	19.0 (13.42-32.67)	4.66 (2.09-12.27)
Loading	0.52 (0.31-0.70)	18.50 (14.81-27.71)	4.37 (1.52-6.89)

Sources: CMRS Annual Report, 2011-12

In the report, nearly 0.56% sulfur, 15.70% ash and 4.05% silica of irrespirable dust is produced per meter of 43 mm diameter hole drilled in coal seams during 2011-2012. The irrespirable dust generated during cutting by different machines is summarized in Table 4. Mechanized cutting of coal, concentrated heavy production, movement of heavy machine and slow velocity of the air are responsible for heavy concentration of air borne coal and silica dust. The problem in case of long wall and continuous mining is being tackled by the use of sharp bits, use of dust extractor and directional clearance of dust by improved air velocity.

Table 4: Irrespirable dust concentration during different mining operations in India

Operation	Dust concentration Average (Range)	Remarks
Development workings Undercutting	2.75 (1.50-4.00)	Face naturally wet
Drilling	2.20 (2.15-2.25)	Face naturally wet

* SDL- Side Discharge Loaders

After blasting	7.13 (7.00-7.25)	Face naturally wet
Manual loading	1.50 (1.25-2.35)	Coal naturally wet
Depillaring operation	2.00 (1.30-2.20)	Air velocity 5.7m/min
Drilling	1.10 (1.05-1.15)	Face naturally wet
Manual loading	5.75 (3.07-8.85)	Face naturally wet
Drilling	5.00 (4.36-5.64)	Coal dry
Chute discharge LHD loading*	1.05 (1.02-1.05)	Wet Dry

Sources: CMRS Annual Report, 2012-2013.

Surface atmospheric pollution in coalmining region in India

Mining below the surface destabilizes the ground, while the process of mining particularly blasting under shallow cover causes vibration of the surface structures and noise menace. The transfer of the raw coal, its beneficiation and handling generates coal dust while open burning of coal for steam or other usage releases gaseous discharge to the surface atmosphere. The movement of coal from the pit head to the loading or consumption points in open leaky trucks or open wagons also adds coal dust to the environment all along the route. The dump from the waste rocks, discharge of effluents from the machines and pumping out of the hard, polluted water to the surface water sources make the water unfit for mass consumption. The surface subsidence due to caving or fire damages the surface structures and endangers the surface dwellers. The underground mines are ventilated by large size fans discharging up to 12,000 m^3 /min. through fan evasive of 3m to 5m diameter at over 200 mm pressure (Dhar, 2000). The air absorbing moisture from the underground workings often reduces the suspended particulate matter but the fumes of explosives, methane, SO_2, and Oxides of Carbon are added to the general body of air. The concentration of these hostile gases often creates a little impact over the surface and the population nearby. With the latest realization about the impact of these green house gases over the Ozone layer has drawn the attention of the global community and efforts are made on to drain methane and put it to use as a fuel. The biodiversity and the local populace are also disturbed by the mining activities though they were mostly underground (CMPDI Report, 2012).

Dust concentration in coalmining areas

The dust concentration in the coal mining area is one of the worst menace affecting the common residents and miners alike. The miners from the organized sector get health support and other medical facilities while the common citizens suffer without any such insurance. Major portion of the menace is indirect; associated with open stock burning of coal, dumping, of the waste rock and road transport of coal and sand. The suspended particulate matter in mining atmosphere of Katras coalfield is revealing in this respect. The predominant air emission source in most of the coalfields is road generated dust and vehicular exhaust. In some of the areas road transport is the only mode of coal movement where open, leaky, inefficient trucks and dumpers carry coal on ill maintained roads and pollute the region. In Jharia coalfield, the vehicular movement contributed nearly 47% of total SPM load while the direct contribution of the underground mining was estimated to be 6% only (CMPDI report-2012).

The ambient air quality of the mining area often polluted by the associated activities is of the non mining origin but of public concern and required remedial steps. The vehicular discharge engaged for the transport and handling of the coal within the coalfield is responsible to a large extent in adding suspended particulate pollutants in the general atmosphere. The concentration of suspended particulate matter in ambient air of the coalfield on an average is high and the extreme is up to 1464 mg/1 at *Nirsa colliery*. The trace elements are also reported as pollutant in ambient

* LHD- load-haul-dump

air of Jharia coalfield, including lead, manganese, arsenic chromium and cadmium (CMPDI report-2012).

Table 5: Suspended particulate matter (SPM) in coal mining areas in India

Location	SPM	Level –Microgram/m^3
Mining cum residential area	801	(664-910)
Do (in rainy season)	480	(288-802)
Town residential area	786	(585-1010)
Do (in rainy season)	491	(147-713)
Average	618	-

Sources: CMPDI Survey Report, 2013

Dust concentration in mine fire area

Depillaring or partial extraction of thick coal seams under shallow depth cover has caused cracks traversing the overburden. This has been facilitated breathing of air to the seat of coal resulting in spontaneous heating and fire. The underground coal mine fires are the common picture in Jharia and Raniganj coalfields. The record of coal mine fires are available for Raniganj even before 1869 and Jharia coalfield since 1916. In the process of burning, everything from coal to surface grass is burnt with smoke all around resulting rise in temperature of the whole area. Jharia coalfield alone has over 70 active fires extended over 17.5 sq km emanating huge amount of noxious gases including poisonous CO to the atmosphere.

The occurrence of fire in underground mines in Jharia coal field has devastating impact over the atmosphere due to release of Hydrocarbons, SO_2 and other gases from the coal mass with the rise in temperature. The ambient air pollution near mine fire area of Jharia coalfield is given bellow in the following table.

Trace element pollutants in air surrounding coalmines

The toxicity of trace elements and complexities of biological and chemical interaction and its impact on the health makes the study of trace element in the environment very relevant to the healthy living of the population. Most of these elements are present in soil or rock mass but their concentration increased in the mining areas because of large scale lithosphere disturbance. The metals released with different mining and associated activities get suspended in atmosphere and get easy access to human body. The survey of the ambient atmosphere of Jharia coalfield shows significant concentration of iron, lead, zinc and copper given bellow in the form of table.

Table 6: Trace element in suspended particulate matter in Jharia coalfield in India

SL.No	Element	Area 1	Area 2	Area 3
1	F_e	5.67-13.33	4.38-14.29	5.12-14.92
2	M_n	0.128-.493	0.143-.682	0.148-0.801
3	P_b	0.136-.581	0.148-.623	0.125-.712
4	C_d	0.028-.067	0.018-.073	0.021-.061
5	C_u	0.281-.489	0.362-.521	0.302-.621
6	Z_n	1.32-1.52	0.920-1.203	0.822-1.008

Sources: CMRI Report, 2013.

Measures to control dust

The concentration of dust in the presence of moisture underground has shown decreasing trend because of agglomeration of the suspended particulate matter. The use of scrubber at different critical points as such could suppress the dust generation and dispersal. Even in the case

of conventional loading of the blasted coal. Water spraying has been practiced to control the dust in Indian mines. The system is quite popular in case of continuous miners and transfer points of the conveyors. The water infusion in the coal seam and spraying of water during cutting has been practiced for dust suppression.

Plain water or water mixed with surfactants and polymers has been injected into dry low volatile coal seams to reduce the dust generation in the India. The surfactant in very low dilution improved the dust suppression by 15 to 20% compared to plain water. The best arrangement appeared to have one spray behind each cutting bit that provided 4 liters/minute of water at 1-2 MPa[*]. Hydro jet cutting in shearer has been a common practice to reduce the dust generation during fast cutting of coal at high productive faces.

Noise pollution due to mining activities

The noise is now being recognized as a major health hazard; resulting in annoyance. Cases of Partial hearing loss and even permanent damage to the inner ear after prolonged exposure are noticed. The problems of underground are of special importance because of the acoustics of the confined space. The ambient noise level of the underground mining area is affected by the operation of the cutting machines, tub/conveyor movement and blasting of the coal. The movement of coaling machines and transport units-conveyor, tubs and transfer points caused audible noise which becomes disturbing underground because of the poor absorption by the walls (Singh. 2012).

The most noise generating equipments in underground are the haulage, ventilators-main, auxiliary and forcing fans, conveyor transfer points, cutting and drilling machines. The ambient noise level due to different operations in underground mines varies within 80-1040 dB (A). In Raniganj and Jharia coal field, the noise level near fan house, conveyor system shearer and road headers is reported to be within 92-93 dB (A). The degree of pollution is increased in many Indian mines due to poor maintenance of the machines, which sometimes exceed the permissible limit of 90 dB (A) for 8 hours per day exposure. The transfer points of the coal underground were the main point of the noise menace. The result of a noise survey for a coal mine conducted by DGMS[†] is summarized in the following table, which indicates noise over 90 dB by the drills, breaking and crushing units and transport system underground (Banerjee, 2007).

Table 7: Noise level in underground coal mines in India

Location of survey	Average Noise level (dB)[‡]
Near shearer	96
Transfer point	99
Tail end belt conveyor	89
Power pack pump	91

Sources: CMRS Annual Report, 2012-2013

The mechanized mines have lower noise problem in comparison to the old conventional mines operational mines operating with haulage and coal cutting machines. The results shows that covering wholly manual, partly mechanized with coal cutting machines and partly mechanized with SDL[§] loading has been showed reduction in the noise level in underground.

[*] MPa- Mega Pascal
[†] DGMS- Director General Of Mine Safety
[‡] Db- The decibel
[§] SLD- Side Discharge Loaders

Impact of underground mining on surface domain

Most of the leases acquired for the mining purpose are interior barren land, agricultural farms, or government controlled fallow and forest cover. The development of the underground mining establishments, residential complex and civic amenities required nearly 10% of the total lease area which has to be restored at the cost of forest, farms, or fallow land (Dhar, 2000). These lands are used for the common facility development with the marginal disturbance to the soil cover and green carpet. However the naturalized biological genes of the mining area are driven out or disturbed with the human settlement, noise nuisance has been created by heavy vehicles and construction of jungle of concrete. With the clearing of the exotic plants, the natural plant succession of the area is hindered and the loss of the green cover followed soil erosion.

The concentrated underground mining of coal in and around Jharia, Raniganj town have transferred the underground pollutants to surface atmosphere. The mine exhaust through main ventilators and the return airways added the gaseous and particulate pollutants to the surface atmosphere. Weathering of the coal and rock mass, leachets from the dumps and noise menace from blast wave and movement of surface handling plants pollute the surface environment to variable degrees.

The non mining activities like burning of coal in open stock, active fires and road transport of the coal have added a new dimension to the atmospheric pollution in this region. The sources of pollution associated with underground mining are summarized as follows:

a) Change in land use pattern and land depredation.
b) Ground Vibration with blasting.
c) Suspended particulate in the atmosphere.
d) Noise and vibration menace due to mining and vehicular movement.
e) Societal problems due to cultural, economic invasion and displacement.

Change in land use pattern due to mining activity

The underground mining has caused land degradation because of surface subsidence, solid waste and coal dumping, underground fire and silting of the surface. The disturbance of the aquifers and subsurface water table follows loss of green cover and vegetable mass. The subsidence and disturbance of hydraulic regime has been dealt separately because of their importance. The bunker age in Indian coalfields have been very poor when the excavated coal has to be stocked open along the railway siding. In the off seasons the pit head stock varied up to the production level of 15 days in a month covering a large area. The green cover over the patch is lost and the dust pollutes the area under the influence of underground mining and fire, affecting even the local non mining population. The waste rocks are picked and scattered around created severe eye shore. The surface condition of Jharia coalfield is self revealing.

As the size, shape and magnitude of the dumps varied with demand, the land degradation under its influence is variable. Nevertheless, an area once under coal heap remained permanent eye shore unless reclaimed by systematic plantation.

The other factors are responsible for the degradation of land in coalfields of Raniganj and Jharia. The subsidence in normal cases has caused undulation of the surface, damage to the structures and drainage pattern. In case the slope exceeds 15 degrees, erosion of the soil occurs; usually the top soil is removed with torrential rains. This converts the farms to wasteland of low fertility and caused siltation of the dams, streams and ponds. According to estimate, over 5.5 million hectares of land is already converted to waste land in Damodar valley alone (Goswami, 2013).

Land Disturbance due to mining activity

Leaseholds for the underground mines are procured from the land lords who have granted them the right for underground coal. The land for houses, dwellings and the associated activities are purchased piecemeal from different sources while large portion of the surface right remains under the control of farmers and landlords. Underground mining in these areas are conducted with full responsibility of the surface protection by the operators who normally maintains pillars as the natural support to the surface features. Now the condition is very damaging under the Jharia coalfield where thick coal seams are worked under shallow cover. There are some pockets in the coalfield which have subsided by over 10m due to repeat depillaring activities. In geologically

disturbed areas, deep pot holes are formed through which valuable fertile soil is drained to underground and many times surface structures are damaged, distorted or spoiled (Singh, 2006).

The land of Jharia coalfield is under regular threat because of mining operation; failure of pillars and stocks, pillar crushing and advancing fire in adjacent pockets. The story of Raniganj coalfield is in no way different where nearly 4000 He of land subsided up to the year 2010. The impact of underground coal mining in terms of loss of agricultural land is estimated to be nearly 1000 He in *Jamuria, Asansol* and *Kulti* blocks of Raniganj coalfield until today.

Water pollution due to mining activity

The hydraulic cycle starting from ocean to sky and ultimately precipitation to the earth is no exception for the coalfield where the rain, natural moisture and surface to subsurface water sustain biodiversity of the region. The infiltrated water is charged to the coal measure aquifers and is retained by the aquiclude or aquifuge. Depending upon the thickness, porosity, permeability and storage coefficient of the rock mass, the capacity of the aquifers varies extensively over *Damodar* valley to *Pench Kanhan* coalfields. The coal seams are known to be impervious, restricted the cross infiltration when different layers charges along the exposure serves as the confined aquifers. The extraction of the coal has followed disturbance of the aquifers and lowering of the water table. In this process mineral leaching occurs, affecting the water quality of underground. The water pollution problems in mining may be broadly classified into the following four major heads (Chadwik, 2007).

- Acid mine drainage due to sulfur content
- Deoxygenating and Eutrophication of coal
- Hardness of water due to leached
- Heavy metal pollution oil, tan and grease mixing in water

The mine effluents have high level of dissolved chlorides, nitrates, phosphates or sulfates of sodium, calcium magnesium and iron. At low levels, nitrates, and phosphates act as nutrients, causing rapid growth of algae and subsequent deoxygenating while at higher level, the character of the water is altered with deleterious effect over the fishes. The bicarbonates, sulfates, chlorides and calcium and magnesium cause hardness of the water and make it unsuitable for industrial and human consumption. The characteristic of the mine water of Jharia coalfield in different seasons is summarized in the following table.

Table 8: Average characteristic of Jharia coalfield mine waste water in India

Parameters	Winter	Summer	Rainy season
Temperature	30.5	26.8	29.5
pH value	8.5	7.4	8.0
Alkalinity:	-	-	-
Phenolphthalein mg/1	32.6	21.3	48.6
Methyl orange mg/1	224.3	256.8	283.8
Total Hardness mg/1	483.6	400.9	487.1
Permanent mg/1	314.2	256.2	413.2
Temporary mg/1	169.4	144.7	74.8
Chlorides mg/1	43.6	60.5	35.5
Sulfates mg/1	180.4	73.1	28.2
Phosphate mg/1	141.7	114.6	87.8
Suspended solids mg/1	119.3	111.8	161.4
Dissolved solids mg/1	558.2	497.7	698.1
Chemical Oxygen Demand mg/1	14.8	21.5	37.7
Iron mg/1	2.1	2.2	2.6

Sources: CMPDI Report, 2013.

Land degradation and its effect on agriculture due to mining activity

The land is non-renewable asset and its degradation therefore has far reaching implications affecting the life of thousands of inhabitants living in the degraded land. Land loss and land degradation due to mining may be due to underground or opencast mining. In underground mining subsidence causes the major loss of land and in Raniganj and Jharia coalfield, extensive area may be considered to be degraded due to instability created by wrong mining procedure (Goswami, 2014). In the surface mining, the excavation and spoil heaps is the major cause of land degradation. There are other causes of land degradation which are associated with mining. Land may become less productive and therefore degraded due to deposits of coal dust and other suspended particulate matter. The extension of urbanization associated with mining also contributes to land loss in many ways. Traditionally, coal production in Raniganj and Jharia coalfield was mostly from underground mines though the scenario has changed significantly in favour of opencast mining after nationalization as has been stated earlier. A number of prestigious underground projects have been undertaken in Raniganj coalfield after nationalization, including one at Jhanjra which is already under implementation with Russian collaboration (Bhengara, 1996). Jhanjra underground project has been planned to be one of the biggest underground mining project in India. The work on an Indo - French project at *Khottadih* has been started recently. The estimate presented in the fore – going paragraphs indicates that approximately 15 to 17 percent of the total land in the coalfields in Raniganj and Jharia would be degraded due to mining and related causes. It is very difficult to assess the quantum of agricultural land involved in the total land degradation. The sample survey presented earlier shows that agricultural land has generally been 18–55 percent of land degraded in a project. The quantum of agricultural land involved increases with mining entering into a relatively new area, whereas when the project is on an area where mining activities are already in full swing, the quantum of agricultural land involved may be smaller. A reasonable estimate may be that 35–40 percent of the total land involved may be agricultural land, which means around 10,000 hector of agricultural land may be involved in the Raniganj coalfield during the process of mining up to 2010. The total land use pattern in the coalfield has never been verified in Raniganj coalfield though some aerial survey data is available for Jharia coalfield.

Conclusions

Mining below the surface destabilizes the ground, while the process of mining particularly blasting causes vibration of the surface structures and noise generation. The transfer of the raw coal, its beneficiation and handling generates coal dust, whiles open burning of coal for steam or other usage release gaseous discharge to the surface atmosphere. The movements of coal from the pit head to the loading, or consumption points in open trucks or open wagons also add coal dust to the environment all along the routes. The air absorbing moisture from the underground workings often reduces the suspended particulate matter but the fames of explosives, methane, S02, and Oxides of carbon were added to the general body of air. The concentration of these hostile gases often creates negative impact over the surface and the population nearby. With the latest apprehension about the impact of these green house gasses over the ozone layer has drawn the attention of the global community and efforts are made to drain methane and put it use as a fuel. The bio – diversity and the local people are also disturbed by the mining activities though they are mostly underground mining. The adverse effects of subsidence fissures have made most of the subsided areas barren and unstable. The indirect effect of subsidence has contributed to drying up of many tanks and dug wells in the vicinity. Much of these subsided land may however be put back to productive use with joint effort from coal companies and local administrations, but no concerted and coherent effort has however been taken in this direction. Not much study has been done towards reclamation of subsided land in Indian coalfields. In a few areas of Raniganj coalfield, plantation on subsided land has been tried. The scientists are of the opinion that before starting reclamation of subsided land, the purpose of reclamation in terms of “land-use” should be decided in consultation with the local people. The most important thing is to plug the cracks and it may not be necessary to bring the subsided land to original profile even for use for agriculture, plantation and housing. The human dimensions of these physical impacts have been marginalization of the poor tribal from the mainstream, formal economy, displacement of peasantry and the growth of small scale, informal, illegal coal mining under local initiative. A degraded environment has fore

closed alternative employment opportunities especially in the forestry and agricultural sector, leading the poor people to unlawful activities. This is so because environmental degradation has affected especially the common property resources such as land and water on which the subsistence and well-being of the poor community depends.

References:

1. Biswas, A.K and Q. Geping. (2007), "Environmental Impact Assessment for Developing Countries": Tycolly International, Londan, 232.
2. Boliga, B.P. (2010), "Challenges of environmental management", 4th National Convention of Mining Engineers, March, Dhanbad, India. 25.
3. Banerjee, S.P (2007), "Land Reclamation in Mined Areas". National workshop on environmental management of mining operation in India – a status paper. February, Varanasi, 63-73.
4. Bhengara, R. (1996). "Coal Mining Displacement", *Economic and Political Weekly*, 31, no. 11, Mar. 16, 647-649.
5. CMPDI Survey Report, 2012. 12.
6. Chadwik, M.J. (2007), "Environmental impacts of coal mining and utilization". Pergamum Press Oxford, 5-211.
7. CMRS Annual Report, India. 2012.
8. Coal India Annual Report. 2012. 120.
9. Dhar, B.B. (2000), "Environmental impact and abatement of noise pollution". National Workshop on environmental management of mining operation, Varanasi, India. 168-204.
10. Goswami, S. (2013). "Need for Clean Coal Mining in India", Environmental Research, Engineering and Management, 4(66), 79-84.
11. Goswami, S. (2013), "Coal Mining, Environment and Contemporary Indian Society", Global Journal of Human Social Science, U.S.A (B) (Volume 13 Issue 6 Version 1.0 Year 2013) 17-26
12. Goswami, S. (2014), "Coal Mining, Communities and the Environment", 1st ed. New Delhi Publishers, New Delhi. 9.
13. Goswami, S (2014), "Clean Coal Initiatives in India", *European Researcher*, 81, 8-2, 1502.
14. Singh T.N. and M.L. Gupta. (2012), "Clean coal initiatives", C.M.R.I., Dhanbad, India, Scientific publishers, Jodhpur, 12.
15. Singh, G, Laurence, David and Lahiri-Dutt K (eds.) (2006). "Managing the Social and Environmental Consequences of Coal Mining in India", The Indian School of Mines University, Dhanbad, India.
16. Wathern, P. (1988), "An introductory guide to EIA in: Environmental impacts assessments (2nd ed.), London, U.K, 3-28.

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Isolation of Stem rot Disease Causing Organism of Brinjal and their *in-vitro* Inhibition with Fungicides and Bio-control Agents

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Abstract

Different strains of *Sclerotinia sclerotiorum* were isolated from the diseased samples collected from different hosts and locations. Among the 14 isolates, 12 isolates colonies covered the entire Petri plates within 96 hours but, two isolates from fababean and yellow mustard showed slow colony growth within 96 hours. All isolates produced sclerotia which were varied in number, but the fenugreek isolate produced maximum (43) number of sclerotia and lambs quarter isolate produced minimum number of sclerotia (12) on PDA medium. To examine inhibitory effect of fungicide on the mycelial growth of the pathogen, 9 fungicides were tested *in vitro* against *Sclerotinia sclerotiorum,* of those carbendazim, carboxin, topsin-M and carbendazim+ mancozeb (SAAF) were found most effective and inhibited the mycelial growth of pathogen up to 100 per cent at 0.05%, 0.1%, and 0.2% concentration. The effect of different bioagents viz., *Trichoderma harzianum, T. viride, T. koningii, T. atroviride, T. longibraciatum, Aspergillus niger, Chaetomium globosome* and *Penicillium notatum* in inhibiting the growth of *Sclerotinia sclerotiorum* was studied through "Dual Culture Technique". The data showed that among the eight biocontrol agent six were fond effective. The maximum inhibition was found by *T. harzianum* causing 70.82% inhibition of mycelial growth of the pathogen *S. sclerotiorum*.

Keywords: *Sclerotinia sclerotiorum;* fungicides and biocontrol agents.

Introduction

Sclerotinia sclerotiorum (Lib.) de Bary is a soil-borne plant pathogen that infects over 400 plant species at all stages of growth, development and harvested products. The diseases it causes are commonly known as white mold, sclerotinia wilt or stalk rot [1]. In addition, as most inoculum is ascosporic, a few germinating sclerotia can lead to significant infection levels in the field [2]. Also, ascospores could travel long distance from neighboring fields and infect petals [3]. During the growing season, depending on various environmental factors, the sclerotia germinate and form

either mycelium, which can infect plants or produce ascospores by developing an apothecium [4]. Ascospores are the primary inoculum for epidemics in many crops [1, 5]. *S. sclerotiorum* is capable of infecting flowers, leaves, fruits or stems. Management of disease with crop rotations is unrealistic due to the persistence of survival structures (sclerotia) in the soil for long periods and due to its wide host range [6]. These factors necessitate the use of fungicides, which have been known to have adverse effects on non-target organisms [7]. Biological control as a disease management strategy in protected agricultural areas would not only be economical but also durable by sustaining the reduction of inoculum potential and amount of disease produced by *S. sclerotiorum*. A number of biocontrol agents have been characterized for the control of *S. sclerotiorum* [8]. Antagonists such as *Ulocladium atrum* is an effective biocontrol agent as a mycoparasitic fungus on *S. sclerotiorum* [6] and *Pseudomonas sp*. inhibit the germination of ascospores of *S. sclerotiorum* by antibiosis [9,10]. The suppression of *S. sclerotiorum* by *Trichoderma harzianum* (Th38) and *Epicoccum purpurescence* was due to colonization on petals of brinjal [9]. Although, most of the species of *Trichoderma* and *Bacillus* are effective BCAs and very few species have been tested on *S. sclerotiorum* [9, 10]. Therefore, there is a need for research into biocontrol of *S. sclerotiorum* on brinjal crop. In this paper we studies the morphological variations among the different isolates from different host of *S. sclerotiorum*, check the efficacy of different fungicides against the pathogen *S. sclerotiorum in vitro* and evaluate different bio-control agents against the pathogen *S. sclerotiorum in vitro*.

Material and method

1. Collection of diseased samples from different hosts and locations

The samples (plant/plant parts infected with *Sclerotinia sclerotiorum*) were collected from different hosts and locations under natural condition to isolate the strains of *S. sclerotiorum*. The plant/plant parts showing prominent symptoms of the disease were examined for the presence of the causal organism.

In vitro studies were done in Centre of Excellence for Sanitary and Phytosanitary (SPS), Department of Plant Pathology, Sardar Vallabhbhai Patel University of Agriculture and Technology Meerut during 2012-2014.

2. Isolation and purification of the pathogen

The diseased part i.e. fruits and stem of brinjal showing typical symptoms along with sclerotia were collected for isolation of the causal organism. The selected plant parts and sclerotia were thoroughly washed with sterilized water for removing the dust and other surface contaminants. The diseased plant parts were initially cut into small pieces with the help of sterilized knife. These pieces were first washed in sterilized water and then dipped in 0.1 per cent mercuric chloride ($Hgcl_2$) solution for 30 seconds and were thoroughly washed in sterilize water three times to remove the traces of mercuric chloride. Excess moisture of these pieces was removed by putting them in two folds of sterilized blotting paper under aseptic condition and then three to five pieces of infected parts and sclerotia were transferred into sterilized petri dishes containing potato dextrose agar (PDA) medium and incubated at room temperature. After about 24-48 hours of incubation, the whitish mycelia growth appeared out from the pieces and sclerotia. The hyphal tips of mycelium were transferred aseptically to PDA medium plates. The culture obtained from different diseased pieces and sclerotia were subjected to preliminary microscopic examination, which revealed the presence of the pathogen responsible for disease.

3. Host range of the pathogen

To ascertain host range of the fungus *Sclerotinia sclerotiorum,* the selected host plants of different species of different families were artificially inoculated with mycelial discs, mycelial suspension and sclerotia. The inoculated plants were covered with polythene bags for 7-10 days, irrigated and maintained throughout the experiment. After 10 days of inoculation the polythene bags were removed from the inoculated plants. The critical observations were recorded for the appearance of diseased symptoms on artificially inoculated plants.

4. Morphological variation among different isolates of *Sclerotinia sclerotiorum* by observing its mycelial and sclerotial characters

The mycelia and colony characters of different 14 isolates of *S. sclerotiorum* were studied on PDA medium. The Petri dishes containing the medium were inoculated with 5.0 mm disc of each isolates which were taken from 3 days old actively growing culture. The Petri dishes were incubated

at 25 ± 1° C in BOD incubator. The mycelial colony characters were examined after 7 days incubation. On these plates after production of sclerotia by different *S. sclerotiorum* isolates were studied and observed its characters.

5. Efficacy of fungicides against the pathogen

Nine fungicides belonging to the different group were tested against the pathogen *Sclerotinia sclerotiorum in vitro* to select the best effective fungicide, which could inhibit the growth of the pathogen in culture to maximum extent. This could be achieved by "poisoned food technique" [11]. The requisite quantity of each fungicide was incorporated in PDA medium, thoroughly mixed by shaking prior to pouring in sterilized petri plates and were allowed to solidify. These petri plates were inoculated with 5 mm discs of three day old culture of the pathogen with three replications. The petri plates were incubated at 25 ± 1° C with one set of control. The data on radial growth of fungal colony were measured in millimeter (mm) after every 24 hours till the control petri plates were not filled up. The percent inhibition over control was calculated by the following formula suggested by Bliss (1934) [12].

Per cent growth inhibition over control= dc – dt /dc × 100

where,

dc = colony diameter in control

dt = colony diameter in treatment

6. Evaluation of bioagents against the pathogen

Eight isolates of different bio-control agents were collected from different location of North India viz. *Trichoderma harzianum* and *T. viride* collected from Bikaner (RAU), *Trichoderma koningii* from IARI (4302), *Trichoderma atroviride, T. longibrachiatum, Chaetomium globosum,* and *Aspergillus niger* from Kanpur (CSA), and *Penicillium notatum* from Meerut (SVP), were evaluated by dual culture technique [13] (Morton, D.J. and Strouvle, W.H. 1955). Discs of 5 mm diameter were taken from the actively growing colonies of the test pathogen (*S. sclerotiorum*) and antagonists with the help of sterilized cork borer. The disc of the pathogen were placed on one side of poured PDA plates aseptically while, the discs of antagonists were placed on opposite side of pathogen in same petri plates and the control were also maintain. The experiments were carried out in three replications. These petri plates were incubated at 25 ± 1°C. After 7 days of incubation, the mechanism of interaction was observed and the data were recorded as per cent inhibition by following formula [12].

Per cent growth inhibition over control= dc – dt /dc × 100

where,

dc = colony diameter in control

dt = colony diameter in treatment

Results

1. Isolation and purification of the pathogen

The isolation of the fungus *Sclerotinia sclerotiorum* from diseased sample collected from different hosts and locations/places were done from the affected plant parts showing characteristic symptoms of the disease on PDA medium. After isolating the fungus *Sclerotinia sclerotiorum* was purified by subsequent transferring of fungal mycelium into culture tubes (PDA poured) and then these purified culture tubes were kept in refrigerator at 5°C temperatures for further research purpose.

2. Host range of the pathogen

The host plants have an important role in occurrence and spread of the disease in crop season by maintaining, survival and multiplication of the inoculum during off season. Therefore, the knowledge of host range of the pathogen is very useful in controlling the disease. The 14 isolates of *Sclerotinia sclerotiorum* were inoculated on 25 plant species including crop plants, medicinal and weed plants belonging to different families with mycelial disc and sclerotia of the fungus.

The results presented in table-1 revealed that out of 25 plants, 16 plant species belonging to seven different families were infected by the pathogen. The mycelial mat and black sclerotia were also noticed on highly susceptible plants. It is clear that the pathogen had a wide host range in different plant families and these species might help pathogen in its survival during the off season and spread the inoculums early in the crop season.

Table 1: Host range of *S. sclerotiorum* under artificial inoculation condition

S. N.	Name of host plant inoculated with *S. sclerotiorum*		Family	Pathogenic reaction
	Common Name	**Botanical Name**		
1	Aloe vera	*Aloe barbadensis*	*Liliaceae*	-
2	Ashwagandha	*Withania somnifera*	*Solanaceae*	-
3	Fababean	*Vicia faba*	*Leguminoseae*	+
4	Lambs quarters	*Chaenopodium album*	*Chenopodiaceae*	+
5	Indian Hemp	*Canabis sativa*	Geraniaceae	-
6	Brinjal	*Solanum melongena*	*Solanaceae*	+
7	Brocolii	*Brassica oleracea*	*Cruciferae*	+
8	Cabbage	*Brassica oleracea*	*Cruciferae*	+
9	Chickpea	*Cicer arietinum*	*Leguminoseae*	+
10	Coriander	*Coriander sativum*	*Umbellifereae*	-
11	Fenugreek	*Trigonella foenugracum*	*Leguminoseae*	+
12	Field bind weed	*Convolvulus arvensis*	*Convolvulaceae*	+
13	Lentil	*Lens esculenta*	*Leguminoseae*	-
14	Indian sweet clover	*Melilotus indica*	*Fabaceae*	-
15	Mustard	*Brassica juncea*	*Cruciferae*	+
16	Parthenium	*Parthenium heyterophorus*	*Asteraceae*	+
17	Pea	*Pisum sativum*	*Leguminoseae*	+
18	Potato	*Solanum tuberosum*	*Solanaceae*	+
19	Fennel	*Foeniculum vulgare*	*Umbellifereae*	-
20	Sowthistale	*Sonchus arvensis*	*Asteraceae*	+
21	Canarygrass	*Phalaris minor*	*Gramineae*	-
22	Wheat	*Triticum aestivum*	*Gramineae*	-
23	Pippapra	*Fumaria parviflora*	*Fumariaceae*	+
24	Sour dock	*Rumex dentatus*	*Polypogonaceae*	-
25	Yellow mustard	*B. brassica*	*Cruciferae*	+

Here (+) infection and (-) no infection.

3. Morphological variation among different isolates of *Sclerotinia sclerotiorum* by observing its mycelial and sclerotial characters

The colony color of yellow mustard isolate was found blackish and mustard isolate colony color was yellow, Field bind weed isolate showed brown color and remaining other isolates did not have much differences. The colonies of other 11 isolates were found white, creamy, compact, uniform, and circular with irregular margin. Among the 14 isolates, 12 isolates colonies covered the entire petri plates within 96 hrs. But, in the colony of two isolates i.e. fababean and yellow mustard, colony growth did not cover the entire petri plates within stated period (Figure-1, plates-1 to 14). The initial sclerotial formation started after 120 hours of inoculation. The colony color of all isolates turned to blackish, creamy, and brown and the hyphal arrangement were closely septate, laterally branched; variable and different.

The sclerotia produced by different 14 isolates were found varied in color from black, grey to brown and differed in shape (irregular to branch). The fenugreek isolate produced maximum (43) number of sclerotia and Lambs quarters produced minimum number of sclerotia (12) on PDA plates after 10 days. These sclerotia were formed terminally, arranged in 1-2 or more concentric rings and sometimes sclerotia were also formed scattered on old PDA plates (Table 2).

Figure-1 *S. sclerotiorum* isolates from different plant species

Plate-1 brinjal

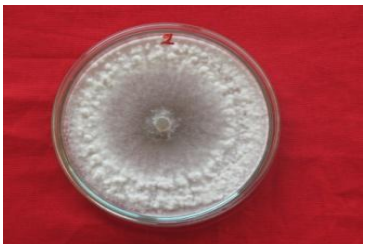

Plate-2 mustard

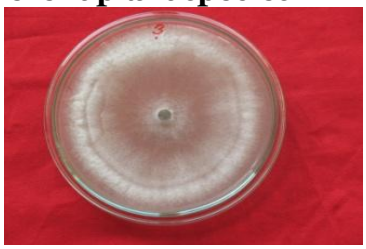

Plate-3 Parthenium

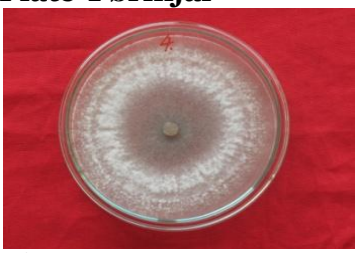

Plate-4 Pea

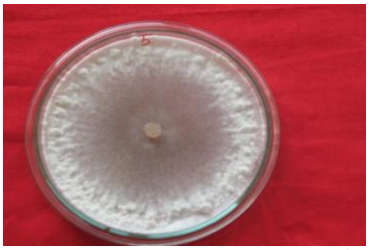

Plate-5 Potato

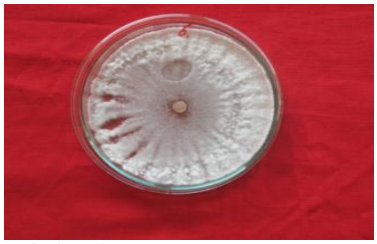

Plate-6 faba bea

Plate-7 sowthistle

Plate-8 wild fumeria

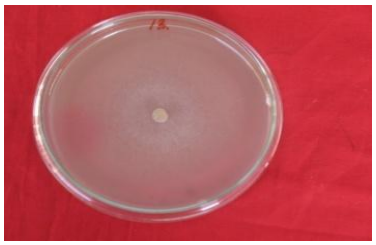

Plate-9 fenugreek

Plate-10 chickpea

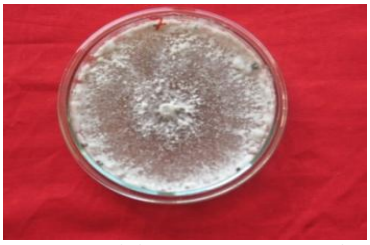

Plate-11 cabbage

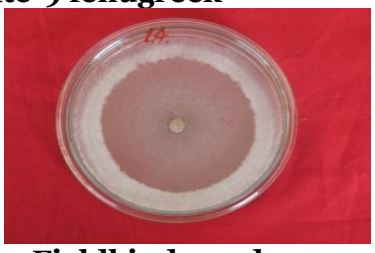

Plate-12 Fieldbind weed

Plate-13 Lambs quarter

Plate-14 yellow mustard

Table 2: Colony and Sclerotial character of *S. sclerotiorum*

S.N.	Isolates from different host	Characteristic features of *S. sclerotiorum* on PDA					
		Colony characters		Sclerotial characters			
		Color	Morpho-logy	Color	Shape	Formation (hrs.)	No. of sclerotia
1	Brinjal	Beige	Compact	Grey	Round	120-144	32
2	Mustard	yellow	Compact	Black	Semispherical	96-120	19
3	Pea	Brown	Compact	Black	Round	120	18
4	Parthenium	White	Fluffy	Grey	Semispherical	144	17
5	Sowthistale	White	Fluffy	Black	Round	120	29

6	Potato	White	Compact	Black	Round	120	15
7	Cabbage	White	Compact	Black	Branched	144	31
8	Fababean	White	Fluffy	Black	Round	156	16
9	Yellow mustard	Blackish	Fluffy	Brown	Irregular	120	14
10	Lambs quarters	Creamy	Compact	Black	Semispherical	144	12
11	Chickpea	Beige	Fluffy	Black	Semispherical	120	34
12	Wild fumeria	Creamy	Compact	Black	Round	120	19
13	Fenugreek	Brown	fluffy	Black	Round	144	43
14	Field bind weed	brown	fluffy	Black	Round	120	24

4. Efficacy of fungicides against the pathogen

A preliminary screening of nine fungicides viz. carbendazim, thiram, tricyclazole, carboxin, copper oxy-chloride, captan, mancozeb, topsin-M, carbendazim + mancozeb (SAAF) belonging to different groups were used at different concentration viz. 0.05%, 0.1% and 0.2% against pathogen, the results were presented in table 3.

The fungicide carbendazim, carboxin, topsin-M, and SAAF (carbendazim + mancozeb) were found most effective at 0.05%, 0.1% and 0.2%, but at 0.1% the fungicide thiram and at 0.2% tricyclazole also completely inhibited the growth of the pathogen. The other fungicides (captan, mancozeb) were found partially effective against the pathogen. The least effective fungicide was copper oxy-chloride.

Table 3: *In-vitro* inhibitory effect of fungicides at different concentration and time on growth of pathogen

S.N.	Fungicides	% Inhibition over control								
		at 0.05%			at 0.1%			at 0.2%		
		24 hr.	48 hr	72 hr	24 hr	48 hr	72 hr	24 hr	48 hr	72 hr
1	Carbendazim	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
2	Thiram	100.0	100.0	97.1	100.0	100.0	100.0	100.0	100.0	100.0
3	Trycyclazole	100.0	95.2	91.4	100.0	96.7	92.2	100.0	100.0	100.0
4	Carboxin	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	94.8
5	Copper oxy chloride	27.3	12.7	14.3	16.7	30.0	25.2	39.9	42.4	10.4
6	Captan	100.0	95.2	94.3	100.0	100.0	100.0	100.0	100.0	95.6
7	Mancozeb	63.8	25.4	41.9	58.3	33.4	48.5	100.0	62.7	43.7
8	Topsin-M	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
9	SAAF (C+M)	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
10	Control	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

5. Evaluation of different bio-control agents against the pathogen

The antagonist effect of *Trichoderma harzianum, T. viride, T. koningii, T. atroviride, T. longibrachiatum, Aspergillus niger, Chaetomium globosome* and *Penicillium notatum* against *Sclerotinia sclerotiorum* (*in vitro*) were evaluated on the basis of the percentage inhibition of pathogenic strains, the results were presented in table 4.

Six bio-control agents suppressed the mycelial growth of the pathogen (*Sclerotinia sclerotiorum)*. The data showed that the bioagent *Trichoderma harzianum* was found most effective and caused 70.82 per cent inhibition of mycelial growth of *S. sclerotiorum* followed by *Trichoderma koningii* (22.96 %). *Aspergillus niger* and *Penicillium notatum* did not inhibited the mycelia growth of the pathogen.

Table 4: *In-vitro* inhibitory effect of different bio-control agents on growth of pathogen

S.N.	Bio-control agents	% inhibition over control		
		4 days incubation	8 days incubation	12 days incubation
1	*Trichoderma harzianum*	24.92	54.67	70.82
2	*Trichoderma viride*	-	4.23	4.44
3	*Trichoderma koningii*	7.67	16. 25	22.96
4	*Trichoderma atroviride*	5.44	9.33	11.84
5	*Trichoderma longibrachiatum*	-	4.75	5.93
6	*Chaetomium globosum*	2.66	5. 44	6.67
7	*Aspergillus niger*	-3.93	-12.67	-15.55
8	*Penicillium notatum*	-2.23	-6.92	-8.88
9	Control	0.00	0.00	0.00

Discussion

Host range of the pathogen revealed that the fungus *S. sclerotiorum* was capable of infecting 16 plants of 9 different families. Most of the infected plants belonging to plant families viz., *Asteraceae, Brassicaceae, Chaenopodaceae, Convalvulaceae, Cruciferae, Fumeraceae, Solanaceae, Leguminocae,* may help in inoculum buildup, before and after sowing of brinjal plants and help in secondary infection or spread of the disease. Roy (1973) reported 27 different hosts of *S. sclerotiorum*, of which 13 host were records from India [14], Liu XueMin *et al.* (2002) reported 9 families, 15 genera and 15 species [15], which showed the more or less similarity with present investigation. After isolating the 14 strain of *S. sclerotiorum* from the collected diseased samples from different hosts and locations and their morphological characters were studied on PDA medium. The isolated strains produced mycelium fluffy and compact and also found variable in color (Beige, yellow, Brown, White, brown, Creamy to Blackish). The colony color of yellow mustard isolate was found to be blackish and mustard isolate colony color was yellow, Field bind weed isolate showed brown in color and remaining other isolates have not much more differences. The colonies of other 11 isolates were found white, creamy, compact, and uniform to circular with irregular margin. All the 14 isolates produced sclerotia which were varied in number of sclerotia, but the fenugreek isolate produced maximum (43) number of sclerotia and lambs quarter isolate produced minimum number of sclerotia (12) on PDA medium. Willet and Wong (1980) reported morphological character of *S. sclerotiorum* sclerotia were black, round or semispherical in shape measuring 3-10 mm in size [16]. Kolte (1985) reported the mycelium of *S. sclerotiorum* which was varies from 9 to 18 micrometer in diameter with numerous lateral branches of smaller diameter than the main hyphae [17]. Garg *et al.*, (2010) found no correlation between pigmentation and colony diameter of different isolates of *S. sclerotiorum* [17].

To examine inhibitory effect of fungicide on the mycelial growth of the pathogen, 9 fungicides were tested *in vitro* against *Sclerotinia sclerotiorum,* of those carbendazim, carboxin, topsin-M and SAAF were found most effective and inhibited the mycelial growth of pathogen up to 100 per cent at 0.05%, 0.1%, and 0.2% concentration, and at 0.1% conc. the fungicide thiram and at 0.2% tricyclazole were completely inhibit the growth of the pathogen in culture plates and were found significantly superior to remaining fungicides. However, in the present study most of the fungicides were found effective *in vitro* against *Sclerotinia sclerotiorum*. Mueller *et al.* (2002) reported thiophanate methyl and vinclozolin inhibited mycelial growth up to 18 to 93% and 93 to 99% [18]. Iqbal *et al.* (2003) reported Benlate, Ridomil gold, Tecto-60 and Topsin-M at 50 and 100 ppm concentrations found effective [19]. Singh *et al.* (2008) found that the Bavistin (0.1%), Vitavax (0.1%), and Topsin-M (0.15%) to be the most effective in inhibiting the growth of pathogen *in vitro* [20]. Prajapati and Narain (2008) reported Vitavax, Companion, Bavistin, Score, Mancozeb and Thiram to be the most effective as they inhibited the growth of fungus completely (100%) [21].

With more awareness of people and environmental scientists concerned about biological control is a supplement to the chemical control. The effect of different bio-control agents was studied and the data showed that among the eight biocontrol agent six were found effective. The

maximum inhibition was found with *T. harzianum* which showed 70.82% inhibition while *A. niger* and *P. nitatum* were found ineffective. However, the present finding are in consonance with the observation of Cundom *et al.* (2000) they reported *Trichoderma* species significantly inhibited the mycelial growth of *S. sclerotiorum* in dual culture [22]. Das *et al.* (2002) found *Trichoderma harzianum, Gliocladium virens* and *Aspergillus flavus* effective against *S. sclerotiorum in vitro* [23]. Singh *et al.,* (2008) found *T. viride* exerted the maximum activity against *Sclerotinia sclerotiorum* (33.4 %) [20].

Conclusion

The pathogen present in different weed host plant may cause disease in crop plants in same and or other plant families. It is clear from above study that the pathogen had a wide host range in different plant families and these species might help pathogens survival during the off season and spread the inoculums in the next crop season. The fungicide carbendazim, carboxin, Topsin-M, and SAAF (Carbendazim + Mancozeb) were found most effective at 0.05% concentration were provide 100 % inhibition, so the above fungicides should be recommended at 0.05 % concentration to make best cost: benefit ratio and for biological control of the pathogen *Trichoderma harzianum* was found most effective about 70.82% inhibition of mycelial growth of *S. sclerotiorum.*

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References

1. Purdy, L.H. (1979). *Sclerotinia sclerotiorum* history, disease and symptomatology, host range, geographic distribution and impact. *Phytopath.*, **69** (8) : 875-880.
2. Davies, J. (1986). Diseases of oilseed rape. In: Scarisbrick, D.H., Daniels, R.W. (Eds.), Oilseed Rape. Mackays of Chantham, Great Britain, pp. 195–236.
3. Venette, J. (1998). Sclerotinia spore formation, transport and infection. In: Proceedings of the Sclerotina Workshop. 21 January 1998. Fargo, North Dakota, USA
4. Abawi, G.S., Grogan, R.G. (1979). Epidemiology of disease caused by Sclerotinia species. Phytopathology 69, 899–904.
5. Schwartz, H.F., Steadman, J.R. (1978). Factors affecting Sclerotium populations of, and Apothecium production by, Sclerotinia sclerotiorum. Phytopathology 68, 383–388.
6. Li, G.Q., Huang, H.C., Acharya, S.N. (2003). Antagonism and biocontrol potential of Ulocladium atrum on Sclerotinia sclerotiorum. Biol. Control 28, 11–18.
7. McGrath, M.T. (2001). Fungicide resistance in curcurbit powdery mildew: Experiences and challenges. Plant Dis. 85, 236–245
8. Hjeljord, L., Tronsmo, A. (1998). Trichoderma and Gliocladium in biological control: an overview. In: Harman, G.E., Kubicek, C.P. (Eds.), Trichoderma and Gliocladium. Taylor and Francis Ltd., UK, pp. 131–151.
9. Savchuk, S., Fernando, W.G.D. (2004). Effect of timing of application and population dynamics on the degree of biological control of Sclerotinia sclerotiorum by bacterial antagonists. FEMS Microbiol. Ecol. 49, 376–388.
10. Fernando, W.G.D., Nakkeeran, S., Zhang, Y., Savchuk, S. (2007). Biological control of Sclerotinia sclerotiorum (Lib.) de Bary by Psedumonas and Bacillus species on canola petals. Crop Prot. 26, 100–107.
11. Schmitz, H. (1930). A suggested toximetric method for wood preservation. *Indust. Engin. Cham. Analyst. (Ed.2nd)* 3: 361-363
12. Bliss, C.I. (1934). The method of probits. *Science,* **79**: *38.*
13. Morton, D.J. and Strouvle, W.H. (1955). Antagonistic Stimulatory effect of soil microorganism upon *Sclerotium rolfsii. Phytopath,* 45, 417-420.
14. Roy, A.K. (1973). Host range of *Sclerotinia sclerotiorum* and *Sclerotium rolfsii* in Jorhat, *Assam, Sci. & cult.,* 39**,** 319-320.

15. Liu XueMin Liu ShuYan Zi JiaWen (2002). Studies on the host range of *Sclerotinia sclerotiorum* from *Cleome spinosa*. *Journal of Jilin Agricultural University,* **24** (2): 91-93.

16. Willet, H.J. and Wong, J.A.L. (1980). The biology of *Sclerotinia sclerotiorum* with emphasis on specific nomenaclature. *Bot. Rev*., **46**: 101-165.

17. Garg, H.; Kohn, L. M.; Andrew, M.; Li Hua; Krishnapillai Sivasithamparam and Barbetti, M.J. (2010). Pathogenicity of morphologically different isolates of *Sclerotinia sclerotiorum* with *Brassica napus* and *B. juncea* genotypes. *European Journal of Plant Pathology*, **126** (3): 305-315.

18. Mueller, D.S.; Dorrance, A.E.; Derksen, R.C.; Ozkan, E.; Kurle, J.E.; Grau, C.R.; Gaska, J.M.; Hartman, G.L.; Bradley, C.A. and Pedersen, W.L. (2002). Efficacy of fungicides on *Sclerotinia sclerotiorum* and their potential for control of Sclerotinia stem rot on soybean. *Plant Disease*, **86** (1): 26-31.

19. Iqbal, S.M.; Ghafoor, A.; Ahmad, Z. and Haqqani, A.M. (2003). Pathogenicity and fungicidal efficacy for sclerotinia rot of brinjal. *International Journal of Agriculture and Biology,* **5** (4): 618-620

20. Singh, A.K., Singh, A.K., Mandvi, S., Jitendra, S. and Singh, S.B. (2008). Bio-intensive management of soil-borne diseases of sunflower. *Annals of Plant Protection Sciences* **16** (2): 433-437.

21. Prajapati, C.R. and Udit Narain. (2008). Effect of fungicides and neem formulations on management of sclerotinia rot of dolichos bean (*Dolichos lablab* L.). *Agricultural Science Digest*, **28** (2): 133-135.

22. Cundom, M.A., Mazza, S.M., Mazzanti, M.A., Gutierrez, S.A. and Couthino, M. (2000). *In vitro* antagonistic activity of saprophytic fungi from the Capital Department, Corrientes Province, Argentina, against *Sclerotinia sclerotiorum*. *Fitopatologia,* 37 (2): 133-141.

23. Das, M.G., Das, B.C. and Sarmah, D.K. (2002). *In-vitro* studies of some antagonists against *Sclerotinia sclerotiorum* (Lib) de Bary. *Journal of the Agricultural Science Society of North-East India,* 15 (1): 67-70.

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Wood-destroying Basidiomycetes, found on the elder woods in the South Urals (Orenburg Oblast, Russia)

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Abstract

The article shows the results of a study of wood-destroying basidiomycetes on two species of elder trees (Alnus glutinosa, Alnus incan), growing in the South Urals (Orenburg Oblast). The comparative analysis of basidiomycetes on two species of elder trees was conducted. The reasons for structural differences of these complexes are discussed. It is consumed that the reason lies in growth conditions of the trees.

Keywords: basidiomycetes; species diversity; mycocenosis; alder tree; Alnus glutinosa; Alnus incana; the South Urals.

Introduction

From a systematic point of view, wood-destroying macromycetes is a diversified group. The combining element for it is its throphism, meaning the ability to exist on dead fallen woods, dry woods and vegetative woods, which is fed through degradation of cellulose wood wool, and specific ferments.

Within the trophism group, we identify the species of different degrees of substrate specialization, adapted to wood decomposition with different physical and chemical properties. For macromycetes, the throphic specialization is identified through its frequent occurrence on various substrates (vegetative trees, fallen trees, stumps. [9]. The ferment complexes mainly indicate the specialization of macromycetes and they ability to exist on woody plants. And in most of the cases, specialization is possible for a certain woody plant. This mostly refers to oak trees. (*Fomitoporia robusta (P.Karst.) Fiasson & Niemela, Inocutis dryophila (Berk.) Fiasson & Niemela* and others.), *Piptoporus betulinus (Bull.:Fr.) P.Karst*. can be found met on birch trees, *Pleurotus* and other species of macromycetes exist oak and poplar trees. It's hard to say whether association of all these macromycetes is interrelated with their fermentative complex or growth conditions of woody plants where they live.

We can pup forward a suggestion that on the woods of allied plant species living in the same conditions, a general complex of wood-destroying macromycetes must be formed. This is mostly applicable to woody plants, growing in floodplain areas.

The object of our study were the macromycetes found on two species of alder trees – *Alnus glutinosa (L.) Gaertn. и Alnus incana (L.) Moench*, growing within the limits of the Orenburg Urals. European alder (Alnus glutinosa) forms pure forests in floodplain areas and

shallow waters. [3]. In general, these are wet and damp black alder sudubravas with I-II AV quality grades. In floodplain areas, the AV quality grade is little bit lower. There are also alder forests in the steppe part of the oblast. The black alder forests are considered as a relic element of the oblast's plant cover. [5, 11]. In the North-West regions, the black alder is jointed by the gray alder (Alnus incana).

Materials and methods used

Within the framework of this study, the research on species composition of wood-destroying macromycetes in the South Urals between 1994–2013, was conducted. The project areas included alder forests in different regions of Orenburg oblast and the republic of Bashkortostan (pic. 1).

Picture 1. Location of researched alder forests.

1 – Alnus glutinosa; 2 – Alnus incana

The sample collection was conducted through shore-based surveys. On the route, they performed the description of biotopes, vegetation and substrates on which the macromycetes lived. As a model, the substrate unit was taken. Around 500 samples were collected in total. All collected samples are stores at the department of general biology, ecology and teaching methods of biology science of Orenburg State Pedagogical University. The identification of collected samples was conducted with the use of the Russian and foreign literature. [1, 2, 9, 12-16].

During description, the system of higher macromycetes published in the "Nordic Macromycetes" book, was used [13, 14].

Results and Discussions

During the study, around 489 fruit plants and 14 sports were found and identified as 73 species, which refer to 47 varieties and 29 macromycetes families. For these species, the alder wood is (*Phellinus alni (Bond.) Parmasto, Pholiota alnicola (Fr.) Sing.*), as suggested by the titles of the species. As for the other species found on the wood of both kinds of alder trees are widespread in the region and can be found on the wood of a wide range of woody plants (*Cerrena unicolor (Bull.:Fr.) Murrill, Fomes fomentarius (L.: Fr.) Fr., Fomitopsis pinicola (Sw.:Fr.) P.Karst., Irpex lacteus (Fr.:Fr.) Fr., Stereum, Trametes* and others) [6]. Findings of some species, in particular *Auricularia mesentarica (Gmel.:Fr.) Pers., Exidia glandulosa (Bull.:Fr.) Fr., Pleurotus, Polyporus,* are probably explained not so much by the substrate factor, but the

conditions of back swamps with high wetting as they are found on the floodplains, dead woods, elm trees and other species of trees.

In terms of general bio-diversity, species grown on the woods of black and grey alder trees significantly differ (table. 1).

Table 1: Taxonomic structure of macromycetes, associated with alder trees in the South Urals

Alder species	Number of		
	species	genuses	families
Alnus glutinosa	51	23	21
Alnus incana	45	33	24

Below is the alphabetical list of the discovered wood-destroying fungi with an indication of their incidence on the wood of one or another species of alder in the South Urals (Table 2).

Table 2: Wood-destroying fungi, affecting the wood of alder trees in the South Urals

Species	Alder species	
	A. glutinosa	*A. incana*
Antrodiella hoehnelii (Bres.) Niemella		+
Antrodiella parasitica Vampola	+	
Auricularia mesenterica (Gmel.: Fr.) Pers.	+	+
Bjerkandera adusta (Willd.: Fr.) P.Karst.	+	
Ceraceomyces eludens K.H.Larss.		+
Ceriporia reticulata (Hoffm.: Fr.) Domanski	+	
Cerrena unicolor (Bull.: Fr.) Murrill	+	+
Chondrostereum purpureum (Pers.: Fr.) Pouzar	+	+
Coniophora puteana (Schumach.: Fr.) P.Karst.		+
Crepidotus mollis (Schaeff.: Fr.) Kumm.	+	+
Daedaleopsis confragosa (Bolton: Fr.) Schroet.	+	+
Daedaleopsis septentrionalis (P. Karst.) Niemela		+
Daedaleopsis tricolor (Pers.) Bond. & Sing.		+
Datronia mollis (Sommerf.: Fr.) Donk	+	
Datronia stereoides (Fr.: Fr.) Ryvarden	+	
Exidia glandulosa (Bull.: Fr.) Fr.	+	+
Flammulina velutipes (Curt.: Fr.) Singer	+	
Fomes fomentarius (L.: Fr.) Fr.	+	+
Fomitoporia punctata (P.Karst.) Pilat	+	+
Fomitopsis pinicola (Sw.: Fr.) P.Karst.	+	+
Ganoderma lipsiense (Batsch.) G.F.Atk.	+	
Gloeocystidiellum luridum (Bres.) Boidin		+
Gloeoporus dichrous (Fr.: Fr.) Bres.	+	+
Hericium coralloides (Scop.: Fr.) Pers.		+
Hymenochaete tabacina (Fr.) Lev.	+	
Hyphoderma litschaueri (Burt.) J.Erikss. & A.Strid	+	
Hyphodontia arguta (Fr.) J.Erikss.		+

Hyphodontia flavipora (Berk. & M.A. Curtis ex Cooke) Sheng H. Wu		+
Hyphodontia radula (Pers.: Fr.) E.Langer & Vesterholt	+	
Hypholoma capnoides (Fr.: Fr.) Kumm.		+
Hypholoma fasciculare (Huds.: Fr.) Kumm	+	
Hypochniciellum ovoideum (Julich) Hjortstam & Ryvarden		+
Hypochnicium erikssonii Hallenb. & Hjortstam		+
Inonotus radiatus (Sowerby: Fr.) P.Karst.	+	
Irpex lacteus (Fr.: Fr.) Fr.	+	+
Lentinus tigrinus (Bull.: Fr.) Fr.	+	
Oxyporus corticola (Fr.) Ryvarden	+	+
Paxillus panuoides (Fr.) Fr.		+
Peniophora violaceolivida (Sommerf.) Massee		+
Phellinus alni (Bondartsev) Parmasto	+	
Phlebia martiana (Berk. & M.A.Curtis) Parmasto		
Phlebia radiata Fr.	+	
Phlebia tremellosa (Schrad.: Fr.) Burds. & Nakasone		+
Pholiota alnicola (Fr.) Sing.	+	+
Pholiota aurivella (Batsch: Fr.) Kumm.	+	
Pholiota squarrosa (Weig.: Fr.) Kumm.	+	
Pleurotus ostreatus (Jacq.: Fr.) Kumm.	+	
Pluteus tomentosulus Peck.	+	
Pluteus umbrosus (Fr.) Kumm.		+
Polyporus arcularius Batsch.: Fr.		+
Polyporus badius (Pers.) Schw.	+	
Polyporus brumalis (Pers.: Fr.) Fr.	+	+
Polyporus ciliatus Fr.: Fr.	+	+
Polyporus squamosus Huds.:Fr.	+	
Polyporus tuberaster (Pers.) Fr.	+	
Porostereum spadiceum (Pers.: Fr.) Hjortstam & Ryvarden	+	+
Schizophyllum commune Fr.: Fr.	+	+
Steccherinum nitidum (Pers.: Fr.) Vesterholt	+	
Steccherinum ochraceum (Fr.) Gray	+	
Stereum hirsutum (Willd.: Fr.) Gray	+	+
Stereum subtomentosum Pouzar	+	+
Thelephora terrestris Ehrh.: Fr.	+	
Trametes gibbosa (Pers.: Fr.) Fr.	+	
Trametes hirsuta (Wulfen: Fr.) Pilat	+	+
Trametes ochracea (Pers.) Gilb.& Ryvarden	+	+
Trametes pubescens (Schumach.: Fr.) Pilat	+	+
Trametes trogii Berk.		+
Trametes versicolor (L.: Fr.) Pilat		+
Trichaptum pargamenum (Fr.) G.Cunn.	+	

The index of the similarity of the species composition of Sorensen-Chekanovsky is 48 %. This brings us to the conclusion that the singularity of the compared complexes is rather high.

The species, affecting only the black alder and the grey alder are of special interest. Among the species, discovered only on the wood of the black alder, we should note *Hyphoderma litschaueri (Burt.) J.Erikss. & A.Strid, Lentinus tigrinus (Bull.: Fr.) Fr., Pholiota aurivella (Batsch: Fr.) Kumm.,* which were found in the singular number and only on alder trees; *Inonotus radiatus (Sowerby:Fr.) P.Karst.* are typical species for black alder woods of the region. Some species (*Flammulina velutipes (Curt.: Fr.) Sing., Ganoderma lipsiense (Batsch.) G.F.Atk.*) are generally typical for broad-leaved forest of the South Urals [8].

Gloeocystidiellum luridum (Bres.) Boidin, Hypochniciellum ovoideum (Julich) Hjortstam & Ryvarden, Hypochnicium erikssonii Hallenb. & Hjortstam, Phlebia martiana (Berk. & M.A.Curtis) Parm were singly discovered on the wood of the grey alder only. *Hericium coralloides (Scop.:Fr.) Pers.*, listed in the Red Book of the Orenburg Region [7], was discovered on the windfall of the grey alder in the vicinity of Selo Tashla of Tulgansk Region.

Other species of fungi, which existence differentiate the complexes of species, affecting the wood of different species of alder, are not stenotrophic of alder and are frequent at small-leaved species of the region [8].

The comparative analysis shows that the reason of the greater similarity of the species composition of mycocenosis of black alder woods is the existence of the significant amount of species, specific for alder woods, which also act as the dominants of the community of species. *Inonotus radiatus* dominated in 6 of 9 studied black alder, *Phellinus alni* or unspecialized species – in grey alder, primarily *Fomitopsis pinicola*.

It can be assumed that such distinctions can in some way be detected by the state of the studied stand of trees – the presence and the amount of the dead fallen wood, dead and/ or wounded trees. But the comparison of substrata colonization shows that it slightly differs in the alder woods of different types (Table 3).

Table 3: Distribution of fungi, depending on the substrata state

Species of alder	Substrate state			
	Dead wood (brushwood, windfallen)	Dry trees	Growing trees	stumps
Alnus glutinosa	46	16	8	6
Alnus incana	37	24	4	1

Conclusions

To summarize the above, we can conclude that complexes of wood-destroying fungi, formed on the alder wood of different tree species, have some noticeable differences. This is more applicable to complexes associated with black alder forests. The reason for the difference is probably is not so much in the chemistry of wood of two alder species, in growth conditions and geographical location.

Based on the above data, it is possible to formulate the practical guidelines for preserving the diversity of mycobiota of the region and, in particular, formation mycobiota of alder forests. Special attention should be paid to the complex species associated with black alder trees, which feature a substrate-specific species. The separate grey alder forests in which rare species of fungi were marked are also deserve attention.

References:

1. Bondartseva M.A. (1998) Key to Fungi in Russia: (Aphyllophorales) / M.A. Bondartseva. Literature: Nauka, Edition. 2. 391.
2. Bondartseva M.A. (1986) Key to Fungi in Russia: (Aphyllophorales) / M.A. Bondartseva, E.H. Parmasto. Literature: Science, Edition 1. 192.
3. Milkov F.N. (1951) Forests of Chkalovskaya oblast, /Assays on physical geography of Chkalovskya oblast. Chkalov: Chalovsk Publishing House.

4. Mukhin V.A. (1993) Biota of xylotrophic basidiomycetes of the West-Siberian plain/ V.A.Mukhin. Ekaterinburg: Science. 231.

5. Ryabina Z.N. (2003) Plant cover of steppe zone of the South Urals (Orenburg region). Ekaterinburg: Ural branch of RAS.

6. Safonov M.A. (2000) Timber fungi of the Orenburg region. Orenburg: OSPU Publishing House. 152.

7. Safonov M.A. (2003) Rare species of fungi of the Orenburg region: problems of revealing, studying and protection. Orenburg; OSPU Publishing House. 100.

8. Safonov, M.A. (2006) Wood-inhabiting aphyllophoroid fungi of the Southern Preurals (Russia). *Mycena*. 6: 57-66.

9. Safonov M.A. (2013) Substrata specialization of wood-destroying fungi and its local variety. *Journal of Orenburg State Pedagogical University*. *Online Scientific Journal*. 3 (7): 44-52

10. Stepanova-Kartavenko, N.T. (1967) Aphyllophoroid fungi of the Urals / N.T. Stepanova-Kartavenko. Sverdlovsk. 293 p.

11. Chibilev A.A. (1987) Green book of the steppe region. Chelyabinsk: Yuzhno-Uralskoe Publishing House. 127 p.

12. Christiansen, M.P. (1960) Danish Resupinate Fungi. Part II. Homobasidiomycetes / M.P.Christiansen // Dansk Botanisk Arkiv. Copenhagen, Bjnar Munksgaard, Bind. 19. 2: 61-388.

13. Nordic Macromycetes. V.2: Polyporales, Boletales, Agaricales, Russulales. Gopenhagen: Nordsvamp, 1992. 382 p.

14. Nordic Macromycetes. V.3: Heterobasidioid, Aphyllophoroid and Gasteromycetoid basidiomycetes. Gopenhagen: Nordsvamp, 1997. 383-620.

15. Ryvarden, L. The Polyporaceae of Europe / L.Ryvarden, R.L.Gilbertson. Oslo: Fungiflora, 1992-1994. V. 1-2. 684 p.

16. Ryvarden, L. The Polyporaceae of Europe / L.Ryvarden, R.L.Gilbertson. Oslo: Fungiflora, 1992-1994. V. 1-2. 684 p.

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Studies on the Analgesic Potential of leaf Extracts of *Allium humile* on *Swiss albino* mice

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Abstract

Allium humile is a medicinal plant found at the Alpine Himalayas of Uttarakhand at altitute of 2500-3000 meters height of sea level. In India, *Allium humile,* is used by local people as a spice and in ethano-medicine. In the present study, *Allium humile* leaves were explored for their analgesic potential on experimental model and compared to standard drugs. *Allium humile* at the doses of 100 mg/kg and aspirin 25 mg/kg exhibited significant ($p>0.05$) inhibition of the control writhes at the rate of 64.25%, 44.54%, 44.54% and 59.89% respectively when compared to that of control. Thus, methanolic extract of the plant can be fully explored for its analgesic potential which has not been reported so far. The plant extract showed a relative low toxicity hence justifies the folkloric use of plant by the local people in Western Himalayan region for curing inflammation and painful conditions.

Keywords: *Allium humile;* analgesic activity; Phytochemical screening.

Introduction

India a country of immense biotic wealth and most of the plant used as medicine in ancient times, it is reported that about more than 7000 plant species used for medicinal purposes most of which are being exploited recklessly of drugs. It will be prudent to study species of indigenous medicinal and commercially valuable plants. The use of traditional medicine and medicinal plants in most developing countries, as a normative basis for the maintenance of good health has been widely observed. However, information on the uses for plants for medicine is lacking from many interior areas of Himalayan regions in India. Utilization of plants for medicinal purposes in India has been documented long back in ancient literature. However, organized studies in this direction were initiated in 1956 and off late such studies are gaining recognition and popularity due to loss of traditional knowledge and declining plant population.

Drugs which are in use presently for the management of pain and inflammatory conditions are eithernarcotics or non-narcotics (NSAIDS) and present well known side and toxic effects (**Dharamsiri, J.R., *et. al,*. 2003; Kumara, N.K.V.M.R., 2001; Park, J.H., *et. al.,* 2004**). On the contrary herbal medicines with good absorption, less toxicity and easy availability have been used since long (**Li, R. W., *et. al.,* 2003**). It is therefore essential that efforts should be made to introduce new medicinal plants to develop cheaper and effective drugs (**Duffy, J.C., *et. al.,* 2001; Ikram, M., 1983**). Plants represent still a large untapped source of structurally novel compounds that might serve as lead for the development of novel drug (**Moody, J. O., *et. al.,* 2006**).

Allium humile is a nutritionally functional food used for aroma and a source of physiologically beneficial and noninvasive medicines. Many pharmaceutical substances with potent and unique health-enhancing properties have been reported from other *Allium* species distributed worldwide. *Allium humile* is hardy to zone 0. The flowers are hermaphrodite (have both male and female organs) and are pollinated by bees, insects etc. It is mainly found at the height of 2500-3000 meters of Alpine Himalayas of Uttarakhand, India near moist rock, dry rock and steep slope with a strong preference of sunny site. The plant prefers light (sandy) and medium (loamy) soils and requires well-drained soil. The plant prefers acid, neutral and basic (alkaline) soils. It cannot grow in the shade. Edible plant part used induced flowers; leaves; root. Bulb (raw or cooked), leaves (raw or cooked) are dried and used as a flavoring, while raw flowers are used as a garnish on salads. Although no specific mention of medicinal uses has been for this species, member of this genus are in general very healthy additions to the diet. They contain sulphur rich compounds with antianalgesic antioxidant, antiinflammatory, and antimicrobial properties. Thus, in the present study attempts were made to investigate its analgesic potential with a view of justifying the use of this plant in treatment of analgesic disease locally.

Materials and methods

1 Collection of Plant Materials

Whole plant of *Allium humile* was collected from various parts of Uttarakhand, India during August to September 2008. The seed samples were submitted for conservation at National Gene bank, National Bureau of Plant Genetic Resources, Pusa Campus, New Delhi, India and the national identity number (SR-01-IC 567645) was obtained. The leaves of this plant were dried under shade at 27°C to 30°C for 15 to 30 days, after which the leaves of the plant were chopped and grounded into coarse powder.

2 Preparation of Plant Extract

The coarse powder of material (200g) was successively extracted with solvents in order of increasing polarity like petroleum ether, chloroform, methanol and water using hot sox let extractor. The resulting extracts were concentrated by vacuum evaporator keeping the maximum temperature 48 °C to 50 °C.

3 Phytochemical Screening-

The presence of various phytochemical constituents in the extract was determined using standard screening tests (**Edeoga, H.O., 2005**)

4 Experimental Animals

White *Swiss Albino* Mice (20-30g) were used for this study. The animals were obtained from the animal house of the Department of Pharmacy, Sardar Bhagwan Singh (P.G) Institute of Biomedical Sciences and Research, Dehradun, Uttarakhand, India. The animals were maintained under standard environmental condition and had free access to food and water before administration of plant extract.

5 Anti-analgesic Activity

Six groups of white mice weighing 20-30 gm, of either sex or each group containing six mice were chosen for the study. One group was kept as control and another group was treated with the standard drug (aspirin). The extracts (Saline, Aspirin, Pet. Ether, and Methanol) were given to the rest of the groups.

The method employed was that of acetic acid induced writhing method in mice. The standard and extract were administered at a dose of 1 ml/kg and 25 mg/kg respectively all the test extract and standard were dissolved in tween 80, boiled and cooled water.

The animals were tested for 16h prior to the treatments. One hour after treatment, the control group of mice was administered 1ml/100 gm of normal saline and after this 1% acetic acid solution was injection at a dose level of 1ml/100 gm intraperitonially of body weight. Next the animals were placed individually under glass jar for observation. The number of abdominal constriction (writhing) and stretching with a jerk of himb was counted between 5 and 15 minutes after acetic acid injection.

The second group of animal was injected aspirin (25mg/kg). Fifteen minutes later they were administered acetic acid solution as in control group. Rest group of animal were inject test extract (saline, aspirin, pet. ether, methanol) at a dose of acid solution. The onset of writhing response was observed and continued for fifteen minutes, were recorded. The response of the extract and aspirin treated group were composed with those of the animal in the control group (0.1ml saline).

Percentage protection against writhing movement (% inhibition of writhing) was taken as an index of analgesia and it was calculated as follows:

% inhibition= Wr (control) - Wr (test group) x 100 / Wr (control)

Where Wr = Mean Number of Writhing

6 Statistical Analysis

Data were expressed as mean ± S.E. The result was statistically analyzed by the student t-test: $p<0.05$ versus respective control was taken as significant.

Results:

1 Phytochemical Screening-

The dried leaf samples of *Allium humile* were subjected to extraction of active compounds with different solvents. The results of qualitative chemical investigation of these extracts have indicated the presence of following compounds that are tabulated in Table (1). All the four extracts as mentioned in table were found to possess of steroids, proteins, saponines, flavonoids, alkaloids, carbohydrates. Out of four, the aqueous extract was found to be rich in alkaloids and saponine while the petroleum ether extract was found to have a very low concentration of these compounds while the concentration of steroids was more. The methanolic extract was found to have a considerable concentration of alkaloids, saponines, and phenolic components.

2 Anti- analgesic Activity

The result represented in tables, shows that extracts of *Allium humile* at the doses of 100mg/kg and aspirin 25mg/kg exhibited significant ($p>0.05$) inhibition of the control writhes at the rate of 64.25%, 44.54%, 44.54% and 59.89% respectively when compared to that of control.

Extracts of *Allium humile* at the above mentioned doses, potentiated analgesic activity of aspirin shown by further decreasing the writhing response when given in combination. Statistical analysis showed that the extract of methanol showed highest analgesic potential than petroleum ether extract (Table 2) of 59.87% of inhibition as compared to the standard aspirin that gave 64.25% inhibition. The results of the present investigation indicate that the methanolic extract of *Allium humile* showed profound peripheral analgesic activity. The finding of this experimental

animal study indicate that the leaf methanolic extract of *Allium humile* possesses analgesic ethnomedical, folkloric uses of the plant in the management and or control of painful, arthritic and other inflammatory condition in some rural communities of uttarakhand.

Discussion

The presence of alkaloids and organosulphur compounds, which has been indicated in analgesic activities, supports the traditional and local use of *Allium humile*. In the present study, the abdominal constriction (Writhing) model adopted is thought to partly involve local peritoneal receptors (**Atta, A.H. and A. Alkofahi, 1998; Benteley, G.A., *et. al.*, 1983; Mat Jais, A.M., *et. al.*, 1997**). The ability of the methanolic extract to cause a significant reduction in the number of acetic-acid induced writhes in mice probably suggests an anti-nociceptive property. The use of abdominal constriction (writhing) model is known to be very sensitive when compared with other models such as tail flick model (**Benteley, G.A., *et. al.*, 1983; Collier, H.O.J., et. al., 1968**). This study also showed that anti-nociceptive effect of the aqueous and chloroform extract showed very less effect in same duration of time as compared to methanolic extract. The result obtained complimented the earlier investigation that methanolic extract of *Allium* species contains copious amount of flavonoids, organosulphur compounds (**Wilson, E.A. ; B.D. Adams, 2007**). Previous study on different *Allium* species also shows that these flavonoids and organosulphur compounds are potent analgesic and anti-inflammatory agents. This method is not only simple and reliable but also affords rapid evaluation of peripheral type of analgesic action.

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Table 1: Quantitave Phytochemical analysis of different extracts of *Allium humile*

Test performed	Petroleum ether extract	Chloroform extract	Methanol extract	Water extract
1. Test for carbohydrates				
i. Fehling' test	(-)	(+)	(+)	(+)
ii. Molisch's test	(-)	(+)	(-)	(-)
iii. Barfoed's test	(-)	(-)	(-)	(+)
iv. Benedict's test	(-)	(+)	(+)	(-)
v. Selivinoff's test	(-)	(-)	(+)	(+)
2. Test for proteins and amino acid				
i. Millon's test	(-)	(-)	(-)	(-)
ii. Biuret test	(-)	(-)	(-)	(-)
iii. Ninhydrin test	(-)	(-)	(-)	(-)
3. Test for steroids				
i. salkowski	(+)	(+)	(+)	(-)
ii. Gilberman Buchard's test	(+)	(+)	(-)	(-)
iii. Hensen's test	(-)	(-)	(+)	(+)
4. Test for alkaloids				
i. Wagner's test	(-)	(-)	(+)	(+)
ii. Hager's test	(-)	(-)	(+)	(+)
iii. Mayer's test	(-)	(-)	(-)	(-)
5. Test for phonolic and flavonoid compounds				
i. Vanilin- HCL test	(-)	(-)	(+)	(+)
ii. Ferric chloride test	(+)	(+)	(+)	(-)
iii. Zinc hydrochloric acid	(-)	(-)	(-)	(-)

reduction test				
6. **Test for tannins**	(-)	(-)	(+)	(+)
7. **Test for saponins**	(-)	(-)	(-)	(+)

Table 2: comparative study of analgesic activity of Allium *humile* extracts vs. aspirin

Treatment	Dose	No. of writhing (mean)	Percent inhibition
Saline (control)	10 ml/kg	22.83±6.08	-
Aspirin	100 mg/kg	8.16±1.47	64.25%
Pet. Ether extract	100 mg/kg	12.66±2.16	44.54%
Methanol extract	100 mg/kg	9.16±1.72	59.87%

*p<0.05 compared with control; student's t-test.

References:

1. Dharamsiri, J.R., A.C. Jayakodi, G. Galhena, S.S.P. Liyanage and W.D. Ratnasoriya, (2003). Antiinflammatory and analgesic activities of mature fresh leaves of *Vitex negundo*. *Journal of Ethanopharmacology*, 87: 199-206.
2. Kumara, N.K.V.M.R., (2001). Identification strategies to improve research on medicinal plants used in Sri Lanka. In: WHO Symposium. University of Ruhuna, Galle, Sri Lanka, pp: 12-14.
3. Park, J.H., K.H. Son, S.W. Kim, H.W. Chang, K. Bae, S.S. Kang and H.P. Kim, (2004). Antiinflammatory activity of *Synurus deltoids*. *Phytotherapy Research*, 18: 930-933.
4. Li, R.W., S.P. Mayers, D.N. Leach, G.D. Lin and G. Leach, (2003). A cross cultural study: Antiinflammatory activity of Australian and Chinese plants. *Journal of Ethanopharmacology*, 85: 25-32.
5. Duffy, J.C., J.C. Dearden and C. Rostron, (2001). Design, Synthesis and biological testing of a novel series of anti- inflammatory drugs. *Journal of Pharmacy and Pharmacology*, 53: 1505- 1514.
6. Ikram, M., (1983). Hamdard Medicus, 26: 16-17.
7. Moody, J.O., V.A. Robert, J.D.Connolly and P.J. Houghton, (2006). Anti-inflammatory activities of the methanol extracts and an isolated furanoditerpene constituent of Sphenocentrum *jollyanum* Pierre (Menispermaceae). *Journal of Ethanopharmacology,* 104: 87-91.
8. Edeoga, H.O., D.E. Okwu and B.O. Mbaebie, (2005). Phytochemical Constituents of some Nigerian medicinal plants. *African Journal of Biotechnology*, 4(7): 685-688.
9. Atta, A.H. and A. Alkofahi, (1998). Anti-nociceptive and anti-inflammatory effects of some Jordian medicinal extract. *Journal of Ethnopharmcology*, 60: 117-24.
10. Benteley, G.A., S.H. Newton and J.B. Starr, (1983). Studies on the anti-nociceptive action of alphaagonist drugs and their interaction with optoid mechanisms. *British Journal of Pharmacology*, 79:125-134.
11. Mat Jais, A.M., Y.M. Dambisya and T.J. Lee, (1997). Anti-nociceptive activity of *Channa striatus* (haruan) extracts in mice. *Journal of Ethnopharmacology*, 57: 125-130.
12. Collier, H.O.J., L.C. Dinnen, C.A. Johnson and C. Schneider, (1968). The abdominal constriction response and its suppression of analgesic drugs in mouse. *British Journal of Pharmacology,* 32: 295-310.
13. Wilson, E.A. and B.D. Adams, (2007). Antioxidant, anti-inflammatory and antimicrobial properties of garlic and onions. *Nutrition and Food Science*, 37: 178-183.

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Pedagogical sciences

Педагогические науки

The Learning of Mind Mapping in Higher Education: A Comparative Study Between Universidad de Córdoba and Università di Roma-La Sapienza

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Abstract

In this paper we propose Mind Mapping as a technique which enhances holistic learning or whole brain learning in higher education. The dynamics performed in the learning and application of Mind Mapping is part of a participatory approach in the classroom as an element of the learning process. The research approach follows a quantitative methodology. The results reflect the views of students about the learning of Mind Mapping and its effectiveness in the study. The findings indicate that mental maps can be used with any type of material, making it a tool applicable to any university degree course.

Keywords: Mind Maps; holistic learning; brain hemispheres; creative thinking; thinking and learning; self-learning; participatory methodology.

Introduction

Current education and training of teachers in all educational stages need new strategies and techniques to respond to the society of information and communication. At the same time, advances in the research of the brain and it function have opened new perspectives on learning. This includes an educational approach that aims and fosters the holistic learning of a person. This strategy permits to learn using the whole brain.

In this sense the goal is to convert the amount of information available today through personal knowledge processing. According to McCarthy (1991) "knowledge is the result of personalized information, it convert the mass of incoming data significant concepts and images. This process is developed reflecting on the information that comes with understanding, evaluating it and translating it into the language that we use" (p.142). An enabling strategy of such conversion is Mind Mapping. According to Buzan (1996), "can be defined as a graphical technique that takes advantage of all cortical capabilities and implement the potential of the brain" (p. 175) and can be

applied in all ages and professions to encourage creative thinking in line with the knowledge society of the twenty-first century.

Mind Mapping and the Impact on Learning

This section will briefly reflect on Mind Mapping as a learning technique. It will include it's origin, conceptualization, and it's relevance with current theoretical approaches.

1. Origin of Mind Mapping

The origin and development of Mind Mapping is connected with the movement of cognitivism or the "cognitive revolution", consolidated during the decade 70-80 of the twentieth century. The cognitive thinking evolved focusing in the mechanisms of acquisition of information and skills to understand the meaning and the creation of new cognitive structures.

Tony Buzan, is considered the creator of Mind Mapping through his book "*The Mind Map Book* (1996) along with the Spanish edition of "*Tu mente en forma*" (2004). In addition Antonio Ontoria, has led to the spread of this technique in Spain with his books books "*Potenciar la capacidad de aprender y pensar*" (2007, 4th edition) and "*Aprender con Mapas Mentales* " (2006, 4th Ed.)

2. Existing theoretical approaches and the relationship with Mind Mapping

For the theoretical foundation of Mind Mapping as a learning technique strategy, there are three relevant scientific approaches:

1) *The Development of Neuroscience*: In order to explain the brain function three major theorists, Sperry (1973), MacLean (1978, 1990), and Herrmann (1989), are cited. In regards to field of learning and integrating it to brain research the work of Carter (2002) and Jensen (2003) is exposed.

2) *The "Visualization of Information" and the Expansion of TIC's in Society*: The use of the Mind Mapping technique is associated with the construction of knowledge through graphic organizers for visual learning (Tufte, 1994; Wurman, 1997, Dürsteler, 2000; Engelhart, 2002. Ware, 2004). The mind map is by definition a graphic expression of thought, and using the "neuron" as an analogy it applies the idea of irradiating, simultaneously imaginative and structured thinking (Buzan, 1996, 2004; Ontoria, 2004, 2006). The connection between information technology and audiovisuals fully respond to the teacher training need for this century.

3) *Multiple Intelligences and Emotional Intelligence*: Finally, the concept of "multiple intelligences" by Gardner (1994) and the movement of emotional intelligence through the work of Goleman (1998, 2006) are mentioned based on their support for a holistic approach toward learning.

3. Conceptual perspective of Mind Mapping

In this subsection, three definitions of Mind Mapping are collected:

"It's an expression of radiant thinking and therefore a natural function of the human mind. It is a powerful graphic technique, which offers a master key to access the potential of the brain." (Buzan, 1996, p. 69)

"Mind Mapping is a powerful graphic technique that leverages the full range of cortical skills and starts the real potential of the brain" (Buzan, 1996, p. 175).

"A method that distills the essence of what we know and organize it visually". (McCarthy, 1991, p. 142)

Also three aspects to facilitate a better understanding of Mind Mapping as a learning technique are developed, including:

1. Main characteristics: Buzan (1996), mentions that mind maps are "powerful graphic techniques that triggers the true potential of the brain" (p. 69). The Mind Map is a multidimensional reality that includes space, time and color (p. 175). They are characterized for thinking and combining words and images, classifying and categorizing (Ontoria et al., 2006). The word is considered, in Western thought, a sign of mental maturity, while the use of images is labeled as a sign of immaturity. This view reflects a cultural mindset in which the word is the main instrument of communication and information. However, the image connects with diverse skills in the brain related to shapes, colors, lines, dimensions, etc. Those skills stimulate the imagination and encourage creative thinking and memory. Currently, the integration between both areas and the integration to the brain is enhanced. McCarthy (1994) specifies more elements in Mind Mapping including: personal commitment, multichannel learning, organization, association, and

visual images. These basic components are the "laws of Mind Mapping" (Buzan, 1996, p.113), which are the terms of reference for the construction of mental maps that are synthesized in the search for emphasis, association, clarity and personal style. Finally, classification and categorization is highlighted, which facilitate the management and structuring of thought. An expression used to achieve this is to identify the *basic orders of ideas*. These are the key concepts from which a frame of new concepts in terms of their importance is organized.

2. Radiant thinking and expression of Mind Mapping: The thought of radiant expression is referred to the mental structure of Mind Mapping. In order to explain this idea an analogy is presented in the concept of the neuron and the tree. The neural functioning with multiple branches, and the tree as an image of the graph structure intended to reflect graphically the radial structure of Mind Mapping. The thematic core or motivating issue is the central image (trunk), from where the main ideas of the subject are presented in a branched form and departing from a center it branches in different directions. The branches include a picture or a printed word with a line associated. The minor points are also represented as branches attached to higher level branches. The mind map, therefore, tries to reflect graphically the radial structure, establishing relationships that are the basis for building the mind maps. Buzan (1996) uses the expression radiant thinking to mean "associative thought processes that come from a central point or connect with it" (p. 67).

3. Metacognitive function of Mind Mapping: The movement of metacognition considers that people, tasks and strategies form the basis of metacognitive activity. This is understood as the ability to combine and balance information from the three interactively considered aspects. From his choice of an interpretive – phenomenological model McCombs (1993) argues that self-awareness of the processes experienced in metacognitive activity reflects the involvement of the oneself as agent of learning. On the other hand the optimization of learning is related to an awareness of responsibility to the expectations and confidence in the possibilities for the effort involving the tasks. With Mind Mapping cognitive and social skills along with personal capabilities are enhanced. Definitely the concept of Mind Mapping is tuned with a holistic approach toward education and learning.

Research design

1. Research objectives

The main purpose of this study is to know the perceptions of the students regarding the learning process of mental mapping through an active and participative methodology in the classroom, in order to acquire specific content of a transversal theme in the undergraduate program of elementary education at Universidad de Córdoba and Communication Sciences at Università di Roma-La Sapienza, as is that of Social Media. This purpose is based following these specific objectives:

- To analyze the perception of university students about the learning process of mental mapping as learning technique based on gender, age and nationality of the participants in the study.
- To analyze the relationship between the different scale and dimensions of learning perception of mental mapping.

2. Dynamics of learning

The learning dynamics followed for the design and implementation of this study was similar to that developed by Muñoz and Marín Serrano (2014), which is divided into:

1. An introductory phase in the process of developing the mind maps, determined by an explanation of the technical characteristics and the development process.
2. First phase contact where the students were invited to make a first exploratory reading, followed by a second reading comprehension which facilitated the selection of the main and secondary ideas for the document along with synthesis on keywords.
3. A Mind Mapping manual assembly phase where finally, key words obtained in the previous phase, are used to form the mental map, using, in turn, drawings or pictures related to them, and the use of colors and shapes that facilitate understanding and memorizing the same subsequent recall of knowledge.

3. Participants The students who participated in this research has been surveyed at the end of the learning process. We collected data from college students enrolled in the undergraduate degree of elementary education from Universidad de Córdoba, and college students enrolled in the degree of Communication Sciences at the Università di Roma-La Sapienza during the 2011-2012 academic year. This exploratory study, had a sample of 130 participants, 65 Italian students (Università di Roma-La Sapienza) and 65 Spanish students (Universidad de Córdoba). A total 69.2% of students were female and 38.2% male, with a mean age of 23 years.

4. Data collection instruments

In order to determine the degree of achievement of the objectives, we proceeded to apply at the end of the experience, a questionnaire that measured the application of Mind Mapping as a learning strategy for skills development within the convergence model (EHEA) of student centered learning. The original questionnaire consisted of a total of 25 items measured on four Likert scale items (1 = never, 2 = little, 3 = somewhat, 4 = very much). However, this work only used 16 items responding to the sentiment analysis arising during the learning technique (α = .671), the analysis of emerging learning difficulties (α = .716) and analysis the positive aspects of the application of the technique (α = .893.). The reliability of the overall scale was demonstrated as Cronbach coefficient obtained a value of .703, score enough, according to Matthew (2006) to consider that the instrument is reliable. The validation of the instrument was made by a group of experts in the field, from different Spanish and Italian universities whose process led to the reduction of the questionnaire from 25 to 16 items, as shown below in Table 1.

Also some demographic data of the students was taken into account in the study. To do this, students were asked to reply to questions about their gender, age, nationality and academic major.

Table 1: Student perception questionnaire about the process of learning the technique of Mind Mapping

Indicate the degree of agreement of the following statements under the rating scale:
Never (1), Little (2), Somewhat (3) and Very much (4).

1. *I got doubts*	1	2	3	4
2. *I felt distressed*	1	2	3	4
3. *I was confused*	1	2	3	4
4. *Problems with space*	1	2	3	4
5. *Problems with amount of text*	1	2	3	4
6. *Problems with content structure*	1	2	3	4
7. *Problems with adaptation*	1	2	3	4
8. *Problems with the elaboration of the map using the computer*	1	2	3	4
9. *Problems to draw*	1	2	3	4
10. *Problems to synthesize ideas and concepts*	1	2	3	4
11. *Facilitated the understanding of issues worked*	1	2	3	4
12. *Facilitated the synthesis of information*	1	2	3	4
13. *Facilitated the organization of content*	1	2	3	4
14. *Provided comprehensive memorization of content*	1	2	3	4
15. *Facilitated remembering content*	1	2	3	4
16. *Facilitated the recall of subjects worked*	1	2	3	4

5. Data Analysis

Data was analyzed using SPSS v.18.0 statistical package. Frequency analyses were used to describe the responses of students in the various items evaluated in the questionnaire. To compare the mean scores of the variables, when there were only two possible values in the grouping variables, Student T-test was used. An example included the Student T-test measure of the mean difference between the different scales of the instrument and the gender and nationality of the participants. In addition, the Pearson r coefficient was used to estimate the effect size (Brysbaert, 2011; Field, 2009), with values between .10 and .30 which indicated little effect; values between .30 and .50 which indicated a medium effect; and finally, the values of 50 or higher the broad effect pointing. Moreover, to measure the mean difference between the different dimensions of the questionnaire and the age variable an Analysis of Variance (ANOVA) was performed. A Levene test was asked to check homogeneity of variances in both the Student T-test and the ANOVAs. In the

case of the ANOVAs, post hoc multiple comparisons were performed to test mean differences between groups. These contrasts were on the Tukey tests when the variances were equal and Games-Howell when they were not (Pardo and Ruiz, 2002). At the same time, the Cohen's statistical d was used to measure the effect of size, being a value of 20, indicating a small effect; a value from .50 moderate effects and a value of .80 or more indicated a large effect (Cohen, 1977). Finally, bivariate correlation analyzes were performed, and Pearson correlation coefficient was asked. Pearson values equal to ± 1 indicate a large and perfect correlation values between ± 9-99 would indicate a very high correlation, those who oscillate between ± 0.7 and 0.89 would target a high correlation between .4 and .69 ± moderate correlation between .2 and .39 ± low correlation and a value of 0 would indicate no correlation between the measured variables.

Results

First, a descriptive analysis of frequencies and percentages was performed for the values of the items of the questionnaire on each of the 3 dimensions of the learning perception of Mind Mapping (see Table 2).

For dimension 1, which correspond to "feelings that arise during the learning of the technique" the results indicated that a high percentage of students (more than 50% of the sample) said they felt or feel little doubt, anguish or confusion during learning process. Specifically, 55.4% did not emerge or show little doubt arose during the learning, 80.0% did not feel or felt little worried, and 77.5% felt little or no confusion.

The data of dimension 2, which refer to the "emerging difficulties for learning the technique" indicated that students found greater difficulty in the process of developing the mind map related to the space, the amount of main and secondary ideas (text) and the synthesis of these concepts (47.6% somewhat or very difficult space-related, 47.3% to the amount of text, and 49.3% with the synthesis of ideas into concepts). Aspects of learning that presented less difficulty for adapting included the development of mind maps using the computer and the making of drawings and pictures, as approximately 60% and 70% of students said they had no or have little trouble to adjust and develop mental maps and make drawings (67.9%, 65.7% and 60.5% respectively). As for the problems related to the structure of the content, data suggested that approximately half of the sample experienced none or few problems, while the other half said enough or many problems to structure the contents of mental maps (see table 2).

Finally, the results of dimension 3, related to the "positive aspects of the application of the technique" indicated in all items evaluated that the use of the technique is fairly or very flattering. Data have shown that the aspects that facilitates the use of mind maps is the synthesis and organization of content studied, finding 86.8% of students said their application or provided them pretty much both the synthesis and the organization. It was also found that to a high percentage of students, the application of the technique of Mind Mapping provided enough or much understanding of content (72.9%), comprehensive storage (69.9%) and the memory (81.5%) and the study (75.4%) of the topics (see Table 2).

Table 2: Descriptive of the items of the student perception questionnaire about the process of learning the technique of Mind Mapping

ITEMS: Feelings that arise during the learning of the technique	**(1)Never**	**(2)Little**	**(3) Somewhat**	**(4) Very much**
I got doubts	11 (8.5%)	61 (46.9%)	47 (36.2%)	11 (8.5%)
I felt distressed	50 (38.5%)	54 (41.5%)	20 (15.4%)	6 (4.6%)
I was confused	29 (22.5%)	71 (55.0%)	24 (18.6%)	5 (3.9%)
ITEMS: Emerging difficulties of learning the technique	**(1)Never**	**(2)Little**	**(3) Somewhat**	**(4) Very much**
Problems with space	23 (17.7%)	45 (34.6%)	44 (33.8%)	18 (13.8%)
Problems with amount of text	17 (13.2%)	51 (39.5%)	39 (30.2%)	22 (17.1%)
Problems with content structure	10 (7.7%)	64 (49.2%)	47 (36.2%)	9 (6.9%)
Problems with adaptation	25 (19.5%)	62 (48.4%)	35 (27.3%)	6 (4.7%)
Problems with the elaboration of the map using the computer	33 (30.6%)	38 (35.2%)	23 (21.3%)	14 (13.0%)

Problems to draw	33 (25.6%)	45 (34.9%)	45 (34.9%)	6 (4.7%)
Problems to synthesize ideas and concepts	9 (6.9%)	57 (43.8%)	56 (43.1%)	8 (6.2%)
ITEMS: Positive aspects of the application of the technique	**(1)Never**	**(2)Little**	**(3) Somewhat**	**(4) Very much**
Facilitated the understanding of issues worked	6 (4.7%)	29 (22.5%)	70 (54.3%)	24 (18.6%)
Facilitated the synthesis of information	3 (2.3%)	14 (10.9%)	81 (62.8%)	31 (24.0%)
Facilitated the organization of content	4 (3.1%)	13 (10.1%)	84 (65.1%)	28 (21.7%)
Provided comprehensive memorization of content	7 (5.4%)	23 (17.7%)	75 (57.7%)	25 (19.2%)
Facilitated remembering content	4 (3.1%)	20 (15.4%)	78 (60.0%)	28 (21.5%)
Facilitated the recall of subjects worked	6 (4.6%)	26 (20.0%)	74 (56.9%)	24 (18.5%)
N= 130				

A descriptive analysis of mean values was conducted, including the same, mean and standard deviation obtained on each of the items of the 3 dimensions of the questionnaire. In addition, the T-Student statistical test was applied to analyze comparatively the mean values of each variable, differentiating between males (Group 1, N = 40) and females (Group 2, N = 90) who participated in the study. This analysis allows us to measure the relationship between different variables of the questionnaire and the gender of the students.

As it can be seen on Table 3, the results obtained show the relationship between the different variables of the questionnaire and the gender of the participants. In it, you can see the comparison of means for the two groups (males/ females). The 16 measured variables, belonging to the 3 dimensions of the questionnaire appear with abbreviated nomenclature on the subject to which it relates each item in the first column of the table (see Table 3).

The results of the Student T-test indicated no significant differences between the group of males and females in the studied variables. While descriptive noted that the means obtained in the items of the first dimension “Feelings that arise during the learning of the technique” were higher in the group of females, specifically in the variables doubt (M = 2.55 vs. M = 2.40) and distress (M = 1.88 vs. M = 1.86); and higher in the group of males in the confusion variable (M = 2.04 vs. M = 2.03). Descriptive variables for the second dimension "emerging difficulties of learning the technique" aimed a higher average for females in the space variables, making drawings and synthesis, while males had higher means in the variables related with the amount of text, content structure, adaptation and development of mind maps. In the descriptive of the third dimension "positive aspects of the application of the technique", the females showed higher average in comprehension, synthesis, storage and recall of information, while a higher mean in males, in organization and study (see table 3).

Since no statistically significant differences were found in any of the questionnaire items based on gender, the data suggest that learning the technique of Mind Mapping seems to imply no differences between boys and girls in any of its dimensions.

Table 3: Mean comparison between males and females

VARIABLE: FEELINGS THAT ARISE DURING THE LEARNING OF THE TECHNIQUE	**Group**	**Mean**	**D.S.**	**Student-t**	**Sig.**
Doubts	**Male**	2.55	.846	1.028	.306
	Female	2.40	.731		
Distress	**Male**	1.88	.791	.121	.904
	Female	1.86	.868		
Confusion	**Male**	2.03	.733	-.138	.890
	Female	2.04	.767		
VARIABLES: EMERGING	**Group**	**Mean**	**D.S.**	**Student-t**	**Sig.**

DIFFICULTIES OF LEARNING THE TECHNIQUE					
Space	**Male**	2.33	.797	-.999	.361
	Female	2.49	.997		
Text	**Male**	2.60	.955	.724	.471
	Female	2.47	.918		
Content structure	**Male**	2.43	.675	.020	.984
	Female	2.42	.764		
Adaptation	**Male**	2.33	.772	1.529	.129
	Female	2.10	.798		
Elaboration	**Male**	2.21	.978	.296	.767
	Female	2.14	1.033		
Drawings	**Male**	2.10	1.008	-.689	.493
	Female	2.22	.808		
Synthesis	**Male**	2.48	.751	-.101	.919
	Female	2.49	.707		
VARIABLES: POSITIVE ASPECTS OF THE APPLICATION OF THE TECHNIQUE	**Group**	**Mean**	**D.S.**	**Student-t**	**Sig.**
Comprehension	**Male**	2.79	.570	-.716	.475
	Female	2.90	.835		
Synthesis	**Male**	3.08	.532	-.094	.925
	Female	3.09	.713		
Organization	**Male**	3.08	.474	.278	.782
	Female	3.04	.737		
Memorization	**Male**	2.83	.636	-.904	.368
	Female	2.94	.812		
Remembering	**Male**	2.98	.577	-.298	.766
	Female	3.01	.757		
Study	**Male**	2.93	.616	.330	.742
	Female	2.88	.805		
N=130					

The possible relationship between the nationality of the students and the questionnaire variables were also analyzed. As was done with age, Student T-test were performed for analyzing possible differences of means between the group of Italian students and the group of Spanish students in the questionnaire variables used in the research.

In Table 4, the results of the descriptive analysis of mean values (mean and standard deviation of the mean), and the value obtained in the Student T-test performed to compare the mean values of each of the variables according to the nationality of the students can be seen (Spain, Group 1, N = 65 and Italy, Group 2, N = 65). The names of each of the variables analyzed are shown in the first column of the table. In it, it has given a more abbreviated nomenclature for each of the items related to the topic to which it refers. Students T-tests showed significant differences in relation to the nationality of the participants in the study. Specifically, significant differences were found in the variables distress [t (128) = 5.836; p = .000] and confusion [t (127) = 3.264; p = .001], both corresponding to the dimension "Feelings that arise during the learning of the technique", where Spanish students score higher than Italian students in the feelings related to distress and confusion that occur during the learning of mental mapping. The effect size was moderate (r = .46) for the item related to distress and small (r = .28) for the item on confusion, so the difference found between being Spanish or Italian and the confusion that arises during learning of mental mapping was largely influenced by the size of the sample, while the relationship between anxiety and nationality was little influenced by the sample size. In addition, statistically significant differences in relation to nationality were seen in the space variables [t (128) = 2.177; p = .031] effect size r = .19 small-, amount of text [t (127) = 4.414; p = .000] r = .36 moderate-size effect, structuring content [t (128) = 2.558; p = .012] r = .22 small effect size, adaptation [t (125,190) = 1.990; p =

.049] r = .18 petty-size effect, and synthesis [t (128) = 3.434; p = .001] r = .29 under- medium-size effect, all belonging to the dimension " emerging difficulties of learning the technique." For all variables, the group of Spanish students scored higher than the group of Italians. According to the data, the Spanish students said that arose further negative feelings during the learning technique, as well as greater difficulty learning emerging mental maps. However, no significant differences with regard to the nationality of the participants in any of the items in the third dimension "positive aspects of the application of the technique," so find that in our sample, the positive aspects the application of the technique are independent of the nationality of the participants in the study. However, although there are no statistically significant differences in all variables except for the memory variable, the Spanish students scored higher than the Italian students.

Table 4: Mean comparison between Italian and Spanish students

VARIABLE: FEELINGS THAT ARISE DURING THE LEARNING OF THE TECHNIQUE	**Group**	**Mean**	**D.S.**	**Student-t**	**Sig.**
Doubts	***Spain***	2.51	.732	.913	.363
	Italy	2.38	.804		
Distress	***Spain***	2.25	.867	5.836	.000**
	Italy	1.48	.615		
Confusion	***Spain***	2.25	.811	3.264	.001**
	Italy	1.83	.631		
VARIABLES: EMERGING DIFFICULTIES OF LEARNING THE TECHNIQUE	**Group**	**Mean**	**D.S.**	**Student-t**	**Sig.**
Space	***Spain***	2.62	.913	2.177	.031*
	Italy	2.26	.940		
Text	***Spain***	2.85	.905	4.414	.000**
	Italy	2.17	.827		
Content structure	***Spain***	2.58	.768	2.558	.012*
	Italy	2.26	.668		
Adaptation	***Spain***	2.31	.828	1.990	.049*
	Italy	2.03	.740		
Elaboration	***Spain***	2.25	1.09	1.053	.295
	Italy	2.05	.872		
Drawings	***Spain***	2.20	.922	.182	.856
	Italy	2.17	.827		
Synthesis	***Spain***	2.69	.705	3.434	.001**
	Italy	2.28	.673		
VARIABLES: POSITIVE ASPECTS OF THE APPLICATION OF THE TECHNIQUE	**Group**	**Mean**	**D.S.**	**Student-t**	**Sig.**
Comprehension	***Spain***	2.98	.739	1.757	.081
	Italy	2.75	.777		
Synthesis	***Spain***	3.15	.537	1.188	.237
	Italy	3.02	.766		
Organization	***Spain***	3.12	.650	1.186	.238
	Italy	2.98	.678		
Memorization	***Spain***	2.95	.672	.689	.492
	Italy	2.86	.846		
Remembering	***Spain***	2.95	.672	-.746	.457
	Italy	3.05	.738		
Study	***Spain***	2.98	.673	1.409	.161
	Italy	2.80	.814		
N= 130					

In order to statistically determine the effect of age on the perception of learning the technique of Mind Mapping, a comparison of means on each of the variables in the questionnaire

was performed. Specifically, ANOVA were performed, as comparing the variable (age) had more than two response values.

In Table 5, the results obtained are shown, indicating significant differences by age in the following variables: distress [W (4, 127) = 8.077; p = .00; d =.] of dimension 1 "feelings that arise during the learning of the technique", being the differences between the age group of 19-20 years with the group 23-24 and 25-26 years, with younger students presented higher mean anxiety than the other two older age groups (23-24 and 25-26 years); synthesis of ideas into concepts [W (4, 127) = 6.889; p = .00; d =.], the second dimension of the scale "emerging difficulties of learning the technique", pointed out the differences between the group of students between 25-26 years with the group of students of 19-20 years and with more than 26 years , being the 25-26 years group said lower half problems with the synthesis of ideas into concepts students 19-20 years group and that group over 26 years; variables regarding understanding [W (4, 126) = 3.315; p = .022; d =] and organization [W (4, 127) = 3.621.; p = .014; d =.], while dimension 3 of the questionnaire "positive aspects of the application of the technique," have found significant differences between the 19-20 years and 23-24 years in the case of variable related to understanding the issues worked, where younger students had higher than average scores older, while the variable related to the organization of content differences were found between the group over 26 years with the group 21-22 and 23-24 years, with older participants (+26 years) scored higher than the younger (21-22 and 23-24 years) scores.

Table 5: ANOVAs, differences by age in the variables of the student perception questionnaire about the process of learning the technique of Mind Mapping

	Age	N	Mean	D.T.	gl	W	P	Tukey/Games Howel
Variable: DISTRESS	*19-20*	41	2.39	.586	4	8.077	.000**	23-24≠19-20 25-26≠19-20
	21-22	23	2.57	.896				
	23-24	41	2.59	.836				
	25-26	8	2.00	.535				
	+26	14	2.29	.914				
	Total	127	1.88	.842				
Variable: SYNTHESIS	*19-20*	41	2.63	.698	4	6.889	.000**	19-20≠25-26
	21-22	23	2.52	.593				
	23-24	41	2.29	.716				
	25-26	8	1.88	.354				
	+26	14	2.86	.770				
	Total	127	2.48	.711				
Variable: COMPREHENSION	*19-20*	41	3.10	.625	4	3.315	.022*	19-20≠23-24
	20-21	23	2.65	.775				
	22-23	40	2.63	.740				
	24-25	8	3.13	.641				
	+26	14	3.14	.864				
	Total	126	2.87	.748				
Variable: ORGANIZATION	*19-20*	41	3.02	.570	4	3.621	.014*	21-22 ≠ +26 23-24 ≠ +26
	21-22	23	2.83	.778				
	23-24	41	2.78	.791				
	25-26	8	3.13	.835				
	+26	14	3.07	.917				
	Total	127	2.92	.741				

Finally, and as a compliment to the reliability of the instrument, a Pearson correlation was conducted on the questionnaire. Table 6 indicates the values of the Pearson coefficients that were reached between the dimensions of the questionnaire. The results indicated that there was a significant correlation between the dimension “feelings that arise during the learning of the technique” and the other two dimensions of emerging learning difficulties on learning the

technique, and "positive aspects of the application of the technique". The correlation established between the size of the feelings that arise during learning and emerging dimension of learning difficulties was a moderate positive correlation (.532), ie, more feelings for most emerging learning difficulties, and vice versa. However, the correlation between the size of positive feelings and aspects of the application of the technique was a low negative correlation (-.260), meaning that more positive feelings for the less technical aspects of its implementation, and vice versa.

No significant correlation between the second and third dimension of the questionnaire was found. That is, the results did not establish relationships between items referring to the difficulties that emerge from learning the technique of mental mapping and items relating to the positive aspects that the application of the technique provides.

Table 6: Correlation coefficients between the dimensions of the questionnaire

	Feelings that arise during learning the technique	Emerging difficulties of learning the technique	Positive aspects of the application of the technique
Feelings that arise during learning the technique		.532** (107)	-.260** (126)
Emerging difficulties of learning the technique			-.056 (105)
Positive aspects of the application of the technique			

** The correlation is significative to a bilateral 0.01 level.
* The correlation is significative to a bilateral 0.05 level.
Number of participants (N).

Discussion and conclusions

This study collected the perceptions of students about learning the technique of Mind Mapping and their application to the university stage. Specifically, in this process three dimensions have been fully addressed and identified, as were the feelings that arise during learning, emerging difficulties of this process and the positive aspects of the application of the technique. In conclusion, we can say that students acknowledge to have found a number of difficulties in the learning process of Mind Mapping, as well as its realization. These stem from the confusion arising from the novelty of the technique as well as by strong methodological change, which has led to the emergence of certain negative states such as feelings of anxiety and confusion, resulting in an initial decrease in motivation and self-esteem. Throughout the process of learning the technique of Mind Mapping, the difficulties encountered by the awareness of the need for greater effort and commitment during this early stage have been overcome, which are crucial for effective learning (Muñoz, 2010).

Therefore, it seems that Mind Mapping is a technique that can be easily use in higher education, providing many advantages, both to students and staff, as it impacts on the development of skills related to compression, organization and storage of the contents worked. In this sense, the mind map can be used with any type of material, making it a tool applicable to subjects of any university.

It is essential in today's society to establish a learning orientation that addresses personal development entirely from the cognitive processes to a personal and social way at the same time, including the development of creativity and decision-making, not forgetting positive mental climate conducive to the process. Assuming that the student is the protagonist and builder of its own learning, it should help you to learn and become aware of what the process involves and how it

is developed to regulate. Mind Mapping is a strategy / technique that attempts to respond to this idea of learning and allows the holistic development of the individual from these areas:

• Building knowledge and enhancing cognitive abilities in order to develop cognitive structures to enter the process of thinking, thereby exercise and development of mental abilities. Furthermore, with the use of the image, Mind Mapping encourage a variety of skills in the brain to operate with shapes, colors, lines, and dimensions that stimulate the imagination and therefore creative thinking is encouraged and memory.

• Working with self-consciousness involves mental maps of the processes experienced in the learning experience, ie metacognition which is a reflective self-awareness and a fundamental aspect of metacognition or self-regulatory basis of activity. In the field of learning, is the result of the involvement of the self in metacognitive, cognitive, affective and behavioral processes that are directly related to academic achievement (McCombs, 1993). If one of the fields or levels of metacognitive activity is self-awareness of their own learning, metacognition is a basic device to "learn to learn" and "learning to reflect." In this sense, we can say that metacognition is the key to learning to think, as it offers the students get the ability to control the learning situation and realizes the processes involved in learning.

In the words of Muñoz (2010), "learning involves the decision to engage in activities entailing personal, social and cognitive maturity, which requires commitment and liability arising from personal conviction. The initiative and autonomy in the functioning of the individual makes an indicator of the effectiveness and efficiency "(p. 394).

References:

1. Brysbaert, M. (2011). *Basic Statistics for Psychologists*. London: Palgrave Macmillan.
2. Buzán, T. (1996). *El libro de los Mapas Mentales. Cómo utilizar al máximo la capacidad de tú mente*. Barcelona: Urano.
3. Buzán, T. (2004). *Tu mente en forma*. Barcelona: Urano.
4. Carter, R. (2002). *El nuevo mapa del cerebro*. Barcelona: Integral RBA libros S.A.
5. Cohen, J. (1977). *Statistical Power Analysis for the Behavioral Sciences*. New York: Academic Press.
6. Dürsteller, J. C. (2000). *Visualización de la información. Una visita guiada*. Barcelona: Gestión 2000.com.
7. Engelhart, Y. (2002). "*The language of graphics*". Diagrammatic Representation and Inference. Pp. 104-108. Heidelberg: Springer Berlin.
8. Field, A. (2009). *Discovering Statistics using SPSS*. London: SAGE.
9. Gardner, H. (1994). *Inteligencias múltiples*. Barcelona: Paidós.
10. Goleman, D. (1994). *Inteligencia emocional*. Barcelona: Kairós.
11. Goleman, D (2006). *Inteligencia social. La nueva ciencia de las relaciones humanas*. (2006). Barcelona: Kairós.
12. Herrmann, M. (1989). *The creative brain*. Búfalo: Brain books.
13. McCarthy, M. J. (1991) *Domine la era de la información*. Barcelona: Robin-Book.
14. MacLean, P. (1990). *The triune brain evolution*. New York: Plenun Press.
15. McCombs. B. L. (1993). Intervenciones educativas para potenciar la metacognición y el aprendizaje autorregulado. En Beltrán, J. A., y otros: *Intervención psicopedagógica*. Madrid: Pirámide.
16. Mateo, J. (2006). La investigación ex post-facto. En R. Bisquerra (coord.). *Metodología de la investigación educativa*. (pp. 195-230). Madrid: La Muralla.
17. Muñoz, J.M. (2010). *Los mapas mentales como técnica para integrar y potenciar el aprendizaje holístico en la formación inicial de maestros y maestras*. Córdoba, Servicio de publicaciones de la Universidad de Córdoba.
18. Muñoz, J.M.; Serrano, R. y Marín, V. (2014). Innovación educativa sobre aprendizaje colaborativo y el uso de mapas mentales en la formación inicial docente. *Educatio Siglo XXI,* Vol. 32 nº 2, pp. 193-212
19. Ontoria, A., Gómez, J. P. y Molina, A (2007, 4ª edic). *Potenciar la capacidad de aprender y pensar*. Madrid, Narcea.

20. Ontoria, A. Gómez, J. P., Molina, A y Luque, A, De (2006, 4ª edic.). *Aprender con Mapas Mentales*. Madrid, Narcea.

21. Pardo, A., y Ruiz, M. (2002). *Guía para el Análisis de Datos*. Madrid: McGrawHill.

22. Sperry, R. (1973). *Lateral specialization of cerebral function in the surgically separated hemispheres*. en F.J. McGuigan (Ed.). *The Psychophi-sioly of the thinking*. New York, Academic Press.

23. Tufte, E. (1994): *Envisioning Information*. Cheshire, Connecticut, Graphic Press.

24. Ware, C. (2004). *Information Visualization: Perception for design*. San Francisco (USA), Morgan Kaufmann Publishers Inc.

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Economic sciences

Экономические науки

Determinants of Trade Credit: The Case of a Developing Economy

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Abstract

This study answers the call of understanding trade credit determinants and consequences in different cultures and economic setups in order to be able to devise policies. Trade credit is affected by two types of factors including firm specific characteristics and macroeconomic conditions. This study tries to investigate the following firm specific variables such as firm size, liquidity, product quality, price discrimination, inventory and sales growth and found them significantly related to trade credit. Gross Domestic Product (GDP) is the variable which is used as macroeconomic variable and found positively related to trade credit. After collecting seven years data from 2005 to 2011 from non-financial firms of Pakistan, we have applied three models named, pooled ordinary least square method, fixed effects m ethod and random effects method for estimation to reach at the conclusion that which model is more appropriate for this study based on panel data. F-test and Hausman test are used to compare the estimated models and they give their justification in favor of fixed effects model.

Keywords: Credit policy; trade credit; developing economy; bank credit; KSE.

Introduction

Organizations seek various means to finance their capital needs. Theorists has classified two major types of financing modes naming long term financing and short term financing. Constraints in accessing bank short term loans make other modes of short term financing more attractive. These problems are mainly due to the agency costs and information asymmetries as suggested by the economic theorists. Short term financing like trade credit resolves these issues and making it preferable or substitute to bank financing. Trade credit and bank loans are considered as substitute to each other as in tight monetary conditions, the share of trade credit in external financing policy is increased as compared to banks loans (Guariglia and Mateut 2006).

Trade credit, as explained by Martínez-Sola et al. (2012) is an arrangement between a seller and a buyer allowing an exchange of goods with deferred payment terms. Hence trade credit is an important source of financing for firms, especially for the small and medium sized firms (Boyery

and Gobert 2007). Trade credit is general term that is used for either supply or demand for credit goods. When it appears on the assets side of the balance sheet it is called accounts receivables (trade credit supply). Alternatively, when trade credit appears at the liability side is referred to as accounts payable (trade credit demand). Trade credit enhances efficiencies on both sellers' and buyers' part by smoothing out the uncertainties in delivery cycles and simplifying cash management (Schwartz 1974).

Financial advantages that add to supply of trade credit enlists as the suppliers can easily and efficiently evaluate the financial standings and creditworthiness of their customers from close business ties and the power they possess over their customers by controlling the supply of goods in case of late payments or default (Ono 2001). Further, Smith (1987) argues that the firms forgoing the discount signals for a weak financial standing and calls for close monitoring by suppliers.

Further, Wilson and Summers (2002) suggest that trade credit proves to be an important marketing tool. The logic is that trade credit could be used to build business relationships in a new market and new entrants could earn success more easily as compared to building their reputation after years of hard work and marketing their products.

It is for these and many other positive reasons that evidence proves of strong use of trade credit in many developed and developing economies. The aggregate volume of trade credit was a significant part (17.8%) of total assets for all American firms in the early 1990s (Rajan and Zingales 1995) while in the United Kingdom 70% of total short-term debt and 55% of total credit received by firms is made up of trade credit (Kohler et al. 2000; Guariglia and Mateut 2006). Trade credit represents more than a quarter of total corporate assets in France, Germany and Italy and it is also important in emerging economies, like China, where firms get limited support from the banking system (Ge and Qiu 2007). The gap of research remains when the trade credit literature is sought for Pakistan. No study till date had carried out a detailed analysis of the factors effecting trade credit in non-financial firms listed at Karachi Stock Exchange (KSE), the country's largest stock exchange. Main objective of this research paper is to explore the major factors that determine the level of trade credit in listed non-financial firms of Pakistan.

Martínez-Sola et al. (2012) calls for a research on trade credit and firm characteristics in different cultures, as culture have a profound effect on the factors that govern the patters of trade credit. This research will contribute to the literature regarding the factors that influence the optimal quantity of trade credit in a developing country Pakistan.

The remainder of this paper is planned as section 2 reviews the literature that leads us to the gap in the literature and building of hypotheses. Section 3 discusses the sample and empirical methodology. Section 4 reports the results with the analysis and lastly section 5 concludes the study and discusses the implications of the findings.

Literature Review

Many researchers have investigated the determinants of trade credit with respect to their countries to analyze the importance and use of trade credit (Niskanen and Niskanen, 2006; Cheng and Pike 2003; Petersen and Rajan 1997).

In every corporate financing policy trade credit always performs a significant job. Funds involved in trade credit supply have always been considered as an investment in current assets. According to Giannetti et al. (2003) account of trade credit supply stands as a quarter of total assets in balance sheet of European firms. Trade credit is the major source of external financing in underdeveloped countries because they have less access to standardized capital markets (Beck et al. 2008; Ge & Qiu 2007). Creditworthy firms use trade credit as an external source of financing and find it cheaper because they always seek a discount in early payments to suppliers (Giannetti et al. 2003).

Jain (2001) argued that trade credit act as a second flash cover between the relationship of financial institutions and businesses. In case of inefficient financial market it is quiet beneficial for buyers and suppliers to use this second layer to meet their external financing needs (Frank & Maksimovic, 2004). Firms having less credible relation with financial institutions involved more in credit transactions and have enough amount of trade credit in their balance sheet than the firms having good association (Petersen and Rajan 1994).

1 Theoretical Background

The question arises why suppliers and buyers are willing to get involved in credit transactions

whenever they know about other financing channels like bank credit that are more cheaper than trade credit. Literature on trade credit has tried to find out the motives at work in the supply and demand of trade credit. The theories that address some of these motives have explained below.

1.1 Financial Models

Trade credit serves as a monitoring tool for the product quality and shortens the informational asymmetries (Smith 1987; Long et al. 1993; Pike et al. 2005) regarding the quality of the delivered product between buyers and suppliers. This specially is of importance in a scenario where product quality verification needs longer time period (Smith 1987). Thus trade credit serves as a means to guarantee product quality by the suppliers (Lee and Stol 1993; Long et al. 1993; Deloof and Jagers 1996) and buyers could use trade credit as a mechanism to control purchased product quality (Smith 1987; Long et al. 1993). Due to this very reason, trade credit helps in shaping the buyer and supplier relationship towards a long term orientation (Ng et al. 1999; Wilner 2000). This motive leads us to investigate the proxy for product quality that is TURN. This means that more the sales turnover, lesser would be the supply of trade credit because this would be the case when the product quality is not good or according to the buyers requirements. So the first hypothesis is

H1: There is a negative and significant relationship between TURN and trade credit supply.

1.2 Price Discrimination Theory

Trade credit is also used as a tool to design product pricing by sellers and thus, enhancing product demand. This could be done in two ways; either increasing cash discount or by extending credit period that ultimately results in hype in sales (Pike et al. 2005). All these setups results in price discrimination applied by sellers. As the theory of price discrimination put forward by Petersen and Rajan (1997) there are two types of customers one who would make an early payment for their purchases and the other who would delay. Thus the price discrimination allows suppliers to facilitate for repayment to both customers. This theory of price discrimination is widely supported in trade credit literature (Garcia-Teruel and Martinez-Solano 2010a; Guariglia and Mateut 2006).

From this theory we have drawn the variable of price discrimination which is also the measure of market power. Firms having unique products and larger operating margins may generate additional cash flows by offering their additional units to customers having weak financial standing on credit. As the strong customers may pay early against the weak ones, firms are thus able to discriminate price easily. This leads to the second hypothesis

H2: There is a negative and significant relationship between price discrimination and trade credit supply.

1.3 Transaction Cost Theory and Inventory Management Model

Transaction cost is considered as one of the motives that why suppliers and buyers are willing to involved in trade credit transactions. The theory put forward by Ferris (1981) suggests that trade credit could also be used a means to reduce transaction costs. Theory suggests that as the suppliers are able to separate items sold from cash in return, they could thus manage their future cash inflows and hence do not need to withhold surplus deterrent cash.

Inventory management model developed by Bougheas et al. (2009) states three variables naming inventory, liquidity and size of the firm in determining the level of trade credit. They argue that producers produce goods, either sell finished goods or holds them in inventory at cost and thus play a role in the credit chain as middle man. Vaidya (2011) has mentioned that sellers can shrink their finished goods inventory by contributing in credit sales. From this point of view are expecting an inverse relationship between trade supply and firm inventory.

H3a: There is a negative and significant relationship between inventory and trade credit supply.

It appears that firms having liquidity issues would extend more trade credit to their customers in order to have accounts receivables mounted which they may then use as assets or collaterals to banks. On the other hand firms which are in short of liquidity are expected to take more credit from their suppliers. Hence the hypothesis regarding liquidity and trade credit is as follows;

H3b: There is negative and significant relationship between liquidity and trade credit supply.

H3c: There is a positive and significant relationship between liquidity and trade credit demand.

Further, the inventory management model speaks that large firms do not face liquidity issues and do not have much storage cost of holding inventory like the small firm. This fact leads the small firms to resolve their issues of liquidity and inventory cost by granting more trade credit. Also as argued by Long et al. (1993) large firms normally have good reputation and creditworthiness so they have the capacity to get financing from any other source. They have less incentive to involve in credit sales and purchases. Large firms have no need to provide the guarantee for their products (Long et al. 1993). Hence we postulate the hypothesis regarding firm's size as follows;

H3d: There is a negative and significant relationship between firm size and trade credit supply.

H3e: There is a negative and significant relationship between firm size and trade credit demand.

Firms use trade credit to achieve their targets about growth (Niskanen and Niskanen 2006). Sales are the basic indicator of growth. A firm that is willing to increase its growth may seek to improve its sales. It can grant more credit on its sales to attract more customers which will lead to increase in sales. On the other hand, firms which are new in their businesses or facing some problems to acquire credit from other channels can also increase its sales by receiving more goods on credit from their suppliers. On the basis of these arguments we are expecting a positive relationship between sales growth and trade credit.

H3f: There is positive and significant relationship between sales growth and trade credit supply.

H3g: There is a positive and significant relationship between sales growth and trade credit demand.

1.4 Macroeconomic Conditions

A macroeconomic factor is gross domestic product (GDP). Smith (1987) and Walker (1991) advocates that the level of trade credit is settled on the conditions of economy. Firms normally increase the use of trade credit under the conditions of deteriorating in gross domestic product (Niskanen and Niskanen 2006). After finding a negative and insignificant relationship between GDP and trade credit they have mentioned that the results of this variable are difficult to explain. Therefore, we postulate the last hypothesis as under;

H4a: There is a positive and significant relationship between gross domestic product and trade credit supply

H4b: There is a positive and significant relationship between gross domestic product and trade credit demand

Data Analysis and Econometric Methodology

1 Data Analysis

We have used seven years data from 2005 to 2011 for analysis of determinants of trade credit for non-financial firms in Pakistan. Major part of data has been extracted from Balance Sheet Analysis (BSA) and Financial Statement Analysis (FSA) published by State Bank of Pakistan (SBP). Secondly, data have been extracted from the financial statements of non-financial firms listed at Karachi Stock Exchange (KSE). During the analysis firms which do not provide the complete information regarding trade credit supply, demand and other variables were excluded. Firms having missing and extreme values of assets and liabilities were also excluded.

The following Table 1 is showing the industrial distribution and their contributions in overall sample selected. We have selected the data from all non-financial firms listed at Karachi Stock Exchange (KSE) and then divide them into twelve main economic groups.

Table 1: Industrial Frequency Distribution

No.	Sectors	Frequency	Percentage
1	Textile	155	38.85%
2	Food	54	13.53
3	Chemicals, chemical products and Pharmaceuticals	43	10.78

4	Other manufacturing	30	7.52
5	Other non-metallic mineral products	28	7.02
6	Motor vehicles, trailers and auto parts	22	5.51
7	Fuel and Energy	28	7.02
8	Information, Communication & transport Services	13	3.26
9	Coke and refined petroleum products	9	2.26
10	Paper, paperboard and products	9	2.26
11	Electrical machinery and apparatus	8	2.00
12	Other services activities	10	2.51
	Total	399	100

According to table 1 there are 38.85 percent firms belong to the major textile sector of Pakistan. Food and chemical economic groups stood at the second and third position respectively. Services sector belongs to the smallest economic group of the above mentioned distribution.

Table 2 is providing the descriptive statistics of the sample data. To analyze the influence of trade credit in overall volume of balance sheet of non-financial firms, we have divided the table into different subparts. It has been observed that economic group eleven (Electrical machinery and apparatus) have greater mean of trade credit supply than any other group. It means electrical machinery and apparatus group deals more in credit sales as compare to other groups and on average their investment in account receivables is thirty percent. Economic group seven, eight, ten and twelve holds second and third positions respectively. On the other hand we can say that trade credit supply is lesser use in second and fifth economic group. Variation in economic group seven (Fuel and Energy) and eleven (Electrical machinery and apparatus) has been found more than any other group. It has also been observed that non-financial listed firms are not much interested in receiving goods on credit as compare to granting goods on credit. On average economic group twelve (Other services activities) has more volume of trade credit demand as compare to other economic groups. Manufacturing and non-metallic mineral products also have enough amount of trade credit demand on their balance sheets. Although, on average economic group twelve has greater use of trade credit demand, but it also have greater variation in its data. Economic group ten (Paper, paperboard and products) have lesser variation in the data of trade credit demand.

Table 2: Descriptive statistics

	TCS					TCD				
	Mean	Min	Max	Var	SD	Mean	Min	Max	Var	SD
EG1	0.11	0.00	0.76	0.01	0.11	0.04	0.00	0.52	0.01	0.09
EG2	0.03	0.00	0.11	0.00	0.03	0.04	0.00	0.40	0.01	0.08
EG3	0.10	0.00	0.51	0.01	0.11	0.06	0.00	0.34	0.01	0.08
EG4	0.07	0.00	0.59	0.01	0.10	0.10	0.00	0.62	0.02	0.15
EG5	0.04	0.00	0.22	0.00	0.05	0.10	0.00	0.64	0.01	0.12
EG6	0.10	0.00	0.64	0.01	0.12	0.09	0.00	0.80	0.03	0.16
EG7	0.26	0.00	0.85	0.04	0.20	0.08	0.00	0.51	0.02	0.13
EG8	0.13	0.01	0.44	0.01	0.10	0.07	0.00	0.68	0.02	0.14
EG9	0.10	0.01	0.35	0.01	0.08	0.07	0.00	0.31	0.01	0.08
EG10	0.13	0.00	0.43	0.01	0.09	0.02	0.00	0.09	0.00	0.03
EG11	0.30	0.05	0.70	0.03	0.18	0.05	0.00	0.15	0.00	0.04
EG12	0.13	0.00	0.64	0.02	0.15	0.15	0.00	0.58	0.04	0.19

	Mean	Minimum	Maximum	Std. Deviation
Inventory (INV)	0.1901	0.0000	0.7200	0.1471
Price Discrimination (PD)	0.0143	-0.0400	0.0900	0.0407
TURN	-18.2699	-12.7100	27.0100	8.0966
SIZE	3.8717	-2.6400	7.6700	1.3416

Liquidity (LIQ)	0.0525	0.0000	0.9000	0.0932
GDP	8.5929	8.4200	8.8000	0.1139
Sales Growth (SG)	0.1465	-1.5600	9.4600	0.7753

By looking at the minimum and maximum values of the other independent variables, they are indicating that extreme values do not exist in the ratios of these variables. Moreover we can observe that there is not a pronounced variation in data. TURN have a negative mean and greater variation than any other variable. Price discrimination and Liquidity have lesser variation in their data sets.

To check the correlation among variables a Pearson correlation test has been conducted. Table 3 is containing the correlation matrix for variables. Trade credit supply is the ratio of account receivables to sales and it has a positive correlation with TCD, NTC, SG and GDP. TCS have negative correlation with INV, LIQ, PD, SIZE and TURN. TCD is the ratio of account payables to sales. It has a negative correlation with all variables except LIQ and SG. NTC is ratio of account receivable minus accounts payables to sales. It has greater correlation with TCS and TCD, because by definition it has derived from these two variables. It has positive correlation with PD, SIZE and GDP. It has a negative correlation with INV, LIQ, SG and TURN. INV is stand for inventory and can be calculated as inventory to total sales. It has positive correlation with all variables except LIQ. LIQ is liquidity ratio can be measured as firm liquid assets to total assets. Liquidity has a positive correlation with PD, SG and TURN but negative with SIZE and GDP.

Table 3: Correlation Matrix

	TCS	TCD	INV	LIQ	PD	SG	SIZE	TURN	GDP
TCS	1								
TCD	.031	1							
INV	-.115	-.099	1						
LIQ	-.073	.053	-.073	1					
PD	-.029	-.144	.034	.055	1				
SG	.127	.091	.006	.068	-.076	1			
SIZE	-.153	-.186	.294	-.065	.027	-.096	1		
TURN	-.197	-.007	.079	.029	-.046	.063	-.028	1	
GDP	.064	-.175	.037	-.230	.294	-.214	.179	-.119	1

Price discrimination (PD) is operating margin to sales. Price discrimination has negative correlation with SG and TURN but positive with SIZE and GDP. Sales growth is calculated as current year sales minus previous year sales divided by previous year sales. SG has a positive correlation with TURN but negative with SIZE and GDP. SIZE can be calculated as natural log of book value of assets. SIZE has a positive correlation with GDP but negative with TURN. TURN is a proxy for product quality and calculated as sales over assets deducting receivables. TURN is negatively correlated with GDP. By looking at the magnitude of the correlations among variables, we can observe that no variable have greater correlation with any other variable which means variables do not have the problem of multicollinearity.

In order to check the violation of ordinary least square assumptions we have performed different tests to check the problems of multicollinearity, autocrrelation and heteroskedasticity. By looking at the variance inflation factor (VIF) it appears that problem of multicollinearity does not exist because all variables have VIF less than five. Values of Durbin Watson indicate that data selected for analysis do not carry out any problem of autocorrelation. To check the problem of heteroskedasticity we draw standard residuals against standard predicted and found them random.

2 Econometric Methodology

As cross sectional and time series data posed some problems, in order to overcome some problems, and panel data estimations tries to capture these problems. By using a large number of observations make a researcher able to acquire more efficient inferences (Wang 2009) and help in to reduce the problem of multicollinearity (Asimakopoulos et al. 2009). According to Wang (2009) panel data allow us to seize the variation in time and cross section components.

To check the strength of the results we have applied three models as Pooled OLS, Fixed Effects and Random Effects Model. Nobody till date has analyzed the determinants of trade credit in this proper way of analyzing. Rationality behind using these three models is to reach at more suitable explanation of the results from the given data. We have analyzed the hypotheses after selecting the more appropriate regression method.

Basic regression method for pooled data is pooled ordinary least square, which tries to minimize the sum of squared residuals. Since, simple linear regression model for panel data can be written as

$$Y_{it} = \alpha + \beta X_{it} + u_{it} \quad (1)$$

Where, i is representing ith firm at time t. Y is dependent variable and X is an independent variable. u is an error term. Equation one based on the postulation that α is equal for all cross sections. By introducing some heterogeneity in equation one allows us for identical α for all cross sections. Then, equation one can be written as:

$$Y_{it} = \alpha_i + \beta X_{it} + u_{it} \quad (2)$$

Where, αi is different for all cross sections. Now, this linear panel data model can assess by using common constant method, fixed effects method and random effects method.

Common constant method also known as pooled OLS method, works on the assumption that the given data set is priori homogeneous. It means this model estimate a single constant (α) for all given cross sections. On the other hand fixed effects model permit different constants for all sections. After allowing different constants for different sections it includes a separate dummy for all sections. That is why it is also known as least square dummy variable estimator. General form of the least square dummy variable is as follows:

$$Y_{it} = \alpha_i + \beta_1 X_{1it} + \cdots + \beta_k X_{kit} + u_{it} \quad (3)$$

Equation three can be written in matrix equation as:

$$Y = D\alpha + X\beta + u \quad (4)$$

Where, dummy variable sanctions to take different constants for different groups.

$$Y = \begin{bmatrix} y_1 \\ y_2 \\ \vdots \\ y_N \end{bmatrix}_{NT\times 1}, D = \begin{bmatrix} i_T & 0 & \cdots & 0 \\ 0 & i_T & \cdots & 0 \\ \vdots & \vdots & \vdots & \vdots \\ 0 & 0 & \cdots & i_T \end{bmatrix}_{NT\times N}, X = \begin{bmatrix} x_{11} & x_{12} & \cdots & x_{1k} \\ x_{21} & x_{22} & \cdots & x_{2k} \\ \vdots & \vdots & \vdots & \vdots \\ x_{N1} & x_{N2} & \cdots & x_{Nk} \end{bmatrix}_{NT\times k}$$

and

$$\alpha = \begin{bmatrix} \alpha_1 \\ \alpha_2 \\ \vdots \\ \alpha_N \end{bmatrix}_{N\times 1}, \beta = \begin{bmatrix} \beta_1 \\ \beta_2 \\ \vdots \\ \beta_k \end{bmatrix}_{k\times 1} \quad (5)$$

Before making any analysis the question arises whether we should allow for different constants for different sections. F test is a measure that can be used to assess whether we should use fixed effects method or pooled ordinary least square method, which allows for common constant. In this analysis we have developed the following hypothesis

H0: α1 = α2 = α3 = ... =αn (Pooled OLS is appropriate)

H1: Fixed effects model is appropriate

By using following standard formula of F-statistic we have calculated F-estimated.

$$F = \frac{R^2_{FE} - R^2_{CC}/N-1}{1-R^2_{FE}/NT-N-K} \sim F(N-1, NT-N-K) \quad (6)$$

Where, R2CC is coefficient of determination of common constant model and R2FE is coefficient of determination of fixed effect model. Lesser value of F-critical than F-calculated would leads to reject the null hypothesis. F-calculated for trade credit supply is 16.8813 which is significantly greater than F-critical that is 1.1048. On the basis of this evidence we can reject our null hypothesis. It means fixed effects model is more appropriate for trade credit supply than pooled ordinary least square. By adopting same procedure for trade credit demand we have found that F-calculated (5.1401) is significantly greater than F-critical (1.1044) lead towards making decision in favor of fixed effects model.

Random effect model based on the assumption that constants of each section do not remain fixed. It assumes that constants of each group are random parameters. This variation in these constants originate from

$$\alpha_i = \alpha + v_i \quad (7)$$

Where vi is standard random variable which have expected value equal to zero. In general, random effects model can be offered in the following form

$$Y_{it} = (\alpha + v_i) + \beta_1 X_{1it} + \cdots + \beta_k X_{kit} + u_{it} \quad (8)$$

$$Y_{it} = \alpha + \beta_1 X_{1it} + \cdots + \beta_k X_{kit} + (v_i + u_{it}) \quad (9)$$

To measure the difference between fixed effects and random effects models Hausman test can be used (Ahn and Moon, 2001).

$$H = \left(\beta\hat{}^{FE} - \beta\hat{}^{RE}\right)' \left[\mathrm{var}\left(\beta\hat{}^{FE}\right) - \mathrm{var}\left(\beta\hat{}^{RE}\right)\right]^{-1} \left(\beta\hat{}^{FE} - \beta\hat{}^{RE}\right) \sim x^2(k) \quad (10)$$

It is applied to make the selection between the use of fixed effects or random effects models. This test based on the following hypothesis

H0: Random effects model is appropriate

H1: Fixed effects model is appropriate

After applying the Hausman test we have found the following results.

Table 4: Hausman Test

	Test Summary	Chi Square statistic	Chi square df.	Prob.
TCS	Cross section random	14.4749	7	0.0434
TCD	Cross section random	8.6417	4	0.0507

Significant values are evidently suggesting that we should reject our null hypothesis and accept alternative hypothesis. On the basis of above arguments we are able to use fixed effects model to capture the effects of firm specific and macroeconomic factors on trade credit.

Equation 11 is used to estimate the factors effecting trade credit supply by using fixed effects model.

$$\frac{AR_{it}}{Sales_{it}} = \alpha_i + \beta_1 \frac{Inventory_{it}}{Sales_{it}} + \beta_2 \frac{Operating\ Margin_{it}}{Sales_{it}} + \beta_3 \left[\left(\frac{Sales_{it}}{Total\ Assets_{it}}\right) - (AR_{it})\right] + \beta_4 Ln(Book\ value\ of\ assets_{it}) + \beta_5 \frac{Liquid\ Assets_{it}}{Total\ Assets_{it}} + \beta_6 Log(GDP) + \beta_7 \left(\frac{Sales\ of\ current\ year - Sales\ of\ previous\ year}{Sales\ of\ previou\ year}\right)_{it} + e_{it} \quad (11)$$

The following equation 12 is used to estimate the factors effecting trade credit demand by using fixed effects model.

$$\frac{AP_{it}}{Sales_{it}} = \alpha_i + \gamma_1 (Book\ value\ of\ assets_{it}) + \gamma_2 \frac{Liquid\ Assets_{it}}{Total\ Assets_{it}} + \gamma_3 Log(GDP) + \gamma_4 \left(\frac{Sales\ of\ current\ year - Sales\ of\ previous\ year}{Sales\ of\ previou\ year}\right)_{it} + u_{it} \quad (12)$$

Results

Table 5 and 6 are showing the effects of different firm specific and macroeconomic factors on trade credit. In both tables, column I, II and III are showing the results of pooled ordinary least square, fixed effects and random effects model respectively. Most of our results are in line with the previous findings of different studies on determinants of trade credit.

In table 5 the results of fixed effects and random effects model for inventory variable turn out to be highly significant with negative mark of coefficient. On the other hand pooled ordinary least square is indicating towards the negative but not significant relationship of inventory with trade credit supply. According to the results of fixed effects model, inventory to sales ratio is significantly related to trade credit supply. Negative sign of coefficient is indicating that one unit increase in inventory would lead towards 15.78 percent decrease in trade credit supply. In order to increase sales non-financial firms in Pakistan tries to grant more credit on sales which leads towards the decrease in inventory. This statement turned our direction towards the important motive of inventory management. Our result for inventory is in line with the empirical findings of (Vaidya 2011) and proves our H3a hypothesis.

In table 5 PD is price discrimination and it is calculated as operating margin divided by sales. Rise in operating margin is an indication for suppliers that they can enhance their cash flows by allowing more goods on credit to their needy customers (Niskanen and Niskanen 2006). Monopolists can practice trade credit as an instrument to differentiate price among those customers which pay early and get discounts than those which cannot. After testing price discrimination variable in all three models, it appears with negative sign of coefficient and remains insignificant. Even though our outcome for price discrimination is against the theory of price discrimination proposed by Petersen and Rajan (1997) but on other hand in line with the empirical findings of Niskanen and Niskanen (2006). This insignificance is might be outstanding due to the fact that not a single non-financial firm in Pakistan has a monopoly power to differentiate the price.

TURN is used as proxy for quality of the product being offered on credit as stated by Garcia-Teruel and Martinez-Solano (2010a). They further argue that lower values of turn represent high quality of products and hence, firms with high quality products would grant more trade credit to convey the quality to their customers. According to table 5 TURN is also in line with hypothesis confirming a negative relationship with trade credit supply and it is significant at p-value<0.01. The empirical findings of Li (1997) also support the negative and significant relationship of TURN with accounts receivables. This is the only variable that is mutually significant in all three models estimated.

SIZE is calculated as natural log of book value of assets. In table 5 we have found that size of the firm is significant and negatively related to trade credit supply in pooled ordinary least square and fixed effects methods. This shows that large firms do not carry out credit sale transactions. These results confirm the empirical findings of Wilson & Summers (2002) who state that young and small firms use trade credit supply as a means to assure their quality and build their reputation among potential customers in order to increase their market share. Also the empirical literature states that as large firms have already built their reputation in the market and their customers are well aware and satisfied with their quality hence they offer less trade credit to customers (Long et al. 1993).

Table 5: Determinants of Trade Credit Supply

	I	II	III
Inventory (INV)	-0.0253 (0.0286)	-0.1578*** (0.0361)	-0.0868*** (0.0305)
Price Discrimination (PD)	-0.0173 (0.1142)	-0.0891 (0.0581)	-0.0658 (0.0646)
TURN	-1.73E-06*** (5.91E-07)	-3.61E-06*** (4.01E-07)	-1.90E-06*** (4.71E-07)
SIZE	-0.0110*** (0.0030)	-0.0100** (0.0043)	-0.0057 (0.0038)
Liquidity (LIQ)	-0.0707* (0.0418)	-0.1167*** (0.0355)	-0.0568* (0.0314)
Sales Growth (SG)	0.0459*** (0.0080)	0.0173*** (0.0032)	0.0336*** (0.0050)
GDP	0.1397*** (0.0442)	0.10592** (0.0246)	0.0808*** (0.0262)
Constant	-1.0597* (0.3776)	-0.6968*** (0.1993)	-0.5635** (0.2245)
Adjusted R-square	0.0887	0.7317	0.1176
F-statistic Prob(F-statistic)	9.4881 (0.0000)	18.5705 (0.0000)	12.622 (0.0000)
Akaike info criterion	-1.8694	-2.5173	
Schwarz criterion	-1.8115	-1.7733	
Durbin-Watson stat	0.5111	1.4879	0.4882

Standard errors are reported in parentheses. *** and ** are showing the significance at 1% and 5% level of significance respectively.

The negative sign of firm size with trade credit supply can also be justified in our study by the Diversion Value Theory put forward by Burkart and Ellignsen (2004). They argue that buyers may divert bank loans instead of purchasing inputs for their projects. Buyers may take inputs on credit and may complete their projects rather having bank funding. Moreover, it is useful for the sellers to extend trade credit as they may use the accounts receivables as collateral for bank financing. This theory has been used by Giannetti et al. (2003) in providing evidence that the producers of standardize goods have less incentive to offer trade credit than the producers of differentiated goods. In case of repayment failure repossessed goods are more valuable to the supplier than to the bank and this is more pronounced in the case of a differentiated product than a standardize one. As our sample consists of the firms which are listed at Karachi Stock Exchange and are producing standardize goods. We may have got a positive relationship of size of the firm with the trade credit supply if we have included the producers of differentiated goods not listed at Karachi Stock Exchange. Thus the product nature could prove to be a good avenue for future research in context of Pakistan. As for as this study is concerned we will not reject our hypothesis of having a significant relationship between firm size and trade credit supply. According to table 6 it is found that size of the non-financial firms is inversely related to trade credit demand.

In table 5 and 6 LIQ stand for liquidity and calculated as liquid assets divided by total assets. In all three models estimated for factors effecting trade credit it is found that liquidity is inversely related to trade credit supply and positively with trade credit demand. Although the strength of significance is high in case of fixed effects model, but we have also found liquidity significant in all three models estimated. The results are in line with the inventory management model which suggests the significant relationship between liquidity and trade credit. The inventory management model developed by Bougheas et al. (2009) speaks of our two variables naming liquidity and size of the firm in determining the level of trade credit supply. They argue that producers produce goods either to sell finished goods or to hold them in inventory at cost and thus play a role in the credit chain as middle men. This could be explained by the fact that the producers which are not certain about their products demand would be at ease to offer trade credit to customers with financial constraints. This would result in enhancing sales rather than accumulate costly inventories. This mechanism is only appropriate for firms facing liquidity issues in managing their own obligations which they could resolve by extending trade credit to its customer. Thus having twofold benefits generating cash inflows and also enhancing product demand. Thus firms with higher liquidity issues would extend more trade credit than those with enough liquidity to manage their affairs. Hence, we will reject our null hypothesis regarding relationship between liquidity and trade credit supply.

Table 6: Determinants of Trade Credit Demand

	I	II	III
SIZE	-0.0148**	-0.0195*	-0.0166***
	(0.0037)	(0.0100)	(0.0049)
Liquidity (LIQ)	0.1187**	0.1937***	0.1523**
	(0.0527)	(0.0614)	(0.0535)
Sales Growth (SG)	0.0507**	0.0511***	0.0502***
	(0.0101)	(0.0096)	(0.0090)
GDP	-0.0459	0.0346	0.0038
	(0.0552)	(0.0492)	(0.0476)
Constant	0.5017	-0.1426	0.0836
	(0.4720)	(0.4210)	(0.4073)
Adjusted R-square	0.0866	0.5228	0.0829
F-statistic	15.6597	4.0266	14.971
Prob(F-statistic)	(0.0000)	(0.0000)	(0.0000)
Akaike info criterion	-1.3872	-1.6124	
Schwarz criterion	-1.3514	-0.6681	
Durbin-Watson stat	0.8544	1.6052	1.2424

Standard errors are reported in parentheses. *** and ** are showing the significance at 1% and 5% level of significance respectively.

SG stands for sales growth. It is considered as ratio of annual sales growth. Nature of trade credit strategy depends on aimed growth rates. On the basis of two variables namely, Time and Credit terms are considered as driving force for any credit policy (Niskanen and Niskanen 2006). Firms which offer higher discount and time for repayment are consider as firm with higher objective of growth rate and vice versa. To offer more goods on credit require acquiring their supplies from suppliers in time. It might be possible that they believe in to get raw material and other goods on credit. Firms with greater objective of growth rate it might be possible that they will extend more trade credit and also interested in receiving goods on credit. On the basis of above mentioned justifications we can say that sales growth should be positively rated to trade credit supply and demand. As per our expectations we have found a positive and significant relationship between sales growth and trade credit. In table 5 and 6 all three models estimated for trade credit supply and demand are validating this opinion.

GDP is Gross Domestic Product which is calculated as taking log of real values of gross domestic product for Pakistan in given periods. In table 5 the results of three models estimated confirms our hypothesis based on positive and significant relationship between trade credit supply and gross domestic product. On the other hand in table 6 results for demand side relationship found to be insignificant and this insignificance for gross domestic product remains identical in three columns.

We have not included the first three variables estimated for trade credit supply because they were particularly related to trade credit supply. On the basis of different parameters we can compare our estimated models. First thing that we can observe is the value of adjusted R square. In table 5 and 6 values of adjusted R square for fixed effects model are significantly greater than pooled ordinary square method and random effects method. On the basis of Akaike Information Criterion and Shwartz Information Criterion we can also consider fixed effects as superior than other two models. Value of Durbin Watson is also better for fixed effects model. On the basis of all these parameters made for comparison of models estimated we can finally propose that fixed effects model is most appropriate in finding the factors affecting the level of trade credit in Pakistan.

Conclusion

The study adds to the literature by analyzing the determinants of trade credit in context of Pakistan. Many studies has called for this literature gap that trade credit practices should be studied in different cultures in order to have insights into the different patterns prevailing across the nations (Solano et al. 2012). Thus this research has tried to sort the supply and demand side of trade credit prevailing in Pakistan. Furthermore, we have used the variable of liquidity which has not been previously used by other authors expect for the ones who put forward its theory. Results give strength to the inventory management model postulated by Bougheas et al. (2009) that liquidity is important in determining the level of trade credit. The study has found that firms with greater size enhance their sales without getting involved in credit transactions. It is also observed that the firms with low quality products have no need to get involved in credit transaction. As they are scared from losing their customers after measuring the quality of their products so they grant less trade credit. Sales growth remain positive and significant in both cases which suggest that firm with higher objective to achieve higher growth rate are more interested to get involved in trade credit transactions. It is also found that firms can save their inventory cost by granting more trade credit. Large firms in Pakistan have no monopoly power to change the price. In case of progress in gross domestic product non-financial firms of Pakistan practices more trade credit.

The study give some important insights to the industry players in a way that the firms may decide on their trade credit patterns while considering the firm specific characteristics. By this we mean that as firms whose products require more time to verify the quality may give extended credit periods in order to build strong relationship with their customers. Further, firms that are facing liquidity issues may take trade credit as a tool in order to build their current assets and this may serve collateral to get bank loan. Last but not the least; trade credit could be used as an inventory management practice as the units that require storage cost could be dealt profitably by issuing them on credit.

For future directions first, it is need to explore more factors effecting trade credit demand in the industrial sectors of Pakistan. Secondly, a very wide part of our economy stays out of research

area which consists of the non-listed firms and they do not maintain their financial statements in a proper manner. One such research would use primary data from these market players and may bring up the valuable insights in to the trade credit patterns at work.

References:

1. Ahn, S. C., & Moon, H. R. (2001). Large-N and Large-T Properties of Panel Data Estimators and the Hausman Test. Paper presented at the 10th International Conference on Panel Data, Berlin, July 5-6, 2002, International Conferences on Panel Data.
2. Asimakopoulos, I., Samitas, A. & Papadogonas, T. (2009), Firm-specific and economy wide determinants of firm profitability: Greek evidence using panel data. Managerial Finance, Vol. 35 Iss: 11 pp. 930–939.
3. Beck T., Demirgüc-Kunt A., and Maksimovic V., (2008). Financing patterns around the world: Are small firms different? Journal of Financial Economics 89: 467–487.
4. Bougheas S., Mateut S. & Mizen P., (2009). Corporate trade credit and inventories: New evidence of a trade-off from accounts payable and receivable. Journal of Banking and Finance 33 (2), 300-307.
5. Boyery M. M. & Gobert K., (2007). The impact of switching costs on vendor financing. Finance Research Letters 6 (4), 236-241.
6. Burkart M & Ellingsen T, (2004). In-kind finance: a theory of trade credit. The American Economic Review 94 (3), 569-590.
7. Cheng N. S. & Pike R., (2003). The trade credit decision: Evidence of UK firms. Managerial and Decision Economics 24 (6) and (7), 419-438.
8. Deloof M & Jegers M, (1996). Trade credit, product quality, and intragroup trade: some European evidence. Financial Management 25 (3), 33-43.
9. Ferris J. S., (1981). A transactions theory of trade credit use. Quarterly Journal of Economics 96, 243-270.
10. Frank M. Z. & Maksimovic V., (2004). Trade credit, collateral, and adverse selection. University of Maryland, College Park, USA, Working paper MD 20742.
11. Garcia-Teruel P. J. & Martinez-Solano P., (2010a). Determinants of trade credit: A comparative study of European SMEs. International Small Business Journal 28 (3), 215-233.
12. Ge, Y., Qiu, J., (2007). Financial development, bank discrimination and trade credit. Journal of Banking and Finance 31, 513–530.
13. Giannetti, M., (2003). Do better institutions mitigate agency problems? Evidence from corporate finance choices. Journal of Financial and Quantitative Analysis 38, 185–212.
14. Guariglia A. & Mateut S., (2006). Credit channel, trade credit channel, and inventory investment: Evidence from a panel of UK firms. Journal of Banking and Finance 30 (10), 2835-2856.
15. Jain N., (2001). Monitoring costs and trade credit. The Quarterly Review of Economics and Finance 41 (1), 89-110.
16. Kohler M., Britton E. & Yates T., (2000). Trade credit and the monetary transmission mechanism. Bank of England, London, Working paper EC2R 8AH.
17. Lee Y. W., StoI J. D., (1993). Product risk, asymmetric information, and trade credit. Journal of Financial and Quantitative analysis 28, 285-300.
18. Li, W., (1997). The impact of economic reform on the performance of Chinese State Enterprises: 1980–1989. Journal of Political Economy 105, 1080–1106.
19. Long M. S., Malitz I. B., Ravid S. A., (1993). Trade Credit, Quality Guarantees, and Product Marketability. Financial Management 22, 117-127.
20. Martinez-Sola, C., García-Teruel, P. J., & Martinez-Solano, P., (2012). Corporate Cash Holding and Firm Value, Applied Economics, 45 (2), 161- 170
21. Ng C. K., Smith J. K. & Smith R. L., (1999). Evidence on the determinants of credit terms used in interfirm trade. The Journal of Finance 54 (3), 1109-1129.
22. Niskanen J. & Niskanen M., (2006). The determinants of corporate trade credit policies in a bank-dominated financial environment: The case of Finnish small firms. European Financial Management 12 (1), 81-102.
23. Ono M., (2001). Determinants of trade credit in the Japanese manufacturing sector. Journal of the Japanese and International Economies 15 (2), 160-177.

24. Petersen M. A. & Rajan R. G., (1994). The benefits of lending relationships: Evidence from small business data. The Journal of Finance 49 (1), 3-37.

25. Petersen M. A. & Rajan R. G., (1997). Trade credit: Theories and evidence. The Review of Financial Studies 10 (3), 661-691.

26. Pike R., Cheng N. S., Cravens K., Lamminmaki D., (2005). Trade credits terms: Asymmetric information and price discrimination evidence from three continents. Journal of Business Finance & Accounting 32, 1197–1236.

27. Rajan, R., Zingales, L., (1995). What do I know about capital structure? Some evidence from international data. Journal of Finance 50, 1421–1460.

28. Schwartz R. A., (1974). An economic model of trade credit. The Journal of Financial and Quantitative Analysis 9 (4), 643-657.

29. Smith J. K., (1987). Trade credit and informational asymmetry. The Journal of Finance 42 (4), 863-872.

30. Vaidya, R. R., (2012). The Determinants of trade credit: Evidence from Indian manufacturing firms. Working Paper, Indira Gandhi Institute of Development Research.

31. Walker, D., (1991). 'An empirical analysis on financing the small firm', in R. Yazdipmy (ed.), Advances in Small Business Finance (Dordrecht: KluIr Academic, pp. 47–61).

32. Wang, P. (2009). Financial Econometrics, Second edition, Routledge, Taylor & Francis Group, LONDON AND NEW YORK.

33. Wilner B. S., (2000). The exploitation of relationships in financial distress: The case of trade credit. The Journal of Finance 55 (1), 153-178.

34. Wilson N. & Summers B., (2002). Trade credit terms offered by small firms: Survey evidence and empirical analysis. Journal of Business Finance & Accounting 29 (3) & (4), 317-351.

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Psychological sciences

Психологические науки

Stress in Community Health Agents: a Bioethics Protection Perspective

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Abstract

Health care professionals suffer from both regular job stress and caregiver stress that arises from the neglect of their work situation. As principles of bioethics protection, vertical protection ratio, health policies should also target health professionals. So, this paper seeks to understand the issue of stress in relation to mental health professionals, specifically the community health agents of the Federal District in Brazil. **Methods:** This study is an exploratory study that adopts a quantitative approach. Data were obtained by a questionnaire, that mesure social, work and stress factors, in 97 community health agents, a different class of health professional. The SPSS 19.0 program was used to mesure the results. **Results:** The sociodemographic data of respondentes revealed that the majority were women, 40,2% of the group members fall in the age range 30–39 years, 51% of respondents were married and 57.7% were of middle socioeconomic status. All Pearson correlations were significant at the 0.01 level (two-tailed). The results show that all stressors are negatively correlated with the mental health factors. These results showed that mental health deteriorates with increased stress. The mental health indicators are strongly and positively associated, indicating that individuals with better mental health show greater personal,

social and workplace support. **Conclusions:** The results indicate the need for management changes in the public health sector related to Bioethics Protection, which states that populations vulnerable to work exploitation should be protected by guaranteeing minimum working conditions.

Keywords: stress; bioethics; working conditions; community health agentes.

Introduction

The inaugural article on Bioethics Protection began with the following question: "acaso la bioética ha desarrollado las herramientas adecuadas para enfrentar los principales dilemas morales que se dan en programas y prácticas de salud colectiva"[1]. To understand the question, it is important to remember that, during the late 20th century and early in the current century, discussion of bioethics tangentially involved public health problems. Sometimes bioethical principles were applied without context, owing to the use of principalist analysis. Meanwhile, sometimes the analysis was limited to analogies related to medical issues – owing to the importance in this context of clinical biomedicine.

Thus, the article by Kottow & Schramm[1] points out that the principle of protection is best-suited to address moral issues related to public health and can generate agreements between health workers and bioethicists.

Discussions on the Bioethics of Protection have now won support, and include such issues as access to drinking water, the guiding principles of the Unified Health System (UHS), quality of life in the context of globalization, the autonomy of the mentally ill, and so on. However, we have found no discussion on the biases of health professionals.

Regarding the clinical biomedical paradigm, some authors recognize factors that support the reductionist analysis of bioethics protection. In this sense, Clinical Biomedicine and Public Health may be considered two small genera within the broad category of Health. Protection Bioethics has thus changed the Doctor / Patient dichotomy into an Institutions / Collective dichotomy. It can be inferred that this new dichotomy preserved a reductionist perspective on analysis of Public Health, and thus led to the neglect of underlying themes, such as health professionals.

Thinking about the Brazilian case, the UHS does not operate dichotomously, but rather through dialogue with its agents, specifically: government (population representatives); service providers (managers of health services); health professionals (multidisciplinary teams); and users (the population). All these agents have voices on Health Councils, which are bodies responsible for social control that permit the creation of effective public health policies, and help ensure dialogue is focused[2].

We know that some public health policies are ineffective. At this point, the principle of protection can help, because protection is defined as the attitude of safeguarding or providing for essential needs, and providing for other needs and interests only after these essential needs are met[3].

Health professionals have a responsibility to care for users. However, such care only becomes possible through interaction. Since the subjectivities of both the caregiver and recipient of care determine the means of caring, we can deduce that the way of life or situation of the agents involved will influence the care they provide.

According to Moreno[4], the study of psychosocial aspects of work acquires public importance when changes in work organization require emotional and cognitive work, which increases the psychological and mental workload. Today both traditional physical and environmental risks coexist, being known as psychosocial risks, and cause worker discomfort as a precursor of mental pathology.

The principle of protection is useful in this context. In a vertical protection relationship, health policies, which involve program implementation to develop a particular area, should also protect healthcare professionals, since these professionals are the frontline implementers of policy[5]. Public resource allocation must meet the needs of professionals and enable their activity to benefit users of health services.

As public health relationships are dialogical, professionals must do not simply wait for resources to be allocated, but should actively request resources. Foucault[6], in an interview titled "La ética del cuidado de si como practica de la libertad", was asked about the issue of mutual care. He argued: if a person takes care of themselves to the point of understanding his duties as a master of the house, husband, or father, he will gain the respect of his wife and children.

Health care professionals suffer from both regular job stress and caregiver stress that arises from the neglect of their work situation. This second situation puts health care professionals in the violation condition, demanding not only their protection but also — consistent with Foucault's ideas — the transformation of that protection from action into reality.

This reality is also observed in a group of professionals that was instituted in Brazil, more specifically in the state of Ceará, working with the issue of patient care, but where they live. These workers are called Community Health Agents, and differ from other health professional, such as nurses, because they perform their work within their own communities, visiting patients in their homes, and only then, leading to the diagnoses within the hospitals.

For these professionals exposure to stress at work is even more alarming, since many times, besides the involvement that can occur with patients in hospitals, can also be seen in many homes that they need to visit daily. So the bioethics of protection is an important tool in improving the quality of life of such professional as it can act in the public sphere both inside and outside hospitals.

Psychiatric Reform and Protection of Worker Mental Health

Law 10.216/2001, known in Brazil as the Psychiatric Reform Law, sought to institute new mental health practices to deinstitutionalise users of health services, as below[7]:

Article 3. The State is responsible for the development of mental health policy, as well as for the assistance and the promotion of health actions that target mental disorders, with due participation from society and the family, which can be provided in a mental health facility, as well as in specific institutions or units that provide health care to patients with mental disorders.

Article 4. Admission in any of its forms will only be indicated when outpatient resources prove insufficient.

Article 5. Patients hospitalized for a long time or characterized with serious institutional dependence, due to their clinical condition or lack of social support, will receive specific highly planned and assisted psychosocial rehabilitation, overseen by the competent health and supervisory authorities indicated by the Executive, and will be assured of continuity of care when needed.

However, the law does not address the deinstitutionalization of healthcare, understood here as the removal of that which is already established. In other words, we do not find in the law any precepts on the withdrawal of mental health workers from old practices.

Deinstitutionalization forms part of the dialogical relationship between caregiver and patient, as do protective measures for workers responsible for the implementation of public health policies. In this regard, Moreno[4] pondered the decreased importance of Brazil's states in the protection and regulation of labor relations, the decline in the bargaining power of workers, the primacy of the market as an articulator of social relations and a system of work organization that reproduces existing social inequalities, combined with increase part-time work, underemployment and unemployment, erode job security and promote the casualization of working conditions. As work is destabilized and the employment relationship becomes more precarious, health care and related risks are transferred to workers.

The allocation of public resources, which is largely determined by the bioethics of protection, must be discussed on boards of health. Also, since the work of these boards is to realize public policy, they must consider the protection of health professionals.

Instrument designed to measure work stress.

In the 1990s, Brazil conducted the SWS (stress, work, social) Survey, a questionnaire dealing with stress, mental health and work. Earlier studies on stress at work had already examined the following[8]:

- The search for the cause-effect relationship between stress and disease (low correlations were found);
- Differentiation of independent and dependent variables (interaction between them was occasionally found);
- The role of moderator variables using more sophisticated measures, which can be detected via statistical analysis, as well as curvilinear and linear relationships;
- The prospects of using longitudinal studies and multidisciplinary research to overcome the complexity of work stress. (p. 154).

The discussions that preceded the establishment of this survey initially focused on treating the physiological symptoms generated by stress. After this phase, psychological studies found that personal variables, situational and psychological stress could either cause or alleviate stress.

Thus, an operational change has occurred in relation to this issue that involves a shift from the physiological field (treatment of symptoms) to the psychological field (identification of causes). This change resulted in a redefinition of work stress itself, and recognition that mental health at work was not exclusively the result of work demands, but also involves other subjective issues spanning the workplace.

Regarding the evaluation of the stress model, according to Guimaraes and Grubits[8], the questionnaire considers:

1. What support factors can nullify the effects of stressor factors;
2. Separate identification of variables related to three dimensions for diagnostic differentiation;
3. Validation based on the criteria of mental health and life achievements;
4. Distinction between healthy and unhealthy stresses rather than normative comparison (p. 156).

Thus, the questionnaire was a tool that does more than merely diagnose stress and mental illness, and contributes to prevention through early detection of factors, such as lack of support, that may negatively impact the individual. In this sense, this paper seeks to understand the issue of stress in relation to mental health professionals, specifically the community health agents of the Federal District in Brazil.

Materials and methods

This study is an exploratory study that adopts a quantitative approach. The survey was administered to 97 Community Health Agents identified by a matrix as involved in mental health in the district of Riacho Fundo, Brasilia, Brazil. The survey sought to establish relationships between stress, mental health and work for the subjects.

Data collection used the SWS Survey — a questionnaire dealing with stress, mental health and work. The results were collected using SWS questionnaires, with GP shape, and were divided into two sections: Section I described the demographic and socioeconomic profile of participants, while Section II depicted the results observed in the SWS questionnaire. This second section describes the work stress reported by Community Health Agents (CHA), considering the socioeconomic and demographic variables of the sample. The statistical treatment of the data was performed using the statistical package SPSS version 19.

The questionnaire was administered in December 2012, in private rooms on the premises of surveyed health centers. The project was approved by the ethics committee of FEPECS / SES / DF, under No. 643/11, adopted on 15/02/2012. The 97 Community Health Agents who agreed to participate signed an informed consent form that guaranteed their anonymity and the confidentiality of their information. To ensure confidentiality, the names of the family health units surveyed are not disclosed.

Results

Section I: Socio-demographic Data:

The sociodemographic data of the 97 Community Health Agents revealed that the majority were women (78.4%). Almost half of the group members fall in the age range 30–39 years (40.2%), 51% of respondents were married and 57.7% were of middle socioeconomic status. The group is divided between those engaged in basic work (55.7%) and those engaged in work of medium complexity (41.2%). In terms of educational level, the largest group among the respondents were those with a high school education (47.4%), followed by those with a college degree (23.7%). The vast majority of agents work 40 hours per week (97.9%) on the morning / afternoon shift (96.9%). Most of these workers had been working in the field for approximately seven years at the time of the survey. Table 1 presents the sociodemographic characteristics of the participants.

Table 1: Frequency distribution (n) and percentage (%) of Socio-demographic data of 97 Community Health Agents. Brasília, Brazil, 2014

variables	Nº	%
Gender		
Male	20	20,6
Female	76	78,4
Without information	1	1,0
Idade		
20 – 29	19	19,6
30 – 39	39	40,2
40-49	27	27,8
50-59	5	5,2
+60	1	1,0
Without information	6	6,2
Marital Status		
Single	32	33,1
Married	50	51,5
Divorced	6	6,2
Widower	3	3,1
Free union	3	3,1
Without information	3	3,1
Work		
Basic	54	55,7
Medium	40	41,2
Superior	3	3,1
Education		
Complete elementary school	2	2,1
Incomplete elementary school	1	1,0
Completed secondary school education	46	47,4
Incompleted secondary school education	3	3,1
Higher education completed	23	23,7
Higher education incompleted	17	17,5
Post-graduation	1	1,0
Without information	4	4,1
Dependents		
None	27	27,8
1 a 3	59	60,8
4 a 6	3	3,1
More than 9	1	1,0
Without information	7	7,2
Shift Work		
Rotating shifts	3	3,1
Mornnig/Afternoon	94	96,9
Hours of Work		
40 hours	95	97,9
60 hours	1	1,0
+ 60 hours	1	1,0
Economic Level		
Very low	8	8,2
Low	33	34,0
Average	56	57,5

Section II: Mental Health and Psychosocial Risk Factors

The score for each factor of the SWS survey was calculated based only on the "yes" answers that participants indicated for each question. Responses were grouped by watching the screen correction SWS survey, in GP form (Brazilian SWS), with adaptation and translation into Portuguese carried out by Guimarães and MacFadden (1995). According to the riddle, the number of questions per factor is as follows: Psychosocial Risk Factors (PRF) = 19, Mental Health (MH) = 27, Stress at Work (SW) = 26, Work Support (WSp) = 25, Social Stress (SS) = 20, Social Support (SSp) = 23, Personal Stress (PS) = 21, Support Staff (SSt) = 22.

Correlation Between Mental Health and Stress Factors

The data presented in Table 2 show the bivariate correlations between rates of SWS. All Pearson correlations were significant at the 0.01 level (two-tailed). The results show that all stressors (PRF, SW, SS, PS) are negatively correlated with the mental health factors (MH, WSp, SS, SSt). These results showed that mental health deteriorates with increased stress. The average of these correlations was 0.58 (SD = 0.06) suggesting a moderate association between stress levels and mental health.

The correlations also show that stress levels are positively associated with one another. That is, as an indicator of stress increases, so too do other indicators in the same category. The average of these correlations was 0.71 (SD = 0.07) indicating a strong association between the various indices.

The mental health indicators are also strongly and positively associated with one another (mean = 0.71, SD = 0.04), indicating that individuals with better mental health show greater personal, social and workplace support.

Table 2: Pearson Correlation matrix for mental health and stress levels. Brasília, Brazil, 2014

	PRF	WS	SS	PS	MH	WSp	SSp	PSt
PRF	1,00							
WS	0,61	1,00						
SS	0,73	0,77	1,00					
PS	0,77	0,63	0,66	1,00				
MH	-0,60	-0,64	-0,53	-0,64	1,00			
WSp	-0,48	-0,70	-0,52	-0,47	0,68	1,00		
SSp	-0,58	-0,66	-0,62	-0,59	00,76	0,68	1,00	
PSt	-0,60	-0,59	-0,54	-0,54	0,75	0,68	0,72	1,00

Legend: PRF = Psychosocial Risk Factors, WS = Work Stress, SS = Social Stress, PS= Personal Stress, MH = Mental Health, WSp = Work Support, SSp = Social Support, PSt = Personal Staff.

SWS factors depend on socioeconomic and demographic factors

It was impossible to verify significant differences between indicators of mental health and stress in relation to socioeconomic and demographic factors. However, comparing the SWS factors in terms of socioeconomic and demographic factors revealed some interesting answers, as follows:

SWS factors and sex:

Table 3 indicates that most indicators of mental health and stress are slightly higher for women. However, comparisons across multiple chi-squares for each of the indices revealed no significant differences due to participant sex.

Table 3: Distribution of mental health outcomes and stress by gender. Brasília, Brazil, 2014

	Gender	PRF	WS	SS	PS	MH	WSp	SSp	PSt
Average	Male	5,6	10,5	5,5	7,4	18,1	14,6	15,6	16,3
SD	Male	3,9	5,8	3,4	4,6	5,3	6,2	4,5	3,5
Average	Female	6,5	10,2	6,01	7,6	19,3	15,2	16,7	16,3
SD	Female	4,1	5,2	3,9	4,3	4,8	5,0	4,3	3,3

Legend: PRF = Psychosocial Risk Factors, WS = Work Stress, SS = Social Stress, PS= Personal Stress, MH = Mental Health, WSp = Work Support, SSp = Social Support, PSt = Personal Staff, SD = Standard Deviation.

SWS factors and marital status:

Regarding marital status, divorced (n = 6), widowed (n = 3), and free (n = 3) participants were excluded from marriage because the small number of cases in each category is insufficient to produce reliable descriptors. Comparisons across multiple chi-squares for each of the indices revealed no significant differences with participant status.

SWS factors and socioeconomic status:

Comparisons across multiple chi-square for each of the indices revealed no significant differences with socioeconomic level.

Discussion

Based on the socio-demographic data obtained in this study, we found that most Community Health Agents (CHA) were women aged 30–39 years old. Most CHA were married, of middle socioeconomic status, had finished high school, worked for 40 hours a week and had about 7 years of service experience. Similar responses were found by Lopes[9] in a study conducted in two health districts within the Federal District, focussed on model teams implementing the Family Health Strategy in adherence to the National Program for Improving Access and Quality of Primary Care (PMAQ-AB), into which CHA were inserted. The author also noted that most of the teams participating were women (86%). Additionally, respondents were in the 28–56-year-old age group. Regarding length of professional experience, 59.4% of professionals had less than 5 years of experience of the Family Health Strategy.

Corroborating the present work, Ferreira & Parreira[10] conducted a study on gender differences and satisfaction and stress that surveyed cardiology hospital nursing staff, and noted that of the 61 nurses who participated, 65.6% were female and 34.4% were male. Most respondents were aged in or near their 30s and were married (64%). Of the 132 users, 78% were male while the remainder were female, which at times caused embarrassment for the beneficiaries.

In a study of workers from 14 Community Health or Family Health Teams in Paranoá, in the Federal District of Brazil, Lopes[9] noted that the majority of respondents were female and aged between 25 and 42 years old, and that 80% had completed high school. Of the 14 respondents, only three CHA had participated in a training course in mental health.

In a study to estimate the prevalence of burnout and common mental disorders in community health agents, in identifying associated factors, Silva & Menezes[11] found that participants had a mean age of 38.9 years, and predominantly belonged to the 31–40-year-old age group (33.3%). Most were women (92.2%), had completed elementary or high school (73%), and were in a stable relationship (55.4%). Participants had worked as CHAs for an average of 40.9 months, and 92.9% reported having completed a training course.

Barcellos et al.[12] assessed the profile of community health agents of Vitória, Espirito Santo, Brazil. Their results showed that 275 (90.76%) were women, 272 (89.76%) were aged between 21 and 49 years old and 201 (66.34%) had a high school education.

This work, and those mentioned above, identified a trend toward increasing numbers of women working in health in Brazil. This trend was first observed long ago by Machado[13], whose work identified the feminization of the health workforce in Brazil. Flores[14] highlighted this trend and emphasized that behind it lay factors such as gender issues, and the historical linking of care to women's roles. Furthermore, the trend was strengthened by the conscious recruitmnet of women

as CHAs, as occurred in Ceará, Brazil to improve women's living conditions, and the closeness between health professionals and nursing staff.

In this sense, Gomes et al.[15] reported that the first experience of CHA in Brazil as a comprehensive public health strategy structure, occurred in Ceará in 1987, and aimed to create jobs for women in an area of drought and contribute to reducing infant mortality. It confirms the issue of the feminization of CHA.

According to Bezerra et al.[16], in a study of ideas and practices related to community workers providing health care for older people, CHA themselves prefer that such staff be entirely female because of community resistance to male agents. This stance can be partially justified by the collective acceptance of a woman stripping naked in front of a health professional, whether a doctor or a nurse, as necessary given life history and context. However, the same aceptance does not exist in connection to CHA since such work touches on our own daily experiences, including occurring in similar geographic spaces to those we inhabit daily. Thus, male CHAs face a higher risk of involvement in situations that cause embarrassment, which limits their access to certain assisted housing inhabited by older people.

Regarding mental health and psychosocial risk factors, we found that mental health indices decrease with increasing stress levels. We saw similar results in the research of Panizzon et al.[17], who investigated stress among nursing staff in an emergency clinic, and observed that, based on analysis of the Chi-square and Spearman correlation tests, the stress level of the analyzed population is high, and that workload is the main stressor. All sources of work pressure were significantly and positively correlated with level of stress, with predictors of stress being workload, difficulties related to clients and processes, and organizational structure.

Regarding organizational structure, CHA, who participated in the current research, report that security is improved when work is performed as part of a team, as in the Family Health Strategy Programme (FHS). This may be related to lower stress, in relation to organizational structure, among Community Health Agents.

According to Ramminger[18], theories of stress, though based on physiology, resulted in more complex models that incorporated social perspective and subjectivity.

Furthermore, in the present study, the Pearson correlation indicated a positive association with stress levels. In this sense, when one index of stress increases, so too do other indicators. Mental health indicators also exhibited this same behavior, indicating that individuals with better mental health show greater personal, social and workplace support. These associations are important because they reveal that stress levels and mental health vary with related indexes.

In a pioneering work on SWS, Areias[19] found a positive and strong correlation between the Mental Health and Social Support variables. In the present study, social support was the variable with the greatest impact on mental health among all classes of health workers. In this sense, the importance of such support was observed, including the insertion of community and family support to improve quality of life for health professionals, especially in relation to stress.

Areias and Guimarães[20] observed in a study on stress factors in workers that psychosocial risk factors are positively correlated with stressor factors and negatively correlated with support factors. However, mental health was negatively correlated with stressor factors and positively correlated with support factors. These results corroborate the findings of this work, which observed problems with psychosocial factors to be accompanied by increased stressors and decreased levels of mental health.

Taking into account the results suggesting a dependence of SWS factors on socioeconomic and demographic factors, it was observed that most indicators of mental health and stress are slightly higher for women.

These results were corroborated by a survey conducted by Areias and Guimarães[20] that sought to identify by gender, rates of mental health and psychosocial risk factors among workers at a public university. The results of this research found significant associations between mental health and gender, and between psychosocial risk factors and gender. The female subjects showed higher rates of psychosocial risk factors, work stress, and social stress than males, and had poorer mental health.

These higher levels of stress in females may relate to the fact that many women face a double workload. Specifically, women simultaneously engage in both paid service work outside the home

and service within the home. This situation is true in most Brazilian homes and also throughout the world.

However, several investigations indicate that employed women report fewer physiological symptoms, anxiety, depressive symptoms, and psychosomatic symptoms than do women who are not employed[21]. In this sense working may be beneficial to women's welfare, depending on working conditions, the quality of the organization of daily activities and subjective individual perceptions. Thus, some studies identify the need for reorganization, such as sharing of household responsibilities, as well as active public policy to facilitate family tasks, to reduce gender inequalities in health attributable to unequal distribution of family demands.

Regarding SWS factors as a function of marital status, comparisons across multiple chi-square tests for each index revealed no significant differences related to marital status of participants. However, we often observe in everyday CHA activities, and in other workers, that married life interferes with daily work practices.

According to Areias and Guimarães[20], studies show that the beneficial effects of paid work on mental health and the performance of multiple roles exceed the adverse effects. However, these beneficial effects can be reversed when negative attitudes of men towards their wives are observed in relation to paid employment, causing marital conflicts, which can increase stress factors and hamper individuals' personal and professional lives. This fact related to marital problems affects both males and females, and represents a major influence on increased stress and decreased quality of life.

Even the present study could not find significant differences in SWS that correalted with socioeconomic level. However, social level strongly influences various aspects of workers' lives. According to Cooper[22], stressors in the work environment can be categorized into six groups. One such group comprises factors intrinsic to a job, such as inadequate working conditions, work shift, working hours, payment, travel, risks, new technologies and work volume. Since wages are closely related to social level, stressor levels are higher among the working class.

As said before, health professionals have an obligation to care for users of health systems. We must remember that interaction is vital to providing care. Subjectivities also exist around the caregiver and the recipient of their care, and we can infer that the ways of life or situations of agents may interfere with care. Here we add the nature of work as described by Moreno[4], which states that the study of psychosocial aspects of work acquires public importance when changes in work organization demand emotional and cognitive work that increases the so-called psychological and mental workload. The continued coexistence of workers with traditional physical-environmental risks has highlighted certain psychosocial issues and made labor discomfort a precursor of mental pathology.

The principle of protection is useful. In the vertical relationship of protection, health policies, which implement programs for the development of a particular area, should also protect healthcare professionals since these professionals comprise the front line in healthcare provision. The allocation of public resources must meet the needs of professionals such that policy actions actually reach health service users.

Conclusions

Analysis of the effect of demographic variables, based on comparing the average frequencies associated with Psychosocial Risk Factors and Mental Health, found no significant effects of sex, age, education, socioeconomic status, employment, number of dependents, or marital status. However, correlational analysis revealed significant associations between factors. Mental health is negatively associated with stress factors — i.e., higher stress is associated with worse mental health. Stressors are also significantly associated with each other, as are mental health factors. That is, the magnitude of a given stress factor is similar to that of the other stress factors, and the level of mental health revealed by a given mental health factor resembles that revealed by any other mental health factor.

The results indicate the need for management changes in the public health sector related to Bioethics Protection, which states that populations vulnerable to work exploitation should be protected by guaranteeing minimum working conditions and thus reducing their stress.

The principle of mutual responsibility of care, i.e. caring for oneself and for others, generates considerable psychological distress in community health agents, and interferes with the quality of

care these workers provide. In this sense, worker stress levels increase, and the quality of the care they provide decreases. The quality of life of these workers also changes owing to the impacts of professional relationships, along with personal and social relationships. Thus, public subsidies are needed for new policies aimed at improving the organization and working conditions of these professionals.

Developed mainly in the twentieth-century, bioethics has become a legitimate and efficient tool for critically analyzing the morality of public health policies. According to Schramm & Kottow[1], in public health the principle of protection meets the requirements of ethics and allows the moral justification and analysis of public policies, by requiring clear identification of the objectives and authors involved in the implementation as well as the specification of appropriate execution methods. In this sense, according to Schramm[23], the bioethics of protection is seen as applying to moral conflicts involved in human practices, which may have significant irreversible effects on living organisms, particularly human populations, considered in their etiological and sociocultural contexts. Thus the bioethics of protection applications facing health professionals, such as Community Health Agents, can ensure better professional development inside and outside the work environment.

Since measures to support health professionals, related to both bioethics and bioethics of protection, will benefit both professionals and society, the relationship between these two groups is systemic and cyclical — i.e., each individual belonging to these groups is dependent on others.

References:

1. SCHRAMM FR, KOTTOW M. (2001) *Principios bioéticos en salud pública: limitaciones y propuestas*. Caderno Saúde Pública, Rio de Janeiro, 17(4): 949-956.

2. BRASIL. Ministério da Saúde. Secretaria de Atenção à Saúde. Departamento de Atenção Básica. Guia prático do agente comunitário de saúde / Ministério da Saúde, Secretaria de Atenção à Saúde, Departamento de Atenção Básica. – Brasília: Ministério da Saúde, 2009. 260 p.

3. LEPARGNEUR H. (2009) Força e Fraqueza dos Princípios da Bioética. Revista Bioética, Brasília, 4(2). [Acess in: 01 Mar. 2014] Available in: http://revistabioetica.cfm.org.br/index.php/revista_bioetica/article/view/407/370.

4. MORENO EA. (2011) Implicancias bioéticas en salud mental laboral. In: ZANELLI JC, SILVA N, TOLFO S da R. [orgs.]. *Processos psicossociais nas organizações e no trabalho*. São Paulo: Casa do Psicologo.

5. SCHRAMM FR. (2008) *Bioética da Proteção: ferramenta válida para enfrentar problemas morais na era da globalização*. Revista Bioética, 16 (1). 11-23.

6. FOUCAULT M. (1999) *La ética del cuidado de sí como práctica de la libertad. In: Estética, ética y hermenêutica: Obras esenciales, Volumen III*. Barcelona, Buenos Aires, México: Paidos, 393-417.

7. BRASIL. MINISTÉRIO DA SAÚDE. III Conferência Nacional de Saúde Mental. Relatório Final. Ministério da Saúde, Brasília, 2001.

8. GUIMARÃES LAM; GRUBITS S. (2003) Saúde Mental e Trabalho. São Paulo: Casa do Psicólogo.

9. LOPES EAAO. (2013) Programa Nacional de Melhoria do Acesso e da Qualidade na Atenção Básica e seu potencial de gerar mudanças no trabalho dos profissionais / Estela Auxiliadora Almeida Lopes; orientadora Magda Duarte dos Anjos Scherer – Brasília.

10. FERREIRA PAC, PARREIRA PM dos SD. Diferença de Géneros e a Satisfação e Stress Profissional em Enfermagem em contexto hospitalar de cardiologia. In: Rev. Latino-Am. Enfermagem. Suplemento atas do congresso internacional género(s) e saúde: (in)determinações e aproximações, 3, 2013.

11. SILVA ATC da, MENEZES PR. Esgotamento profissional e transtornos mentais comuns em agentes comunitários de saúde. **Rev. Saúde Pública**. São Paulo, 42(5), Oct. 2008.

12. BARCELLOS CSN, PANDOLFI M, MIOTTO MHMB. (2006) Perfil do Agente Comunitário de Saúde (ACS) de Vitória- ES. UFES Rev. Odontol., Vitória, 8(1): 21-28.

13. MACHADO MH. (Coord.) (1997) Os médicos no Brasil: um retrato da realidade. Rio de Janeiro: FIOCRUZ.

14. FLORES O. O agente comunitário de saúde: Caracterização da sua formação sócio-histórica como educador em saúde. Tese (doutorado) – Universidade de Brasília, Faculdade de Ciências da Saúde, Departamento de Saúde Coletica, 2007.

15. GOMES KO, COTTA RMM, CHERCHIGLIA ML, MITRE SM, BATISTA RS. A Práxis do Agente Comunitário de Saúde no Contexto do Programa Saúde da Família: reflexões estratégicas. Saúde Soc. São Paulo, 18(4), 2009, p.744-755.

16. BEZERRA AF, SANTO ACGE, FILHO MB. (2005) Concepções e práticas do agente comunitário na atenção à saúde do idoso. Revista de Saúde Pública, 39(5).

17. PANIZZON C, LUZ AMH, FENSTERSEIFER LM. Estresse da equipe de enfermagem de emergência clínica. Rev Gaúcha Enferm., Porto Alegre (RS), 2008, 29(3): 391-9

18. RAMMINGER T. (2008) Saúde do trabalhador de Saúde Mental: uma revisão dos estudos brasileiros. Saúde em Debate, rio de Janeiro, 32(78/79/80). 60-71.

19. AREIAS MEQ. (1999) Saúde mental, estresse e trabalho dos servidores de uma universidade, Tese de Doutorado, Programa de Pós Graduação em Saúde Mental da Faculdade de Ciências Médicas, Universidade Estadual de Campinas.

20. AREIAS MEQ, GUIMARÂES LAM. (2004) Gênero e estresse em trabalhadores de uma univer-sidade pública do estado de São Paulo. Psicologia em Estudo, 9(2). 255-262.

21. SANTANA VS, LOOMIS DP, NEWMAN B. (2001) Housework, paid work and physichiatric symptoms. **Revista de Saúde Pública,** 35(1). 145-150.

22. COOPER CL. (1993) Indentifyingworkplace stress: costs, benefits and the way forward. Proceeding of the European Conference on Stress at Work. Brussels: Fundation for the Improvemente of Living and Work Condition.

23. SCHRAMM F. (2011) A bioética de proteção é pertinente e legítima?. **Revista Bioética**, Brasília, v.19, n.3. [Acess in: 06 Jun. 2014]. Available in: http://revistabioetica.cfm.org.br/index.php/revista_bioetica/article/view/673/705.

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Analysis of Media Stereotypes of the Russian Image in Media Studies in the Student Audience (example: the screen versions of Jules Verne's Novel “Michael Strogoff”)

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Abstract

As a result of the analysis students come to the conclusion that the screen adaptations of Jules Verne's novel "Michael Strogoff" create, though an oversimplified and adapted to western stereotypes of perception, but a positive image of Russia – as a stronghold of European values at the Asian frontiers, a country with a severe climate, boundless Siberian spacious areas, manly and patriotic warriors, a wise monarchy. At the same time, both Jules Verne's novel and its screen adaptations contain clear-cut western pragmatism – the confidence that if a man has a proper will he can rule his destiny.

Keywords: media stereotypes; Russian image; media studies; media literacy education; film studies; students; screen; film; Michael Strogoff.

Introduction

The last bright *Cold War* movie peak fell on the early 1980s when Russians as part of the monolithic and aggressive system were portrayed as products of their environment – malicious, potent, highly revolutionary in the whole world. Nearly all Russian characters were represented definitely as agents of destruction: they were men who hated and usually threatened the American life-style. This message contained an unceasing and crystal pure demand addressed to advocates of liberty calling for their vigilance in relation to the evil Soviet system and its evil representatives (Strada, Troper 1997, 170).

But not all western films of the last century as well as the present century cultivated a negative image of Russia. Particularly, only during the last 50 years of the 20th century not less than 200 screen versions of Russian classical literature were filmed in the west that made up a fourth of the total number of films about Russia and with Russian characters. It is logical, as already since the second part of the 19th century the works of Russian classical literature produced a significant influence on the western spiritual culture. Many characters of Russian classical literature have become signs, emblems of the Russian national character, Russian soul, and

marked to a large extent the image of Russia. Generally, the western (and later, eastern) national cultures discovered ideas, images, problem collisions keeping with the times, definite circumstances and demands of these cultures in the Russian novel and the Russian culture, especially acute there proved to be the feelings of spiritual deficiency, desacralization of the world, estrangement and anonimity of the human personality... The western culture found major spiritual values; search for absolute truth, tragic depths of the human personality; opened for itself the wealth of Russian-eastern traditions in the Russian culture (Mosejko 2009, 24).

A.P. Chekhov's works have remained mostly screened in the west – his works were adapted for the screen for about 200 times. Also foreign filmmakers turned to the prose of F.M. Dostoevsky and L.N. Tolstoy – each of them inspired more than a hundred of western screen adaptations. They are followed by screen versions of A.S. Pushkin's, N.V. Gogol's, N.S. Turgenev's works (more than 50 screen adaptations for each one). With A.P. Chekhov – his plays were most often translated to the screen. With F.M. Dostoevsky – the novels *Crime and Punishment, The Idiot*, *The Brothers Karamazov and 'The Possessed*. With L.N. Tolstoy – the novels *Anna Karenina* and *War and Peace*. With N.V. Gogol – the plays *The Inspector-General* and *The Marriage* A.S. Pushkin's literary heritage is presented on the western screen in the form of the operas *Eugene Onegin* and *The Queen of Spades*.

It is logical to say in this context that the western culture sees a positive image of Russia generally in retrospect. If media images of the USSR (and now – of contemporary Russia) are apparently negative, then the virtual tsar Russia looks much more positive.

However, the western media culture is not content only with works of Russian classical literature with its deep "view from within". The West needs its own image of Russia that corresponds to the stereotyped notions of mass mentality of the "enigmatic Russian soul". In this regard, Jules Verne's novel *Michael Strogoff* (1875) is an ideal adaptation of the positive image of Russia for the western audience. The novel is set in the epoch of Alexander II. There is only one Jules Verne's novel - "20 000 Leagues Under the Sea" that can compete with *Michael Strogoff* in the number of screen adaptations. If taken together, western screen versions with plots about Russia cannot be compared with *Michael Strogoff* except for *Anna Karenina* (currently, there are more than twenty foreign screen adaptations).

It appears that the analysis of this phenomenal positive image of Russia adapted for the mass western audience will be of great benefit to students of many qualifications – future historians, political scientists, culture experts, art critics, and teachers.

Materials and methods

For the analysis of numerous screen versions of Jules Verne's novel *Michael Strogoff* I will follow the methodology worked out by U. Eco (Eco 2005, 209), A. Silverblatt (Silverblatt 2001, 80-81), L. Masterman (Masterman 1985; 1997), C. Bazalgette (Bazalgette 1995) and I will rely on such key concepts of media education as media agencies, media/media text categories, media technologies, media languages, media representations, media audiences, since all these concepts have a direct relevance to value, ideological, market, structure and content aspects of media text analysis.

It's essential to note that U. Eco's (Eco 2005, 209) and A. Silverblatt's (Silverblatt 2001, 80-81) methodology completely satisfies the basic approaches of the hermeneutical analysis of audiovisual, space-and-time structure of media texts.

It needs to be reminded that the *hermeneutic analysis of cultural context* stands for study of the media text interpretation process, of cultural and historical factors that may have an impact both on the media texts authors/agencies and the audience's viewpoint. The hermeneutic analysis is connected with the comprehension of a media text by matching with the cultural tradition and reality; penetration into the logic of a media text; media text analysis based on artistic images comparison in the historical and cultural contexts. So, the subject of the analysis is a system of media and its functioning in the society, interaction with the man, media language and its usage.

Discussion and results

The authors' ideology in the sociocultural context, market conditions that contributed to the plot, creation and success of a media text (dominant concepts: media agencies, media categories, media technologies, media representations, media audience).

Here by authors we mean both Jules Verne himself and the main creators of screen adaptations of the novel *Michael Strogoff* – Screenwriters and film directors. Jules Verne conceived the novel during the reign of Alexander II, in the short interval of 1874-1875, when Germans became most evident enemies for the French after the war between France and Germany (1870-1871). Russia looked quite positive against this background. A tough confrontation of the Crimean War (1853-1856) in which Russia confronted the coalition of the British, French and Ottoman Empires and the Sardinian Kingdom became a thing of the past, and there were still two years before the Russo-Turkish war (1877-1878).

Besides, a sustained war in Turkestan (the Bokharan khanate and the adjoining areas) waged by Russia in 1865-1881 was not regarded by the western world as a direct threat to their geopolitical interests. Moreover, Russia was seen as a certain outpost against the hostile Asian tribes that tallied with the media context of Chingis Khan's legendary raids.

Thereby, the novel *Michael Strogoff* (see one of the latest editions: Verne, 2010) was to a significant degree a response to the political and sociocultural context of 1872-1876. The novel related the adventures of an imperial courier sent by Alexander II (apparently, in the 1870s) from St. Petersburg to Siberia with an urgent message addressed to the Irkutsk governor (who was the czar's brother, in the great French novelist's version). Michael Strogoff was to warn the governor of the plot of former czar officer Ogareff who went over to the enemy – Tatars (?!) and schemed to occupy Siberia…

At the same time, J. Verne created a distinct positive image of Russia and Russian people (including the Russian Emperor and his brother) in his novel. It especially concerns the protagonist - Michael Strogoff: he is thirty, strong and vigorous, a man with a heart of gold who has coolness and courage (Verne 2010).

As for the fictional war between Russia and Tatar tribes in Siberia it was probably brought about by the author's misgiving that the western reader would have no time for looking into the cobweb of Russian relationships with numerous Central Asian countries and nations whereas the word "Tatars" - the embodiment of the aggressive and perfidious East – was known to everybody in Europe as well as the word "Siberia" which a Parisian or any other European associated with the words "Russia", "Asia", "severe frost", etc.

In 1875, the novel *Michael Strogoff* was first published piecemeal in a journal, and in 1876, it was published as a book. It had such a tremendous success that in 1880 it was staged under the same name in the Parisian theatre "Odeon" and was welcomed by the public. Then the novel was republished dozens of times in many countries including Russia (except for the Soviet period). But to tell the truth, Russian readers with their "view from within" were much less impressed by the novel: it was regarded as a primitivistic fairy-tale rather than a reflection of real Russian life (by the way, *Michael Strogoff* has never been screened either in the UUSR or in Russia). The Russian audience would always prefer other Jules Verne's novels narrating of Captain Nemo's adventures, or of a fantastic moonflight…

The first screen adaptations of *Michael Strogoff* appeared in the age of silent movies. They were short American films made in 1908, 1910 and 1914. At that time the American perception of Russia fully correlated with the French one (1874-1876) - the mass consciousness of Americans pictured it as gigantic empire with snow-covered Siberian spacious areas inhabited by wild bears where courageous Russian aristocrats fought with hostile Asians…

The events of the World War I, the Bolshevist military coup of 1917 and the subsequent civil war in Russia of 1918-1920 accompanied, as is known, by the military intervention of western countries, made *Michael Strogoff* less attractive for the media. But Russian emigrants Victor Tourjansky and Ivan Mozzhukhin who lived in Paris became authors of the most well-known screen version of *Michael Strogoff* in the epoch of silent movies. This French-German screen adaptation that stuck to the main plot of Jules Verne's novel was highly popular with the public. On the one hand, there were thousands of Russian emigrants among them who crowded European capitals in the 1920s and felt nostalgic about the epoch of the Imperial Russia. On the other hand, there were native citizens of Paris, Berlin, Vienna and London among them to whom the previous Russian epoch of the 19th century was much more appealing than the Communist "sovietdom" which ruined the centuries-old way of life. Frankly speaking, that was why none of the screen versions of *Michael Strogoff* was shown in the Soviet Union. In fact, it was impossible to see a film

on the Soviet screen with the main character who served the condemned-by-all-school-textbooks "tsarist regime" with good faith and fidelity.

The following screen adaptations of *Michael Strogoff* were made in the epoch of sound movies – in France, Germany and the USA in 1936-1937. A famous actor Akim Tamiroff – expatriate Russian – starred in the American version. It is interesting, that Nazi authorities in 1936 did not object to the positive treatment of the Russian image in the plot of *Michael Strogoff*. Being in confrontation with the USSR, especially owing to the civil war in Spain, Germany managed to release a romantic adventure story about the czar's messenger, the more so because the fictional enemies of Russia in *Michael Strogoff* had nothing to do either with western Europe, nor with the German allies of that time – Turkey and Japan.

In whole, due to the establishment of the allied coalition of the USSR, USA and Great Britain during the World War II the Russian theme in the foreign cinematograph was increasingly full of sympathy. That explains the pathos of the Mexican screen version of *Michael Strogoff* (1944).

Interest in screen adaptations of Jules Verne's novel *Michael Strogoff* was revived in the era of the Cold War. Practically together with obviously anti-Soviet films *The Girl in the Kremlin, 'The Iron Petticoat, Jet Pilot and Beast of Budapest* a French colored screen version of *Michael Strogoff* (1956) was released on western screens with Kurt Jurgens starring in the film and famous USSR emigrant Valeriy Inkizhinov (*Chingis Khan's Offspring* directed by V. Pudovkin) acting as the Tatar sovereign who contrives to conquer Siberia. And five years after there was a sort of sequel invented by Viktor Tourjansky, - *Michael Strogoff's Triumph* (1961), practically with the same cast of actors.

One should think that the events of the Soviet political "thaw" of the second half of the 1950s and the space progress of the USSR in the 1950s-1960s somehow affected the new interest in the plot of *Michael Strogoff* and actualized the Russian theme.

At the same time, the Cold War went on and, naturally, it was absolutely impossible to imagine a movie about good Russians of the Soviet period in the west. That was why the Russian theme in the positive meaning was present only in the historical subject area (we would remind you that exactly in this period Hollywood released two high budget movies with famous actors - *War and Peace* and *Anastasia*).

Still in the 1970s filmmakers of France, Italy and FRG twice screened this Jules Verne's novel, and in 1975 *Michael Strogoff* was already a television serial.

In spite of the sudden change of the political and sociocultural situation caused by the USSR downfall the western treatment of *Michael Strogoff* did not undergo any changes in the Italian-German serial of 1999 either. It was the same romantic adventure story about the Russians of the remote past...

The popularity of *Michael Strogoff* in the West was confirmed by all the three French animation versions (of 1997 and 2004) as well as by the Parisian musical (2011) based on the novel.

The structure and narrative techniques in the media text (dominant concepts: media/media text categories, media technologies, media languages, media representations)

In the course of the group discussion with students one can draw a conclusion that both the novel *Michael Strogoff* and its screen adaptations are based on simple dichotomies: the hostile and aggressive Asian world, on the one hand, and the Russian world, - exotic, but still resembling Europe, on the other hand (there is the railroad and the telegraph there, after all); 2) positive characters (officer Michael Strogoff, Emperor Alexander II and his brother, beautiful Russian girl Nadya, and many other Russians) and villains (Tatars and traitor Ivan Ogareff); 3) a desire to protect Russia from wanderers' raids (Michael Strogoff and other positive Russian characters) and aggressive schemes (Tatars, Ogareff); 4) plan and result.

Schematically, the structure, plot, representativeness, ethics, genre modification peculiarities, iconography, character sketches of the screen adaptations of *Michael Strogoff* can be represented in the following way:

Historical period, scene: the Russia of the 1870s.

Setting, household objects: luxurious chambers of St. Petersburg palaces and the khan's marquee, comfortable train compartments, modest lifestyle of Siberian victualing-houses and taverns, Russian spacious areas, forests and rivers. The household objects correspond to the social status of the characters.

Representation of reality: an emphasized positive representation of positive characters, especially of romantic czar's messenger Michael Strogoff; a subtle grotesque towards negative characters.

Characters, their values, ideas, clothing, constitution, lexicon, mime, gestures: officer Michael Strogoff and his beloved – a Siberian professor's daughter, they have common patriotic values, though their relations are not without differences in the beginning. Dictatorial and cruel Tatar khan and more cruel and perfidious traitor Ivan Ogareff have a common desire to conquer Siberia. And who can imagine Russia without bears and gypsies! In one of screen adaptations *Michael Strogoff* beats a fierce Siberian bear in a hand-to-hand fight, in another screen version a gypsy instigates the Tatar executioner not to approach very close Strogoff's eyes with a red-hot sabre in order to save his eyesight... Michael Strogoff changes gowns depending on the situation. The czar's and khan's palaces are attired with the proper luxury; military men are dressed in smart outfit, and the gypsy wears exotic clothes. Western correspondents (a Frenchman and an Englishman) are dressed in field and convenient clothes of the European style. Male characters (regardless of their nationality) are robust. Female characters are shapely and graceful. The characters' speech is plain. Their facial expression and gestures are emotional. Naturally, the voices of the negative characters are far from being pleasant unlike the voices of the positive characters.

Significant change in the plot of the media text and the characters' life: the year of 187... Emperor of All Russia Alexander II charges valiant officer Michael Strogoff with an important mission – to pass to his brother – governor of Irkutsk – a package with an important message informing him of the sinister designs of Tatars and traitor Ivan Ogareff to conquer Siberia. Michael Strogoff goes on a long journey straight away (in one of the screen versions he travels from the very beginning with the Siberian professor's daughter named Nadya, in another screen adaptation he encounters her on his way).

Incipient problem: owing to Ogareff's crafty designs Michael Strogoff is taken prisoner by the Tatar khan and is condemned by him to blinding with a red-hot sword. The realisation of Emperor's task as well as Michael Strogoff's life are under threat...

Search for solutions to the problem: in Jules Verne's novel Michael Strogoff manages to avoid blinding thanks to... tears ("at the moment of the execution, Marfa Strogoff was present, stretching out her hands towards her son. Michael gazed at her as a son would gaze at his mother, when it is for the last time. The tears, which his pride in vain endeavored to subdue, welling up from his heart, gathered under his eyelids, and volatilizing on the cornea, had saved his sight. The vapor formed by his tears interposing between the glowing saber and his eyeballs, had been sufficient to annihilate the action of the heat" (Vern 2010). In the screen adaptations Michael Strogoff is rescued not due to the scientifically substantiated laws of moisture evaporation but owing to beautiful women (the khan's concubine and the gypsy) who instigate the Tatar executioner not to press the red-hot sabre very close to Michael Strogoff's eyes.

Problem solution: Michael Strogoff manages to escape, he hands the package over to the emperor's brother and kills betrayer Ogareff. The Russians defeat Tatars...

Conclusions

Thereby, as a result of the analysis students come to the conclusion that the screen adaptations of Jules Verne's novel "Michael Strogoff" create, though an oversimplified and adapted to western stereotypes of perception, but a positive image of Russia – as a stronghold of European values at the Asian frontiers, a country with a severe climate, boundless Siberian spacious areas, manly and patriotic warriors, a wise monarchy. At the same time, both Jules Verne's novel and its screen adaptations contain clear-cut western pragmatism – the confidence that if a man has a proper will he can rule his destiny. The conformists (Ogareff's gypsy mistress) remain prisoners of the Evil Spirit. The real heroes (Michael Strogoff) are able under seemingly desperate circumstances to change their fate (and the fate of their Motherland) for the better...

The discussion is summed up with a problem-solving question checking the audience's level of the acquired skills in the hermeneutic media text analysis: "What famous media texts can one compare this work with? Why? What do they have in common?"

References

1. Bazalgette, C. (1995). *Key Aspects of Media Education*. Moscow: Association for Film Education.
2. Eco U. (1998). *Lack of Structure. Introduction to Semiology*. St. Petersburg: Petropolis, 432 p.
3. Eco U. (2005). *The Role of the Reader. Studies on the Semiotics of the Text*. St. Petersburg: Symposium, 502 p.
4. Eco, U. (1960). Narrative Structure in Fleming, p.52 in: Buono, E., Eco, U. (eds.). *The Bond Affair*. London: Macdonald.
5. Eco, U. (1976). *A Theory of Semiotics*. Bloomington: Indiana University Press.
6. Eco, U. (1995). *The Role of the Reader. Studies on the Semiotics of the Text*. St.Petersburg: Symposium.
7. Eco, U. (1998). *The missing structure. An introduction to semiology*. St.Petersburg: Petropolis.
8. Fedorov, A.V. *Transformation of Russia's image on the Western screen*. Moscow: Information for All, 2010.
9. Fedorov, A.V. (2001). *Media Education*. Rostov: CVVR.
10. Fedorov, A.V. (2003). Media Education and Media Literacy: Experts' Opinions. In: *MENTOR. A Media Education Curriculum for Teachers in the Mediterranean*. Paris: UNESCO.
11. Fedorov, A.V. (2004). The specificity of media education of students of pedagogical institutes of higher education. *Pedagogica,* 4: 43-51.
12. Fedorov, A.V. (2004). Media Educational Practices in Teacher Training. *Pedagogica,* 4: 43-51.
13. Fedorov, A.V. (2006). Media Education: Creative Tasks for Students and Schoolchildren. *Innovations in education,* 4: 175-228.
14. Fedorov, A.V. (2007). *The Development of Media Competence and Critical Thinking of Students of Pedagogical Universities*. Moscow: ICO "Information for All".
15. Fedorov, A.V. (2008). Analysis of Cultural Mythology of Media Texts in the Student Audience. *Innovations in Education*. 4: 60-80.
16. Fedorov, A.V. (2009). Comparative Analysis of Media Stereotypes of the Times of the "Cold War" and Ideological Confrontation (1946-1991). *Media Education,* 4: 62-85.
17. Fedorov, A.V. (2009). The Analysis of Cultural Mythology of Media Texts in Student Audience. *Distance and Virtual Education,* 12: 4-13.
18. Fedorov, A.V. (2010). Umberto Eco and the Semiotic Theory of Media Education. *Innovations in Education*, 5: 56-61.
19. Fedorov, A.V. (2011). *Structural Analysis of Media Texts: Stereotypes of Soviet Cinematic Image of War and V. Vinogradov's Film "Eastern Corridor"* (1966). In: *Problems of Cultural Studies,* № 6, pp.110-116.
20. Fedorov, A.V. (2011). The Virtual World of Crime: The Analysis of the Detective Genre at the Media Education Lessons in the Student Audience. *Distance and Virtual Education,* 11: 88-99.
21. Fedorov, A.V. (2012). *Analysis of Audiovisual Media Texts*. Moscow, 182 p.
22. Fedorov, A.V. (2012). The Contemporary Mass Media Education in Russia: In Search for New Theoretical Conceptions and Models. *Acta Didactica Napocensia, 1: 53-64.*
23. Masterman, L. (1985). *Teaching the Media*. London: Comedia Publishing Group.
24. Masterman, L. (1997). A Rational for Media Education. in: Kubey, R. (ed.*) Media Literacy in the Information Age*. New Brunswick (U.S.A.) and London (UK): Transaction Publishers, 15-68.
25. Mosejko, A. (2009). Transformation of the Russian Image in the West in the Context of the Culture of the last third of the 20th Century. *Social Sciences and Modern Times,* 2: 23-35.
26. Silverblatt, A. (2001). *Media Literacy*. Westport, Connecticut – London: Praeger.
27. Strada, M.J. and Troper, H.R. (1997). *Friend or Foe?: Russian in American Film and Foreign Policy*. Lanham, Md., & London: The Scarecrow Press.

Filmography

***Michael Strogoff*. USA, 1908.**

***Michael Strogoff*. USA, 1910.** Director: J. Searle Dawley. Screenwriter: J. Searle Dawley. Cast: Charles Ogle, Mary Fuller, Marc McDermott, Harold M. Shaw, et al.

***Michael Strogoff*. USA, 1914.** Director: Lloyd B. Carleton. Screenwriter: Benjamin S. Kutler. Cast: Jacob P. Adler, Daniel Makarenko, Eleanor Barry, Betty Brice, et al.

***Michel Strogoff*. France-Germany, 1926.** Director: Victor Tourjansky. Screenwriters: Boris de Fast, Victor Tourjansky, Ivan Mozzhukhin. Cast: Ivan Mozzhukhin, Nathalie Kovanko, Jeanne Brindeau, et al.

***Michel Strogoff. Der Kurier des Zaren*. France-Germany, 1936.** Directors: Jacques de Baroncelli (French version), Richard Eichberg (German version). Screenwriters: Hans Kyser, Jean Bernard-Luc. Cast: Anton Walbrook, Colette Darfeuil, Armand Bernard, et al.

***The Soldier and the Lady*. USA, 1937.** Director: George Nichols Jr. Screenwriters: Mortimer Offner, Anthony Veiller. Cast: Anton Walbrook, Elizabeth Allan, Akim Tamiroff, Margot Grahame, et al.

***Miguel Strogoff*. Mexico, 1944.** Director: Miguel M. Delgado. Screenwriters: Joseph N. Ermolieff, Mauricio Magdaleno. Cast: Julien Soler, Lupita Tovar, Julio Villarreal, et al.

***Miguel Strogof*. Brazil, 1955.** Director: Luiz Gallon. Screenwriter: J. Silvestre. Cast: Percy Aires, David Neto, Josy Parisi, Geny Prado, et al.

***Michel Strogoff*. France-Italy, 1956.** Director: Carmine Gallone. Cast: Curd Jurgens, Genevieve Page, Jacques Dacqmine, Sylva Koscina, Valery Inkijinoff, Francoise Fabian, et al.

***Le triomphe de Michel Strogoff*. France-Italy, 1961.** Director: Victor Tourjansky. Cast: Curd Jurgens, Valery Inkijinoff, et al.

***Strogoff*. Italy - France - FRG - Bulgaria, 1970.** Director: Eriprando Visconti. Screenwriters: Giampiero Bona, Ladislas Fodor. Cast: John Phillip Law, Mimsy Farmer, Hiram Keller, et al.

***Michel Strogoff*. France - Austria - Switzerland - Germany, 1975. TB.** Director: Jean-Pierre Decourt. Cast: Raimund Harmstorf, Lorenza Guerrieri, Pierre Vernier, Vernon Dobtcheff, et al.

***Michel Strogoff*. France, 1997.** TV, animation. Director and Screenwriter: Bruno-Rene Huchez.

***Michele Strogoff, il corriere dello zar*. Italy - Germany, 1999. TV.** Director: Fabrizio Costa. Screenwriters: Enrico Medioli, Patrizia Pistagnesi. Cast: Paolo Seganti, Lea Bosco, Hardy Kruger Jr., et al.

***Michel Strogoff*. France, 2004.** TV, animation. Director: Alex de Rauz Chen.

***Les aventures extraordinaires de Michel Strogoff*. France, 2004.** Directors: Alexandre Huchez, Bruno-Rene Huchez. Screenwriter: Bruno-Rene Huchez.