Dear Reader,

The structure of this year's first English issue of *OPUS* is somewhat different from the usual ones. Of course, the review includes studies that present the international work of domestic researchers, multi-author cooperation, global outlook, and professional communication related to conferences. One of these is the study by *John Mcarthy* and *Tibor Pecze Bors*, exploring the issues of career development strategies and dealing with theoretical questions connecting to the timely renewal of the domestic career choice system. The paper by *Katalin Nagy* is also worth attention; this comparative analysis examines the evidence, but in everyday practice not sufficiently recognized, the interrelation between the quality of education and economic development. The last element in the series of studies is a multi-author paper fitting in today's research trends in an expressive way; this paper by *Tibor Vámos, Rut Bars, László Keviczky a*nd *Dávid Sik* discussing management technology demonstrates this author group's intergenerational work, as well.

It so happened that this year's English issue of *OPUS* has been prepared already by the middle of spring. One of the reasons for this is that the main focus of this issue has been put on the papers of talented doctoral candidates studying in Hungary. They were speakers at the *Today and Tomorrow Education and VET* Conference at the Budapest University of Technology and Economics in November 2019. We strive to offer specific reflections when publishing the English papers of foreign doctoral candidates studying at Hungarian doctoral schools of pedagogy. The perspectives of these, the professional features of the chosen topics, and the introduced national references that are worth attention form a comparative pedagogical point of view offer an exciting outlook. The studies written by the doctoral candidates studying in Hungary within the frames of the *Stipendium Hungaricum Scholarship Programme* are directly connected to the extension of the possibilities of international professional communication. They may be inspiring for our domestic readers and authors, as well.

Following the traditions, this issue is closed by a special recension. *Gabriella Mike*'s writing about the Hungarian study volume of 2019's Today and Tomorrow Education and VET Conference, which is available electronically, as well, allows the introduction of the results of this professional – scientific forum at the international scene.

Finally, as a kind of a service announcement, let me foreshadow here our plan connecting to the crisis known in the spring of 2020: our thematic issue, which is to be published in the summer and analysis the changes that are going on in our days, exert profound impacts on the world of work and education and bear lots of dramatic elements but also open new perspectives from a professional point of view is under preparation with the title *'Digital switchover – constraints, and opportunities of innovation.'*

Budapest May 2020

András Benedek

Editor-in-chief

John McCarthy - Tibor Bors Borbély-Pecze

Aims for, and access to, career development

Introduction

The aims and access to Career Development Programmes (CD), career development services are always interconnected with social norms, values that shape society, demographical trends, the health of the national economy including the labour market, and last but not least, political goals. Guidance is a tool for social mobility but also for workfare development. It is, however, the users and policy makers who make decisions on when, how and why to use guidance services. In this thematic synthesis paper, we review the **aims, access, policy development, and ethical practice** for career guidance in the 33 countries participating in the 9th International Symposium on Career Development and Public Policy, took place in Tromso, Norway June 17-20, 2019. The country papers cover five continents, representing totally different cultures and societies, and level of economic and social development. There is no one single "best model" of career guidance service development. However, there are several previously published and available policy guides (ELGPN, 2015, OECD and EC, 2004) in the field. As Bassot, (2012) noted, career guidance services are bridges, connecting individuals, communities and societies, including the presence in the labour market. The nature and quality of these bridges differ in different social and cultural contexts and also according to the size and shape of the labour markets.

Aims (roles) and access to career development services fit within the framework of a continuously changing balance between *work first vs. train first approaches* (Brown, 1997). Human resource investment in modern societies can be defined in a *lifecycle investment framework* (Heckman, 2016) where investment in human capacities at an early age of the lifespan provides a better pay off later while early engagement with the labour market may terminate the full development of the individual's working capacity.

Citizens' view

The range of citizens' needs are manifold and these include significant concerns about how to make a living, what is the best course of preparation in education and training to make that living, how and whether to participate in or complete an education and/or training programme leading to the labour market, how to visualize and plan their futures in the immediate, short and long terms, how to manage being unemployed, how to stay longer in the workforce, how to balance their work and life and stay healthy, how to overcome personal, social and structural barriers to their participation in work and society, how to juggle different life and work roles simultaneously, how to manage increasingly precarious working conditions, whether and how to retrain when one's skills and/or job becomes obsolete, how to manage underemployment, how to stay employable, whether and how to emigrate for work, how to stay safe and healthy at work etc.

Employers' view

Employers who, along with government (which is also a major employer), control the labour market, have different needs – education and training programmes and qualifications systems that are tailored to their needs, an employment and legal framework that suits their needs, an economic environment (including taxation policy) that supports their business maintenance and development, workers with the right knowledge, skills, including digital and motivation who are competent and adaptable, and possess qualities such as independence, initiative taking, communication, team work, problem solving, responsibility etc. Citizens and employers have mainly different though complementary interests and needs, and governments try to meet both sets of needs through different policy instruments of which the provision of career guidance to citizens is a central one. Career guidance provision is in many senses the fulcrum, the point of balance and/or mediation between both sets of needs and interests but also

supporting both sets of interests in continuous tension. Given such interests, how is career guidance referenced in policy terms, especially in the education and employment sectors? How does this play out in the provision of services and access to such services? What roles, if any, do the key stakeholders, the public and employers, play in the development of policy and services? How do career practitioners manage to balance the often-competing sets of interests?

The aims of career guidance

How career guidance is understood within the policy domain was examined in the OECD (2004) international review of policies for career guidance which noted the belief of policy makers that career guidance contributes to the efficiency and effectiveness of labour markets and of educational systems as well as contributing to social equity[1]. The goals of career guidance are not just centred on the individual, families and community groups; they also concern public policy objectives which the OECD categorized into learning, labour market and social equity goals. Such goals change over time in different countries in response to current issues and developments. Country responses on the aims of career guidance (International Symposium 2019) reflect public policy goals mentioned in the OECD (2004) review but additionally reflect those of a wider range of countries (OECD and non-OECD), and over double the number of countries (OECD 2003 - 14 countries; International Symposium 2019 - 33 countries). On this occasion, country responses on the aims of career guidance may be divided into two general categories: aims that view career guidance as a means to an end (policy instrument) in education, employment, and social inclusion policies; and aims that describe initiatives to improving the functioning of the career guidance system itself (functional). The majority of responses viewed career guidance as a policy instrument that contributes significantly to education, training, and, especially, labour market outcomes. The results are presented in two tables below.

Table 1: ***Summary of aims for career guidance*** (policy instrument)

SKILLS: Addressing skills mismatching (MN, RS, LK, KH, EG, ENG)   Addressing skills shortages (KH, IE, EG, ENG, SCT, JP)   Supporting the upskilling and continuous upskilling of the workforce (EE, HU, LU, NO, SG)   Supporting reskilling (HU, SG)   Supporting the development and adaptability of the skills of the workforce to meet the needs and requirements of the labour market (AT, CA, CH)   Helping to improving the capacity and quality of the workforce, especially the low-skilled (CH, DE)   Supporting the development of the national capacity of skills (SY)   Helping to improve the supply of skilled workers (CH)
LABOUR MARKET: Addressing labour market and economic needs (HR)   Improving rural productivity (IN)   Supporting increased productivity at work (ENG)   Supporting labour/workforce development (SG, LK)   Improving the relationship between education/training programmes and outcomes and the needs and demands of the labour market (HR, QA, SY)   Aiding a better balance between labour market demand and supply (NL, XK, TN)   Supporting labour market adaptability (EG, SCT) in a volatile labour market

---

[1] Key indicators of the efficiency of labour markets include employment rates, employment status and progression, unemployment rates and duration, labour force participation rates, labour force costs as well as labour productivity. Key indicators of educational efficiency include participation, retention, progression, performance, and transitions. Indicators of social equity include education and labour force participation of different population segments, income, access to education and training, at risk of poverty, long-term unemployment.

Supporting workforce adaptability for multiple work transitions (NO)

Increasing the competitiveness of the workforce (EE)

Supporting sustainable integration in the labour market (CH)

Supporting re-entry to the labour market of returners, unemployed and long-term unemployed (AT, CA, IN)

Supporting older adults to stay in the workforce longer (AT)

Supporting a competent and adaptable workforce (SG)

Supporting employers' search for workers (SG)

Supporting an inclusive labour market – older workers, refugees, migrants, low-skilled, disabled (AT, NL)

Improving labour market information (EG)

EMPLOYMENT AND EMPLOYABILITY

Supporting sustained employment and employability (CH, LU) to work longer (AT, NL, SG)

Support labour market adaptability of citizens (EG, FR, SCT)

Helping adults to make multiple career transitions successfully (NO)

Enhancing lifelong learning (AT, NL, QA, SG) and career adaptability (QA)

Promoting citizen wellbeing in a lifelong learning society (KR)

Supporting the maintenance of employability (CH)

Preventing and reducing long-term unemployment (DE) and unemployment (EG, XK)

Promote the economic integration of all citizens (FR)

Supporting female labour market participation (IN)

Supporting early school leavers (CL)

Supporting long-term unemployed to overcome barriers e.g. poverty, to enter the workforce (CA)

Supporting transitions from informal to formal employment (IN)

Supporting youth transitions from unemployment to employment (GH)

Promote the rights of workers, job seekers, and retirees (USA)

Increase the employment rate, especially of youth (GH, RS, SCT)

Assist in job placement activities (CL) and in matching unemployed with existing jobs (NL)

Supporting employers in their hiring activities (SG)

Informing employers and policymakers about qualifications (TN)

Assisting the unemployed (MN)

Assisting the migration of rural workers to urban centres (MN)

Supporting emigration and immigration for work (SG)

Improving labour market information (EG)

SUPPORTING INNOVATION AND ENTREPRENEURSHIP

CL, IN

PREPARATION FOR THE WORLD OF WORK

Changing people's attitudes to jobs (LK)

Encouraging people to seek work in the private sector than in the public sector (LK)

Supporting engagement with STEM careers (ENG)

Increasing the career awareness of young people (EE)

Informing students of the realities of existing labour market opportunities (DE, EG, JP)

Helping young people to plan and to make realistic and good labour market choices (MN, NO)

Helping students to become competent career planners (FR, KH, JP, SG)

Preparing students for a complex future labour market (NL, SG)

Supporting successful transitions from education to employment (CA, DE, FI, FR, XK, NL)

Supporting better allocations of students to education and training programmes (XK)

Promoting lifelong learning (NL)

Supporting youth and parents (TN) Teaching career management skills (AT, RS, SCT) Helping young people to make the right choice first time (DK) Support emigration and immigration for work (SG) Support international student mobility (FR) Prepare people to work in a more culturally diverse workforce and society (JP) Prepare people to work in a society where AI increasingly eliminates jobs (JP) Change people's attitude to life/work balance, especially the value of being present at work for long hours in male dominated corporate culture (JP) Prepare people to manage precarious working conditions with low pay, temporary jobs, and with increasing income disparity (JP)
SUPPORTING TRANSITIONS TO HIGHER EDUCATION CA, CL,
PROMOTING VOCATIONAL EDUCATION AND TRAINING (VET, TVET) Supporting greater participation in VET (AT, DK, HU, IE, LK, XK, JP)
IMPROVING EDUCATION PARTICIPATION AND PERFORMANCE Preventing and reducing school dropout (DE, DK, EE, GH, KH, NL, NO) and early school leaving (HU) Reducing higher education dropout (DE) Support the efficiency of the education and training system (EG) – equality of attainment and achievement (SCT) Promote the rights of all to education (USA)
SOCIAL INCLUSION Supporting social mobility for young people in areas of disadvantage (ENG, FR) Supporting active citizenship (FI, SG) Supporting an inclusive society (SCT, SG) Supporting social inclusion (FI) of marginalized groups (EG, HU) Social integration of all members of society, especially the poor, the vulnerable, and the rural (GH, RS, SY) Supporting social equity of vulnerable groups e.g. disabled (QA) Supporting the reduction of poverty (GH) Reduce inequalities (FR) Fight against discrimination and stereotypes (FR) Educational and occupational integration as a key to social integration (DE) Social and economic integration of immigrants and refugees (NO)

From Table 1 above, the following observations can be made:

- The majority of the aims presented for career guidance were in support of labour market and employment policies, addressing the needs of employers and of the workforce. These aims were framed in terms of the skills needs of employers (skills shortages, upskilling and reskilling of the workforce, skills mismatches); labour market workforce development (adaptability, multiple transitions, productivity, staying longer in the workforce, inclusive labour market); employment and employability of the workforce (lifelong learning, maintaining employability, supporting employers and job placement, overcoming barriers to enter or re-enter the workforce, supporting youth employment, supporting migration, emigration and immigration for work). Two countries referenced the role of career guidance in supporting entrepreneurship.

- The second largest category of responses concerned the role of career guidance in preparing people for the world of work. These mainly concerned educating young people about the realities of the labour market, preparing people to participate in a more complex and diverse working world that include precarious working conditions, the elimination of jobs through AI, more culturally diverse workforce, and a better work/life balance. They were also concerned with helping young people to visualize and plan pathways to the labour market through education and training, changing attitudes to certain jobs (including STEM) and to education and training for these jobs, supporting transitions to higher education and from education to employment, and educating for international student mobility and emigration.
- Improving educational efficiency (student retention, participation and performance) was viewed as a key aim of career guidance in one third of countries' responses.
- The role of career guidance in improving participation rates in VET/TVET was mentioned by several countries.
- The third largest category of responses concerned the role of career guidance in supporting social inclusion policies. The poor, the rural, the disabled, the immigrants and refugees, and those living in areas of disadvantage were specifically mentioned as vulnerable groups that could benefit from such support.

In the country responses, career guidance, from a citizen perspective, is firmly rooted in labour market integration, navigation, and survival; in the successful undertaking of pathways to the labour market; and in overcoming barriers to labour market participation. For employers, career guidance functions to answer their skills needs and to provide them with a trained and competent workforce for the duration of their business lives.

The *functional* aims of career guidance reported by countries are represented in Table 2.

Table 2: ***Summary of aims for career guidance*** (functional)

Improving quality of career guidance system (FI, NO)
Developing digital access for citizens (NO)
Broadening access for immigrants and refugees (NO)
Improving career learning in schools (NO, RS, XK), in higher education (DK, FI, FR, RS), in VET (FI, NL), and in youth centres (XK)
Improving access to career guidance (FI, FR, IN)
Improving labour market information collection and dissemination (IN), including on line provision (XK)
Developing the professionalization of career practitioners (FI, XK)
Strengthening people's self-agency/personal agency to manage their work lives (FI, KR)
Help service users to make good decisions and transitions (SI)

The functional aims concern issues of improving access to career learning (school, higher education, VET, youth centres, immigrant and refugees, online), quality issues (e.g. the training of career practitioners, the provision of labour market information), and content issues (development of self-agency).

Access

The delivery models of career guidance services have traditionally been based in second level schools in most countries, in the public employment services (PES) in other countries, or in a combination of both, all such approaches supported by some form of policy framework. In the case of developing countries, the first initiatives in the development of services are often undertaken by NGOs with the support of external donors, and in the absence of a policy framework. There are relatively few studies of public access to career guidance, the most notable of which is the special Eurobarometer (2014) focusing on skills and qualifications which surveyed 27,998 citizens across 28 EU countries. In that survey, 45% of respondents reported as not using career guidance because they did not have access

to such services while 71% agreed that such services would be useful to help choose the right course of study.

The following table presents an overview of country responses to the question of access to services:

Table 3: *Access to career guidance provision for population segments*

POPULATION GROUP	FREE ACCESS	LEGAL ENTITLEMENT
School students	AT, CA, CH, CL, DE, DK, HR, IE, IN, ENG, EE, FI, FR, HU, KH, KR, LK, LU, MN, NL, NO, QA, RS, SCT, SG, SI, TN, USA, XK	DE, FI, FR, ENG, IE, KR, NO, RS
Higher Education students	AT, CA, CH, DE, DK, HR, IE, KR, EG, ENG, FI, FR, GH, HU, KH, LK, LU, MN, NO, RS, SCT, SG, SI, USA, XK	DE, FR, KR, RS
VET/TVET students	AT, DE, DK, EG, FI, FR, GH, HU, IE, KR, LU, MN, NL, NO, RS, SCT, SG, SI, XK	DE, FR, KR, RS
Unemployed (PES)	AT, CA, CL, DE, DK, HR, ENG, EE, FR, HU, IE, IN, KH, KR, NL, NO, QA, SI, SY, LU, MN, RS, SCT, SG, TN, USA, XK	DE, FR, KR, RS
Employed (PES)	AT, DE, DK, EE, FI, FR, HU, KR, LK, LU, RS, SCT, SG, SI	DE, FR, KR, RS
Adult Guidance Service Users	DK, FR, HR, IE, FI, NO, USA	FR
Youth Centre users	EG, FI, FR, LU, JP, USA	FI, FR
NGO service users	GH,	
Special groups (NEETs, immigrants, refugees, low-skilled, minorities)	AT, CA, CH, CL, DK, FR, HR, JP, KR, LU, ENG, RS, SCT, USA, XK	
E-Guidance/Online services for all age or target groups	DE, DK, ENG, FR, IN, NO, SCT	
Employers	ENG, SG	

School, higher education students, VET/TVET students, and the unemployed appear as the most frequently mentioned categories of the population that are beneficiaries of career guidance provision. But the table does not tell the full story, for example, career guidance provision exists in only 5% of schools in India and a similar low percentage exists for Cambodia. In Egypt, career guidance is provided in only 25% of VET/TVET schools.

In some countries, access to provision is a legal entitlement of all citizens (DE, FR, KR) or of a segment of the population (ENG, FI, IE). However, even when a legal entitlement exists, the reality of provision can vary hugely. For example, in schools in Finland, the ratio of guidance counsellor to students is 1:300

which enables meaningful access to provision whereas in England and Ireland no such ratio exists which makes access more difficult and limited. Unrealistic career guidance staff to client ratios and insufficient time for career guidance were also mentioned as access barriers in a study of career guidance in the public employment services (PES) in 28 European countries (Sultana and Watts, 2006). A further issue is the professionalization of actors (Table 2). In France, for example, the principal teachers who are responsible for career guidance in schools receive no training for that role! Even if one had good access and good professionalism, career learning cannot be achieved without good information about labour market opportunities and occupations and the learning pathways to these (mentioned in Tables 1 and 2). One can safely say that Table 3 above describes theoretical access to career guidance. The reality of provision is quite different, as referenced in the Eurobarometer (2014) survey.

There was wide variety in country responses concerning which segments of the population were excluded from access or who had the most difficulties in obtaining access as shown in Table 4.

Table 4: ***Segments of the population excluded from or having significant difficulties in accessing career guidance***

Indigenous	CL
Older adults	CL
HE graduates	CL, HU, SY
Highly specialized professionals	CL
Rural	AT, CA, IN, LK, USA
Incarcerated	USA
Undocumented immigrants	USA
Disadvantaged, poor in some districts	CA, LK, USA
Unregistered unemployed	SY
Private sector employees	DE, EG, SY
Pensioners	HU, SI
Tribal	IN
Ethnic groups	JP
Religious minorities	JP
Women (on career break)	IN, (QA), LK
By language	CA
Self-employed	NL
Persons with temporary employment contracts	NL
Older adults	DE, EG, NL, QA
Migrants and refugees	AT, NL
Low skilled	AT, EG, NL

Disabled	NL
Employers	TN
Parents	TN
Young adults in career transition	EG, QA
Adults in SMEs	DE, EG, QA
VET/TVET students	QA
Long-term unemployed	AT, EG
Early school leavers	EG, LK
School students	EG

People living in rural areas and adults of all age groups, especially with educational and other disadvantages, appeared to have greater access difficulties. Table 4 above provides a useful checklist for countries considering how to have more inclusive policies and systems for career guidance.

Conclusions on aims and access
When one looks at the policy aims (Table 1) and access (Tables 3 and 4), there seems to be a significant mismatch between the policy expectations of career guidance and the means to their achievement. Given that one's workforce life is expected to be at least 40 years and longer, and to consist of multiple transitions including opportunity and time for reskilling, and of periods of unemployment, the need for support services such as career guidance for adult workers and for employers increases exponentially. The development of E-guidance centres for all age guidance provision (Table 3) is a step in this direction. More attention needs to be paid to the quality and quantity of career learning activities to prepare the workforce of the future. Finally, providing career guidance support to employers, especially those who own SMEs and the self-employed, hardly figures at all in Table 3 and is in stark contrast with the expectations in Table 1. This is a real blind spot. If career guidance provision cannot make itself relevant to address employers' needs and those of the labour market in general, it loses its status as a contributor to workforce maintenance and development.

Public consultation on the policy and practice of guidance
In the past 25 years there has been a shift by public bodies to involving stakeholders in policy and systems development. This shift is based on the belief that the public and other stakeholders who will be impacted by a public policy can help to contextualise the policy, to highlight the multiplicity and complexity of factors that affect the successful implementation of the policy, and to identify the agreements and conflicts of different stakeholder groups (Helbig et al., 2015). Engagement with stakeholders is more likely produce more and better policy options and implementation actions as well as increased ownership (public trust and endorsement) of the policy and implementation actions by the relevant stakeholders. The use of customer satisfaction surveys for services and products, based in marketing research, has a longer history than public policy consultation. These have been evaluation tools by nature with a view to improving services and products and have latterly been used by public services to improve their efficiency and effectiveness. Their usage across private and public sectors has been enhanced and increased by the arrival of the internet.

How have public policy consultation and customer feedback been used to develop relevant policies and practices for career guidance? To what extent are the opinions of the public and service users

collected and used in the development of policies and practice for career guidance? How are stakeholders involved, if at all? The following table provides some of the answers:

Table 5: *Consultation of the public on policies and systems for guidance*

CONSULTATION METHOD	POLICY DEVELOPMENT AND COORDINATION	DELIVERY ORGANISATION/SERVICE LEVEL
Online	FR, IN, JP, NL, RS, SCT, XK	CA, FI
Public hearings/panels	NL, SG	
Customer/client survey, (including of employers)		AT, CA, CH, DE, DK, FI, FR, HR, IE, ENG, JP, NL, NO, SCT, (DE)
Researched case studies		ENG
National Forum for Guidance	EE, IE, NO	
Student feedback		CA, EE, EG, FI, HU, NL, QA, SCT, SY
Youth Voice census		ENG
The Recommendation Index		EE
Graduate destination data		ENG, FI
Complaints Box		SY
Stakeholder meetings, including NGOs	AT, FR	GH, MN, QA, SCT, SG, SY, XK
Inspectorate		IE, NL
National survey		CH, IE
Policy and system reviews	FI, GH, IE	
Advisory bodies	FR	
Monitoring committees	FR	
Regional Economic, Social and Environmental Council	FR	
Equality Impact Assessment	SCT	
Academic (PhD) research		SCT
Co-designing and concept testing with user groups		SCT
School self-evaluation		JP, NO

Table 5 presents a very mixed picture:

- Less than half of countries used mechanisms for stakeholder involvement in policy development and coordination. These mainly took the form of online input and of stakeholder meetings. In only few of those countries have they been used for improving policies for career guidance.
- In over 66% of countries, some form of customer feedback was sought on the delivery of career guidance services but only for some different career guidance service settings. The remaining countries have not yet started to collect such data.
- In all, twenty-one different methods of consultation and data collection were identified. Some countries e.g. Scotland, use a broad mix of data collection and consultation methods.

The content of Table 5 deserves some further elaboration. In Korea, the government recommends that career guidance delivery organisations/institutions should consult with potential users but there is no evidence that this has ever taken place. In India, online policy consultation exists but there is no evidence on what citizen input has been collected and how it has been used. In Canada, there is online consultation to develop labour market information products, but the public has not been made aware of this possibility.

In Germany and Japan, user evaluations of public career services are collected and published annually. In Germany, feedback is sought from employers. Sometimes the evaluations are part of general institutional (e.g. school) evaluations (EG, IE, JP). There are some good examples of practice. In Germany and Scotland, products and services are developed through co-designing with potential user groups, and in Germany, persons with good suggestions are rewarded. In Finland, student feedback has motivated the development of better and more integrated services. However, as several countries (e.g. AT, IE) concluded, there is no consistent strategy, within and across sectors, to collect user opinions in order to improve policies and services for career guidance.

There are many well-known reasons why customer feedback is important: improving product and service design and making them more relevant to customers; improving customer experience; building customer loyalty by making them feel that their opinions are valued; increasing word of mouth advertising and personal recommendations; and making business decisions about the products and services one provides. Good practice in public consultation on policies and services for career guidance requires a clear purpose of engagement, resources for engaging with the public, an appropriate methodology (mix of methods) of engagement, a plan on how and when to incorporate stakeholder input, information for stakeholders on how their input will be used or not, and feedback on its use (Helbig et al., 2015).

While the shift to policy consultation with stakeholders is relatively new and varies in effect across political cultures, it is quite surprising how under-developed customer feedback approaches are for a service such as career guidance which presents itself as client-centred and with a wide range of stakeholders including employers. The lack of attention to this feature of service provision evaluation may have contributed over the years to the underdevelopment of access to the service and to the mixed reputation of the service in many countries where it has been established over a longer time period.

Ethical practice in career guidance work
One of the tensions in the work of career guidance practitioners is how to balance the sometimes-competing needs of the individual, the labour market, and of government employment policy, where it exists. This occurs in its more acute forms in countries with government-funded organisations such as public employment services (PES), when unemployed persons have labour market aspirations for occupations where there is no demand, and especially where career guidance is provided as part of

active labour market policies with the emphasis and priority on forcing an unemployed individual to take whatever occupation is in demand or available. In some countries, public employment service staff are given targets of getting unemployed people into work and off unemployment benefit and the focus is on fulfilling these targets rather than assisting people to develop a life/work project. This also applies where public employment services coerce or influence unemployed people to undertake VET/TVET programmes in which they have no interest and/or aptitude, where the priorities are course participation targets, meeting the needs of course providers, and getting people off the unemployment register, rather than any consideration of the individual concerned. In less acute forms, this balancing act occurs where career guidance practitioners employed by an education or training provider undertake a recruitment role, trying to influence potential students/trainees to participate in a training programme in which they have no interest/aptitude, with the sole intention of meeting the recruitment needs and targets of the training provider. Organisations e.g. government-funded education and training institutions and public employment services, have missions, roles and values. Sometimes their intent is not impartial, and this may not be obvious or transparent to the service user. Many career practitioners are employed by such state-funded organisations and sometimes experience moral dilemmas between their professional beliefs and values and those of their employer or the employers' work programme or the organisation's funder's policy. A similar but different set of dilemmas are faced by career practitioners working in countries where the demand for employment and training opportunities far exceeds the actual supply of such opportunities and where emigration for work is a key release valve for pressure on local labour markets. In a 'slack 'or loose labour market, where job seekers vastly outnumber the job opportunities available, as often is the case in developing economies, the unemployed and employees have very little choice in shaping their occupational futures and in making career moves. Many are willing to accept training or job opportunities that might not match their interests, abilities, and educational level simply because there is no other way for them to make a livelihood or to get a foothold in the workforce. This can lead to significant underemployment.

To help career practitioners cope with dilemmas of conflicting interests of clients, organizations, employment policy, and employment and training opportunities, codes of ethics for career practitioners have been developed. Most of these enshrine the principles of autonomy (freedom of thinking and action), promoting beneficence (the welfare of the client), and avoiding maleficence (causing harm). The following table summarises country responses on the existence of codes of ethics:

Table 6: *Codes of ethics for career practitioners*

Code of Ethics for Career Practitioners	Established by a Professional Association	Provided by a Statutory Body or Organisation	Other Origin	Makes Reference to Dilemmas Caused by Policy Demands and Labour Market Signals
CA, DE, DK, ENG, FR, SCT, EE, FI, HR, HU, IE, JP, KR, NO, SG, USA	CA, DE, DK, ENG, FR, SCT, EE, FI, HU, IE, JP, KR, NO, SG, USA	DE, FR, HR, NO, SCT	CH, HR, NL	DE, DK, ENG, NO, SCT

Just over half of countries have codes of ethics for career practitioners or codes that that include career practitioners. Most of these have been developed by professional associations. Few of them make specific reference to career counselling ethical dilemmas, and there is no strict monitoring of implementation (SG). Such codes have been developed mainly in countries where career guidance

programmes and services have existed for many years. However, as the USA response points out, affiliation to professional associations is not mandatory. Such codes are most likely not recognized by policymakers and may not have legal standing. Labour market signals are sometimes passed on by state organisations and employer bodies to professional associations to bring to the attention of their members (e.g. IE, SG) and can be included formally or informally in career interventions (e.g. Skills Planning Model, SCT).

Conclusions

Career development programmes and services are mainly deployed by political decisions to support the actual socio-economic needs of different countries through education and employment policies and systems, and through social inclusion policies. These goals are usually set in written strategies by governments but not only. The aims of career guidance services can be rooted in these master strategies (e.g. national economic and social development, education and labour market efficiency, human resource development, social inclusion, sustainable development etc.). What we are observing when reading different country responses are socio-political processes manifested in career guidance service design and delivery. In many countries, policies and services are being developed without public input; resources provided are inadequate; the gaps between expectations from and access to services are huge. On the other hand, public and other stakeholder recognition of the value of such services is high. New ways have to be found and old and new ways used to transform public recognition into relevant and adequate policies, services, and practices.

References

- Bassot, B. (2012*) Career learning and development: a social constructivist model for the twenty-first century*, International Journal of Educational and Vocational Guidance, 12(1) pp.31-42.

- Brown, A. (1997) *Work First. How to implement an employment focused approach to welfare reform,* Manpower Demonstration Research Corporation
- ELGPN (2015) *Guidelines for policies and systems development for lifelong guidance.* Jyvaskala: ELGPN
- European Commission (2014) *Eurobarometer - European area of skills and qualifications*, no. 417, (April-May 2014) June 2014, Brussels
- Heckman, J. J. (2016) *Human Development is Economic Development*. Larger Community Foundations Conference, San Diego
- Helbig, N., Dawes, S., Dzhusupova, Z., Klievink, B. and Mkude, C. (2015) *Stakeholder engagement in policy development: Observations and lessons from international experience* in Janssen, M., Wimmer, M., and Deljoo,A. (eds). (2015) *Policy, Practice, and Digital Science: Integrating Complex Systems, Social Simulation and Public Administration in Policy Research* Switzerland: Springer International Publishing
- OECD (2004) *Bridging the gap*, Paris: OECD
- OECD and the European Commission (2004) *Career guidance: a handbook for policymakers*. Paris: OECD
- Sultana R. & Watts, A.G. (2006) *Career Guidance in Europe's Public Employment Services: Trends and Challenges.* Brussels: Directorate-General for Employment, Social Affairs and Equal Opportunities, European Commission.

Katalin Nagy

Enhancing economic development via the increase of the quality of education

Introduction

Sustainable economic development is one of the major concerns of actual economic policy. In order to achieve this end, standard economic theory is aiming at identifying the major factors contributing to economic development. Economic policy has the task to work out the modalities to fostering the increase of these factors.

One of the major factors to contribute to economic development is human capital. However, while the channels via which human capital affects economic development are quite well described, the quantification of these effects is far less obvious. Especially, the quantitative effect of the quality of human capital on economic development is still an open question.

Economic policy provides pragmatic answers on how to enhance economic development on the grounds of economic models. There are two extreme answers. One extremity is considering the investments into human capital solely as private investment regardless of the positive externalities for the society. The return of this investment is calculated exactly like in the case of all other investments along the net present value of the expected discounted pay-offs. The other extremity is considering investments into human capital as investment in the development (better future) of the society. As the returns of such investments are hardly calculable, investments into human capital are not to be determined on the grounds of financial considerations.

In this paper, we overview the channels via which the quality of professors' work affects human capital and hence economic development. We do not intend to quantify these effects here, as we take granted that the increase of the quality or quantity in human capital results in higher productivity and hence higher economic growth.

In order to do so, in the first chapter we overview the channels identified in the literature via which education affects human capital. These channels are basically twofold: on the one hand, education contributes to individual productivity increase (human capital increase), on the other hand education contributes to a better distribution of labor force in the society (screening theory). In a second chapter, we consider the attempts to measure human capital. The quantification implies arbitrary choices, which are determined by the precise question to be answered relative to the economic development. In a third chapter, we briefly sketch some considerations to enhance the quality increase in education, which goes in pair with an increase in human capital and economic development.

The nexus of economic development, human capital and education

Adam Smith (1776, 2008) seems to be the first classical economist who has dealt with the link between economic growth, human capital and education. For Smith, the primary source of all wealth is labor. Trade contributes to increasing wealth only inasmuch it allows for specialization and hence for productivity increase. As, by hypothesis, the price of all commodities including factors of production are determined by the law of supply and demand of commodities, the price of factors of production reflects productivity of these factors. This general principle applied to the different labors regulates labor supply: "When any expensive machine is erected, the extraordinary work to be performed by it before it is worn out, it must be expected, will replace the capital laid out upon it, with at least the ordinary profits. A man educated at the expense of much labour and time to any of those employments which require extraordinary dexterity and skill, may be compared to one of those expensive machines. The work which he learns to perform, it must be expected, over and above the usual wages of common

labour, will replace to him the whole expense of his education, with at least the ordinary profits of an equally valuable capital. It must do this, too, in a reasonable time, regard being had to the very uncertain duration of human life, in the same manner as to the more certain duration of the machine. The difference between the wages of skilled labour and those of common labour is founded upon this principle." (Smith 2008, 145).

However, subsidies injected into the education of some areas of profession results in the decrease of the production costs of labor supply in these professions and hence to the increase of labor supply, which results in a decrease in wages in these professions: "The difference between the earnings of a common labourer and those of a well employed lawyer or physician, is evidently much greater than that between the ordinary profits in any two different branches of trade. (Smith 2008, 159). In professions in which there are no benefices, such as law and physic, if an equal proportion of people were educated at the public expense, the competition would soon be so great as to sink very much their pecuniary reward. It might then not be worth any man's while to educate his son to either of those professions at his own expense. (Smith 2008, 187). Men of letters are pretty much in the situation which lawyers and physicians probably would be in upon the foregoing supposition. In every part of Europe the greater part of them have been educated for the church, but have been hindered by different reasons from entering into holy orders. They have generally, therefore, been educated at the public expense, and their numbers are everywhere so great as commonly to reduce the price of their labour to a very paltry recompense." (Smith 2008,188).

It is worthwhile to add that if positive externalities exist in some professions, subsidizing these professions is a logical political economic step from the point of view of the overall society. However, the magnitude of the subsidies to converge toward an optimal situation is not an easy task to determine.

Gary Becker (1975) was the first to make an attempt to quantifying the investment in human capital via education in order to assess on the one hand its returns and on the other hand to explain the wage differences on the grounds of differences in human capital. In his work, he treats education solely as a private investment in human capital and tries to identify the explicit and opportunity costs of education. The major part of opportunity costs is the not realized earnings from eventual employment during the education period. In evidence, the results of returns from education largely depend on the estimated opportunity costs, on the discount factor to calculate the net present value and on the time period taken into consideration.

To sum up, the standard logic to explain differences in wealth accumulation is that different productivity implies different returns (wages). In competitive equilibrium the reverse is also true: wage difference reflects differences in productivity. Education contributes to productivity, hence education is necessary.

However, the nexus different wage - different productivity is not questioned, the role of education is challenged by some novel theories. (See i.e Polónyi 2011.) Namely, even if education does not contribute to productivity increase of single individuals, it contributes to increasing overall productivity because it screens individuals of different productivity and hence contributes to signaling to the employers the productivity differences. This screening is possible because the efforts spent for heterogeneous agents to obtain the same diploma is different. Those who have higher productivity have comparative advantage to obtain diplomas.

As to education, the message of screening theories and that of standard theory are diametrically the opposite. Screening theories suggest that the quality of education is secondary, because the relevant signal is the efforts spent to obtain a diploma. Standard theories are of the opposite opinion: the quality of education is the primary factor for productivity increase. In the first case, politics should not spend on increasing the quality of education, in the second case these investments are primordial to

enhance economic development. In evidence, the truth lies somewhere between the two extreme standpoints: human capital may increase both in quality and quantity.

Nevertheless, it seems that politics follows rather Friedrich List's idea on the modalities to develop human capital via education. Namely, education is a so important factor in economic development that a nation should renounce of some advantages in the present to be able to assure adequate education in exchange of accelerated growth in the future: „All expenditure in the instruction of youth, the promotion of justice, defence of nations, &c. is a consumption of present values for the behoof of the productive powers. The greatest portion of the consumption of a nation is used for the education of the future generation, for promotion and nourishment of the future national productive powers." (List 1909, 109)

Empirical evidence suggests that,the more educated one is, he has more capital, the yield of which is expressed in the higher productivity of work." (Thünen 1875)

Measuring human capital

Even if we accept the quite reasonable logical chain that more education results in more human capital and hence faster economic development, it is still not clear how to enhance effectively the growth in human capital. For any efficiency measure, we must determine the magnitude of human capital. To do so, there are basically two ways: the costs based and the cash-flow based (capitalization) method.

The cost based measure of human capital determines the magnitude of human capital by adding up all the costs incurred. The first attempt to quantify human capital on the lines of this principle is the work of Ernst Engel (See Zimmerman 1932). He considered 27 years' costs incurred to bring up a man. He simply supposed that education costs increase annually by a constant rate. Put aside the necessarily arbitrary nature of the calculus that affects all calculations to determine the magnitude of human capital (e.x.: time period; estimates of costs) the major drawback of this method that it cannot take into account quality differences: there is not necessarily connection between a man's market value and its production costs.

In principle, the cash-flow based determination of the magnitude of human capital may precisely define a man's market value. However, the market value of human capital is not necessarily in connection with the productivity of human capital. The first attempt to quantify human capital on the lines of the principle of capitalization is the work of William Farr (1853). The value of a man is the net present value of his or her estimated earnings in the future.

Schultz (1983) warns that one must be careful with the determination of the magnitude of human capital. For, a great part of what is generally considered as consumption is in fact investment in human capital.

He also indicates the dangers of focusing exclusively to human capital, because the structure of capital - human and other - is also an important factor in economic development. If human capital does not keep up developing with other capitals, or vice versa, economic development slows down. The equilibrated increase in human capital requires the adequate development in:
- health care facilities and services that affect people's lifespan, endurance and vitality
- on-the-job training;
- formal: elementary, secondary and tertiary education;
- adult education and lifelong learning programs;

The migration of individuals and families in order to adapt to changing job opportunities. The assessment of investments in human capital in order to effectively enhance economic development in a country are generally executed in the following ways in practice:
- determination of the link between education costs and wage increase in a country for a period;
- estimation of the education sector to the GDP;
- comparative studies between countries along indicators like enrollment rate and GDP (Harbison-Myers, 1966).

The effect of the quality of education on human capital

As we have seen in the previous points, there are evident difficulties to measuring human capital and the effects of human capital on economic development. These difficulties do not mean however that one must renounce of the attempts of measuring these effects. We have also seen that the proposition stating that the quality of education significantly contributes to the increase of human capital and of economic development is generally accepted. The problem is hence to determine the modalities to enhance the increase of the quality of the education (Rivkin et al. 2005)

According to several empirical researches (Hanushek and Woessmann 2010, Lee and Barro 2001, Dolton and Marcenaro-Gutierrez 2010), there is a strong positive connection between the quality of education (measured by the results of the students) and the salary of professors in general.

Naturally, the conclusion from this observation is not that if professors' salary is increased the quality of human capital will also increase. This depends on many factors. According to the first McKinsey report (McKinsey&Company, 2007), these factors are:

- adequate people are aiming at becoming professor;
- successful formation to become professors;
- each child have access to the best quality education.

In order to enhance the reform of the educational system to fulfil these requirements one must focus on the following tasks (OECD, 2011):

- the process of entering in teacher training and the quality of teacher training itself;
- the system of professional development of teachers;
- the assessment of the quality of pedagogical work, feedback about the work, the possibilities of teachers' development and career path with easy to follow quality assessment.

The commitment of teachers to a particular reform. These policy advices are based on the findings of some researches that the quality of the education mainly depends on the personality of the professor (Teachers Matter, 2005), and less on the number of students in the class, on the equipment or on the overall expenditures on education. (Rikvin et al, 2005). This said, the most trustful indicators for measuring the quality of education are the indicators that measure the competences of the professors. In order to attract individuals with strong competences required for the profession of education, competitive wages are required. However, competitive wages may represent a great burden, because the wage-share in the education sector is extremely high; it is about 85%. (Sági and Varga, 2012))

As an example, in Hungary in 2003 the wages in kindergartens and in primary schools were 70% of the wages in other professions with the same level of education. This number has gradually declined to 60% till 2009. In secondary schools, the same data for the same period is 10 percent point higher (80% and 70%). The gap between the wages in the education and in other professions with the same level of education increases also with the time spent in the profession. (Sági -Varga 2012)

In addition to the quality of the work carried out by professors, another important factor that determines the quality of the education is the quality of the management in the education sector. The quality increase of the management in the education sector has a multiplicative effect on the quality increase of the education because of strong positive externalities. (Halász, 1966)

Conclusion

One of the main factors of economic development is human capital. The positive effect of human capital on economic development and growth acts through two channels: on the one hand, the increase in individual human capital results in higher productivity per worker, on the other hand, the optimal social organization of labor stemming from the comparative advantage of different human capitals ends up also in higher productivity. An important factor contributing to the increase in human capital is education both in quantity and quality. The quality of education largely depends on the

quality of the professors; according to the latest researches other factors play secondary role. However, one must not forget about the strong effect of the quality of the management in the education sector either, which acts through a great number of positive externalities.

In practical considerations wages play central role. If externalities are not taken into account in a world with perfect information, wages reflect productivity. In the real world however, the education sector is far from this theoretical situation: the existence of positive externalities seem to justify government interventions aiming at raising wages in this sector. Doing so, governments try to make this profession more attractive to increase via the quality of professor economic development.

References

- Becker, G. (1975): Human Capital. *The University of Chicago Press*, Chicago.
- Chevalier, A. and P. Dolton (2004): The Labour Market for Teachers, *Centre for Economic Research Working Paper* Series.
- Dolton, P. (1990) 'The economics of UK teacher supply: the graduate's decision,*' Economic Journal*, pp. 100.
- Dolton, P., and O D. Marcenaro-Gutierrez. (2010). "*If you pay peanuts do you get monkeys? A cross country analysis of teacher pay and pupil performance*." Mimeo. London: Royal Holloway College, University of London.
- Halász, G. (1966): A vezetés fejlesztése és az oktatás minősége. In.: Szabó Imre (szerk.), *Vezetésfejlesztés és vezetőképzés a közoktatásban*, Okker, Budapest, pp. 10-17.
- Hanushek, E. A. – L. Woessmann (2010): The Economics of International Differences in Educational Achievement. *National Bureau of Economic Research* Working Paper http://www.nber.org/papers/w15949.pdf.
- Harbison, F. H. – Ch. A. Myers (1964): *Education, Manpower and Economic Growth: Strategies of Human Resources Development* - McGrawe Hill, New York – Toronto – London.
- Lee, J-H, - R. J. Barr (2001). Schooling quality in a cross-section of countries. *Economica* 68, no. 272.
- McKinsey&Company (2008) – M. Barber – M. Maursched: How the World's Best-Performing School Systems Come Out on Top? *Journal of Educational Change* volume 9, pp. 317–320.
- Rivkin, S. G. – E. A. Hanushek, - J. F. Kain (2005): Teachers, schools, and academic achievement, *Econometrica*.
- Sági, M and V. Júlia (2012) Pedagógusok. In: Balazs É., Kocsis M. & Vágó I. (eds) *Jelentés a magyar közoktatásról 2010*. Budapest, OFI, pp. 295–324.
- Teachers Matter (2005) *Attracting, developing and retaining effective teachers,* OECD.
- Teachers Matter (2011): *Attracting, Developing and Retaining Effective Teachers, Pointers for Policy Development,* OECD.
- Varga, J. (1998): Oktatás-gazdaságtan. *Közgazdasági Szemle*, Budapest.
- Wolter, S. C. – Denzler, S. (2004): Wage Elasticity of the Teacher Supply in Switzerland. *Brussels Economic Review* 47 (3)/ pp. 387-408.
- Smith, A. (2008): *Wealth of Nations (1776)*. The Electric Book Company, London, pp. 145.
- Polónyi I. (2011): Az oktatás és az oktatáspolitika közgazdasági ideológiái. *Educatio* No. 1.
- List, Friedrich: *The National System of Political Economy*. London: Longmans, Green and Co., 1909.
- Thünen von, H. (1968): Costs of Education as Formation of Human Capital. 1875. Megjelent: Bowman, M. J. (szerk.): *Readings in the Economic Education*. UNESCO, Paris

Tibor Vámos – László Keviczky–Ruth Bars – Dávid Sik

Methodology of Teaching the First Control Course

Introduction

System view, understanding systems and how they are controlled is an important discipline in engineering education. Systems are all around us. Basic knowledge about them is important for everybody. Engineers need deep knowledge enabling analysis and design of control systems. Nowadays considering the ever increasing knowledge, the explosion of information available at the internet, the available visual technics and software tools there is a need to revisit the content and the teaching methodology of the first control course.

Considering the software supporting the control courses basically we can observe three directions.

a) Developing programming knowledge and new high level tools for solving control problems.
b) Application of ready program modules and applications (Guzmán et al., 2006, 2014). Here the common platform (Java, C, Matlab, etc) and harmonizing of the different operation systems (Windows, Unix, OS X) should be ensured.
c) Exploratory style using MATLAB. We encourage and guide the students to solve control problems using basic knowledge in MATLAB.

In our experience we prefer method c./ for which we published lecture notes (Keviczky et al. 2019b) providing collection of well chosen exercises. Ready program modules (point b./) are also applied mainly for demonstration and visualization.

A basic control course held for software engineering students at the Budapest University of Technology and Economics in the spring semester, 2019 covered the topics of analysis and design of continuous and discrete control systems. The content of the course and the teaching methodology were overviewed to respond to the challenges of the new teaching environment. A new aspect in the content of the course is the introduction of the YOULA parameterized controller design, which is a very effective method. The other controller algorithms can be considered as special cases of YOULA parameterization.

Considering the teaching methodology we tried to explain the main disciplines in an understandable way to everybody and then going into the precise mathematical description. Some interactive demonstrations presented during the lectures could provide the joy of understanding. Active participation of the students was ensured by problem solving at the end of the lectures and by the computer laboratory exercises using software MATLAB/SIMULINK. The students can contribute to the teaching material by elaborating their own case studies about a system and its control.

Content of a first control course

The course discusses analysis and design of both continuous and discrete linear control systems. Nowadays discrete control systems gain increasing importance in computer control of industrial processes. It is shown how well elaborated methods for investigation of continuous control systems can be imported to the discrete environment. Real systems are generally nonlinear, which can be handled individually. For analysis of linear systems there are general methods. Therefore it is expedient to linearize the systems in a given environment and apply control methods using the linearized models of the systems. Input/output models and also state space models are used to describe the systems. The control system should ensure the required prescribed performance of the plant. The controller is designed considering the model of the plant and the quality specifications. Controller design methods are discussed both for input/output models and state space models.

8 lectures have been elaborated and are available in ppt form covering the following topics:

1. Lecture: Introduction. Systems and control everywhere. System and their models. Analysis methods of continuous time linear systems.
2. Lecture: Analysis in the frequency domain. Relations between the time, Laplace operator and frequency domain.
3. Lecture: Feedback control systems. Stability analysis. Quality specifications formulated in the time and in the frequency domain. Control structures improving disturbance rejection. PID controller design.
4. Lecture: State space representation.
5. Lecture: Controllability, observability, state feedback, state estimation.
6. Lecture: Sampled-data (discrete) control systems. Analysis in the time- and in the z-operator domain.
7. Lecture: Description of discrete systems in the frequency domain. Relation to the continuous frequency functions. Discrete PID controller design. Discrete state equations. State feedback, state estimation.
8. Lecture: Control of discrete systems with time delay. Youla parameterization. Smith predictor. Dead-beat control. Outlook.

The lectures are available in English and in Hungarian at web-site
https://www.aut.bme.hu/Course/szabtech

Recently published Springer textbooks (Keviczky et al., 2019a, 2019b) support the learning process. We refer also to the textbook of Åström and Murray (2008) available on the internet.

About the methodology of teaching the first control course
In the 3 hours of the lectures 2 hours are devoted for lecturing and presentation, in the next hour the students solve problems and then get immediate feedback of the solutions. For good solutions they get extra points considered in the results of the tests. Besides, during the semester they have to fulfill a project designing continuous and discrete controller for a given plant.

Besides these lectures two problem solving lectures support the students in preparing for the tests. Every second week the students solve MATLAB/SIMULINK exercises with the guidance of the teacher.

In the learning process it is important to understand the basic concepts and analyze the behavior of the systems with appropriate methods in order to design their control.

Besides listening to the presentations visual interactive demonstrations have a convincing strength while providing also the joy of learning. Active problem solving using software MATLAB/SIMULINK means learning by doing, while hopefully the students get some expert knowledge in analysis and design of control systems.

Levels of understanding, sysbook platform, interactive demonstrations
Systems and control are all around us.

System view, understanding systems and how they are controlled is important for everyone. The behavior of systems and the basic ideas of their control are determined by some fundamental principles which can be understood by everyone. The idea of T. Vámos dating back for 20 years was to present the main principles governing systems and control on different levels, for everyone, for students, for control experts (Vámos et al., 1999, 2016, 2018, Benedek et al. 2019). Nowadays there is an ever increasing demand to explain these concepts to everyone, simply and especially for non-engineering students (Albertos and Mareels, 2010).

A multi-level e-book has been developed by T. Vámos and coworkers available at http://sysbook.sztaki.hu/.

The first level – knowledge for everyone (Fig. 1.) appears in cartoon like form with explanations.
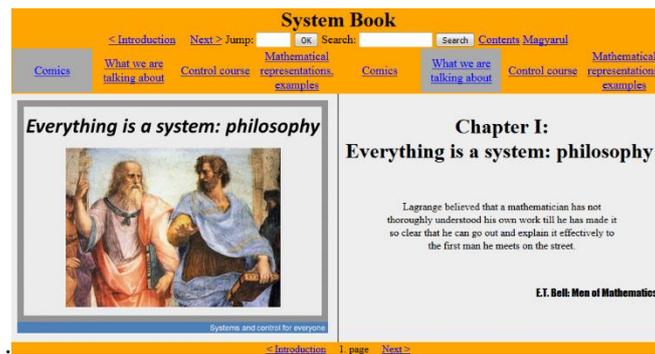

Fig. 1. *Ideas about systems can be explained for everyone*

The second level gives deeper explanations with mathematical descriptions. Some animations and interactive (Java) files demonstrate the main concepts. During the lectures these parts of Sysbook are used for demonstration.

As examples Fig. 2 demonstrates that control of some systems can be a difficult task. A rod balanced by the juggler is an unstable plant, the so-called inverted pendulum. Taking a shower requires appropriate actions when changing the position of the taps considering the time delay of the process. Driving a car should avoid a number of disturbances when following the road and keeping the speed. Control is based on negative feedback, compares the measured output variable with its reference value, and uses the difference to modify the input variable of the system.
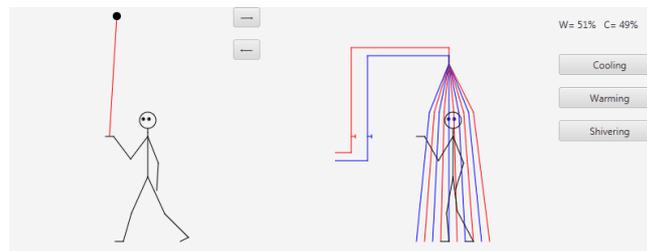

Fig. 2. *Basic control idea: negative feedback. Control of difficult systems is a sophisticated task*.

Analysis of systems in the time and in the frequency domain and their relationship is illustrated by an interactive demonstration shown in Fig. 3. It presents that taking more sinusoidal components in the periodic input signal the output of the system will be better approximated by the sum of the individual output components. So from the frequency response consequences can be made for the time response of a system.

Figure 4 shows an interactive file where the step response and the frequency response of a system can be shown. The parameters of the system can be changed and the responses are visualized.
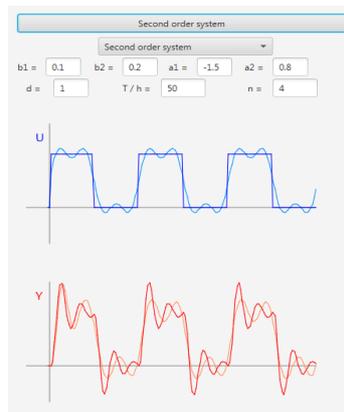
Fig. 3. *Demonstration of the relationship between the time and the frequency domain*
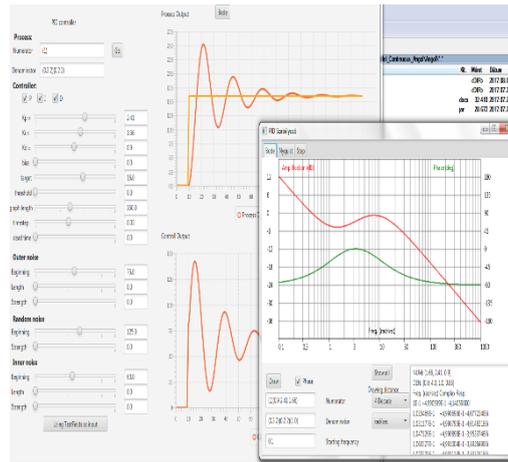
Fig. 4. *Time and frequency responses of a system*

Several control algorithms are discussed. Their behavior is demonstrated analyzing how the system tracks the reference signal, how it rejects the effect of the disturbances, how parameter uncertainties influence the performance, what is the effect of the filters. Figure 5 demonstrates the behavior of the YOULA parameterized controller.

We refer here also to the interactive tools developed by Guzmán et al. (2006, 2014) for PID controller design.

New paradigm in the basic control course: youla parameterization
As a new feature YOULA parameterization has been introduced as an essential control idea in the basic control course (Keviczky and Bányász, 2015). This approach follows in a straightforward way from the basic feedback control idea and provides good properties for the control system especially in case of big dead time. The introduction of this paradigm is shown in the sequel.
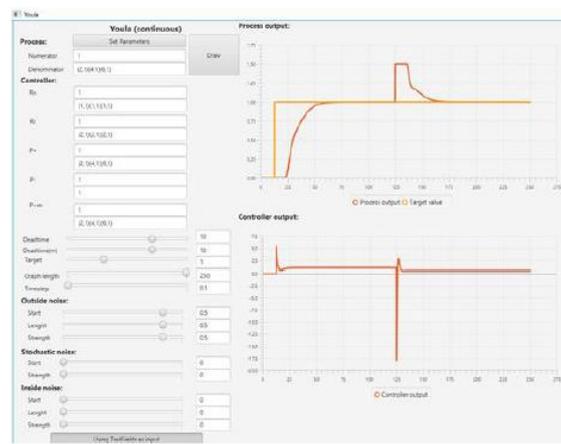
Fig. 5. *Interactive file demonstrating the behavior of YOULA parameterized controller*

In the theoretical part of the curriculum properties of negative feedback, the basic control principle are discussed. The block diagram of the control structure is shown on Fig. 6, where *P* is the model of the plant to be controlled, *C* is the algorithm of the controller and *F* is the input filter.
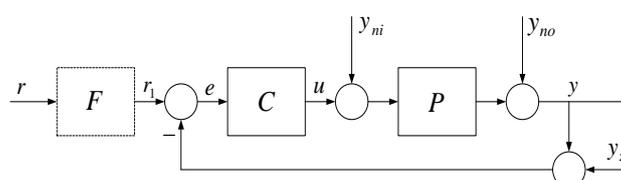

Fig. 6. *Control is realized by negative feedback*

This structure is effective ensuring reference signal tracking and disturbance rejection. The controller *C* is designed for the model of the plant considering the quality specifications. The most frequently applied algorithm is PID controller.

Supposing a unity filter *F* an equivalent structure between the output *y* and the input *r* is given on Fig. 7. Q is called the YOULA parameter. Reference signal tracking would be ideal if the Q controller would realize the inverse of the process model.
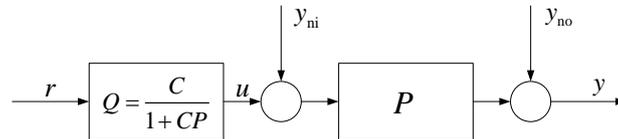
Fig. 7. *Equivalent control structure with the YOULA parameter*

This structure can not reject the effect of the disturbances. Therefore it is enhanced with Internal Model Control (IMC) (Garcia and Morari, 1982) according to Fig. 8.

YOULA parameterized control can be used to control stable processes.

Generally the inverse of the process can not be realized. The process model *P* should be separated to the invertible P_+ part whose poles can be cancelled and to the non-invertible part $\overline{P}_-$ which contains the dead time and the non-cancellable poles. The YOULA parameter realizes the inverse of the invertible part of the process model (Fig. 9.).
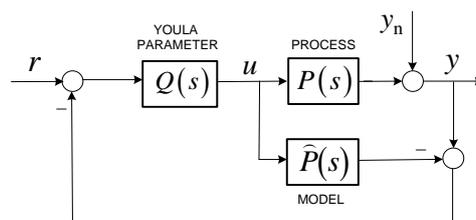
Fig. 8. *YOULA parameterized control with IMC*
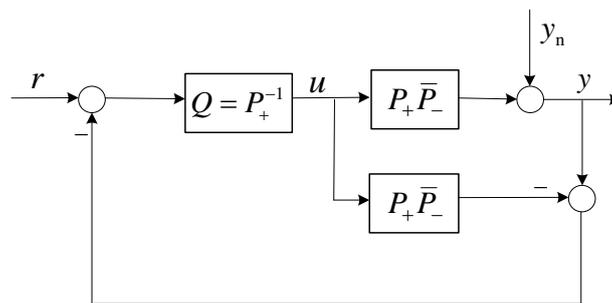
Fig. 9. *Realizable YOULA parameterized control*

This structure can be enhanced by the R_r reference and R_n disturbance filters according to Fig. 10.
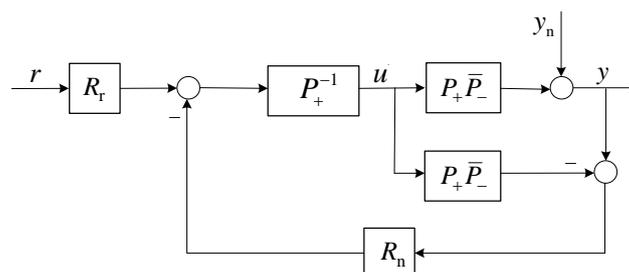
Fig. 10. *YOULA parameterized control enhanced with filters*

133

The role of the filters is threefold: the dynamics of reference signal tracking and disturbance rejection can be different, the maximum value of the control signal u can be restricted, and by appropriate choice of the filters the control system can be made more robust, i.e. more insensitive to model uncertainties.

This structure can be applied both for continuous and discrete systems. For discrete systems the pulse transfer function is denoted by G.

Figure 11 shows the output and control signals for control of a discrete second order system with big dead time when cancelling the whole dynamics. Oscillations in the control signal will cause intersampling oscillations in the output signal, while reaching the required reference value in the sampling points. Figure 12 gives the signals when only the invertible part is inverted in the controller. It is seen that the control performance became calm. Here filters were not applied.

It is shown that other control algorithms as PID, Smith predictor, dead-beat control can be considered as special cases of the YOULA parameterized algorithm.

The YOULA parameterized algorithm is especially effective when the process contains big dead time, and with appropriate design of the filters it is less sensitive to parameter uncertainties than the other algorithms.
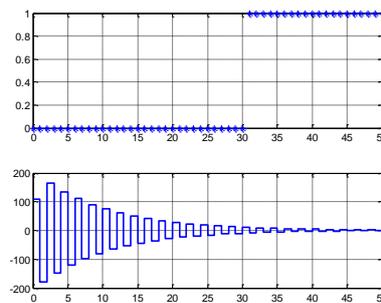
Fig. 11. *Output and control signals when the YOULA parameter cancels the whole dynamics*
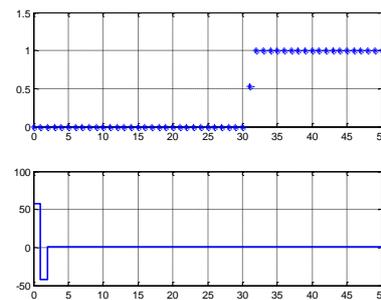
Fig. 12. *Output and control signals when the YOULA parameter cancels only the invertible part of the model*

Matlab/simulink computer exercises
The basic software applied in the computer laboratories is MATLAB/SIMULINK. The students get some expertise in applying analysis and synthesis methods in problem solving.

A MATLAB exercise description gives a short summary of the considered topic and then provides the examples from the simplest to the more complex ones. A MATLAB exercise related to a given topic can be executed within a two hour time frame and provides the knowledge for further individual work in the given topic. The students generally do not get a ready program, they have to build it command by command. This way they have to think over and understand the analysis or design procedure step by step. Based on these computer exercises every student has to be prepared to solve basic control

problems and to solve his/her homework project. The MATLAB exercises cover the following topics: Introduction to MATLAB/SIMULINK and to the control toolbox. Properties and characteristics of typical control elements in the time and in the frequency domain. Stability analysis. PID controller design. State space description. Controllability, observability. State feedback, state estimation. Sampled data control systems. Z-transform and pulse transfer functions. Controller design based on the Youla parametrization. Discrete PID controller design. Smith predictor. Dead beat control. In some cases the problem is solved using MATLAB, then a SIMULINK program is built to simulate the behaviour of the control system. In some cases a core program is given for a specific problem and the student give the input data and running the program they evaluate the behaviour of the system.

As an example the core program of the discrete YOULA parameterization is presented in the sequel.

```
% Youla_discrete basic program
display('... Q='),Q=minreal(Rn/Gp,0.0001)
display('... C='),C=minreal(Q/(1-Q*G),0.0001)
display('... L='),L=minreal(C*G,0.0001)
display('...Tr='),Tr=minreal((Rr/Rn)*Q*G,0.0001)
display('..Ur='),Ur=minreal((Rr/Rn)*Q,0.0001)
pause
t=0:Ts:50;
figure(1)
yr=step(Tr,t);
subplot(211), plot(t,yr,'*'),grid
ur=step(Ur,t);
subplot(212), stairs(t,ur),grid
pause;
display('.....Sn='),Sn=minreal((1-Q*G),0.0001)
display('.....Un='),Un=minreal(-C*(1-Q*G,0.0001)
pause
figure(2)
yn=step(Sn,t);
subplot(211),plot(t,yn,'*'),grid;
un=step(Un,t);
subplot(212),stairs(t,un),grid;
```
Then give the second order process, the sampling time, its separation and the filters in MATLAB,

```
clear; clc; s=zpk('s')
P=1/((1+5*s)*(1+10*s))
Ts=1; z=zpk('z',Ts); G1=c2d(P,Ts)
G=G1*z^(-30)
Gm=1;    %G₋
Gp=G1/Gm        %G₊
Rr=1/z; Rn=1/z;
```
and call the program. The behaviour of the algorithm can be investigated with different separation and with different filters. The SIMULINK diagram can be built enabling analysis of intersampling behaviour as well.

The MATLAB exercises are given in Keviczky et al. (2019b).

Open content development - student case studies

Nowadays in education a new teaching – learning paradigm is Open Content Development (OCD) which means active participation of the teachers and students creating an up-to-date teaching material. This project runs at the Department of Technical Education at the Budapest University of Technology and Economics since 2015 supported by the Hungarian Academy of Sciences. In the frame of vocational

teacher training programs several so-called micro-contents have been developed. Utilizing the experiences of these pilot efforts this approach seemed to be fruitful also in basic control education.

The Sysbook platform has been connected to the OCD model. In a special surface Sysbook provides several case studies for systems and their control (e.g. driving, energy production and distribution, oil refinery, systems and control in the living organism, etc.). Teachers and students studying systems and control can elaborate new case studies in their areas of interest which means active application of the learned topics. After evaluation these projects can be uploaded in the student area of Sysbook.

The system chosen by the learner for analysis is modelled and its control aspects are also considered. In the different examples it is investigated, what is considered a system, how is the system connected to its environment, what are the input signals and what are the output signals? What happens between them? How can this be described mathematically? What are the requirements set for the system? Which balance and energy considerations have to be applied? Can we control the system? How to control the system?

Till now some uploaded student projects are temperature control of a terrarium, speed control, model of the blood circulation and the respiratory system, the model of building a house, organising sport activity in the school, etc. (Fig. 13.)

Fig. 13. *Some student projects*

Later on the student's will be able to rate and comment on each other contribution to the Sysbook. The evaluation of the students can be made with the Sysbook's cooperation with a Moodle based course. This evaluation environment gives some very useful tools for creating and evaluating questionnaire: automatic timer control, different types of questions and feedback about the results.

The system open for the participating students/learners and educators is accessible through the research web page (www.ocd.bme.hu); the page also contains Bring Your Own Device (BYOD) approaches that serve the methodological support of the innovations implemented within the open system.

Conclusion

In the methodology of teaching a basic control course the motivation of the students can be increased by active participation in the learning process, including interactive demonstration of the principles, solving exercises at the end of the lectures and getting immediate feedback, solving analysis and synthesis problems in the computer laboratories, and developing their own case studies for Sysbook in OCD framework.

It should be also emphasized that the examples of systems and their control should be chosen mainly from the area of the specialization of the students (electrical or software engineering, chemical engineering, biology, economics, etc. (A. Leva, 2016)). Also it is important to provide real-time experiments in laboratory work or using distant laboratories. IFAC Repository would be also of great help reaching useful resources.

REFERENCES

- Albertos, P., Mareels, I. (2010). *Feedback and Control for Everyone.* Springer.
- Åström, K. J., Murray, R.M. (2008). *Feedback Systems: An Introduction for Scientists and Engineers.*
- Princeton University Press, http://www.cds.caltech.edu/~murray/books/AM05/pdf/am08-complete_22Feb09.pdf
- Benedek A., Vámos T., Bars R., Sik D. (2019). Open Content Development Applied in Learning Systems and Control, *European Control Conference (ECC).* Nápoly, Italy. pp. 3059-3064.
- Garcia, C.E., Morari, M.: Internal Model Control 1. A Unifying Review and Some New Results (1982). *Industrial & Engineering Chemistry Process Design and Development,* 21 (2): 308–323.
- Guzmán, J. Luis, Hägglund, T., Åström, K. J., Dormido, S., Berenguel, M. and Piquet, Y. (2014). *Understanding PID design through interactive tools.* 19th IFAC World Congress, Cape Town.
- Guzmán, J. Luis, Åström, K. J., Dormido, S., Hägglund, T., Piquet, Y. (2006). *Interactive Learning Modules for PID Control.* IFAC Proceedings Volumes 39(6): 7-12.
- Keviczky, L., Bars, R., Hetthéssy, J., Bányász, Cs. (2019a). *Control Engineering.* Springer.
- Keviczky, L., Bars, R., Hetthéssy, J., Bányász, Cs. (2019b). *Control Engineering: MATLAB Exercises.* Springer.
- Keviczky, L., Bányász, Cs. (2015). *Two-Degree-of-Freedom Control Systems, The Youla Parameterization Approach*, Academic Press, Elsevier.
- Leva, A. (2018). Teaching PID control to computer engineers: a step to fill a cultural gap (2018). *11th IFAC Symp. on Advances in Control Education, ACE'2016*, Bratislava, Slovakia, IFAC-PapersOnline Vol. 51, Issue 4, pp. 328-333.
- Vámos, T., Bokor J. and Hangos, K. (1999). Systems - governing principles and multimedia /CD/. *14th IFAC World Congress*, Beijing, China, PT-5, p. 79. Plenary lecture.
- Vámos, T., Bars, R. and Sik, D. (2016). Bird's Eye View on Systems and Control – General View and Case Studies. *11th IFAC Symp. on Advances in Control Education, ACE'2016*, Bratislava, Slovakia, IFAC-PapersOnline Vol. 49, Issue 6, pp. 274-279.
- Vámos, T., Keviczky, L., Bars, R., Benedek, A., Sik D. (2018). An Introductory Overview About Systems and Control: A Motivation Lecture in Control Education. *26th Mediterranean Conference on Control and Automation (MED'2018).* Zadar, Croatia.

Anna Lᴇʜᴏꜰᴇʀ

Decrypting Historical Ciphers - A Way of Mathematical Competence Development

Improving Mathematical Competences

The need and importance of developing key competences already entered public thinking in the early 1990s. On the World Conference on Education, in 1990, the following thought was communicated as a basic learning need: "Every person − child, youth and adult − shall be able to benefit from educational opportunities designed to meet their basic learning needs. These needs comprise both essential learning tools (such as literacy, oral expression, numeracy, and problem-solving) and the basic learning content (such as knowledge, skills, values, and attitudes) required by human beings to be able to survive, to develop their full capacities, to live and work in dignity, to participate fully in the development, to improve the quality of their lives, to make informed decisions, and to continue learning (World Declaration on Education for All, 1990, p. 3)." Although it was not yet the explicit wording of the need for competence development, the direction was marked out already in 1990.

If we try to find a definition of key competences, we will find many. Many professionals, from many points of view, interpret the notion in different ways. A study about key competences says: "there is no universal definition of the notion of 'key competence.' Despite the differing conceptualization and interpretation of the term, the majority of experts seem to agree that for competence to deserve attributes such as 'key,' 'core,' 'essential' or 'basic,' it must be necessary and beneficial to any individual and society as a whole. It must enable an individual to successfully integrate into several social networks while remaining independent and personally effective in familiar as well as new and unpredictable settings. And, since all settings are subject to change, a key competence must enable people to constantly update their knowledge and skills to keep abreast of fresh developments (Key competences, 2002, p. 14)."

According to the OECD PISA framework, the basic eight mathematical competences are mathematical thinking skill, mathematical argumentation skill; modeling skill; problem posing and solving skill; representation skill; symbolic, formal and technical skill, communication skill, aids, and tools skill. This is a non-hierarchical list of general mathematical skills that are relevant and appropriate to all levels of education. This list includes the following elements and short descriptions (OECD, 1999, p. 43):

- *Mathematical thinking skill.* This includes posing questions characteristic of mathematics ("Is there...?", "If so, how many?", "How do we find...?"); knowing the kinds of answers that mathematics offers to such questions; distinguishing between different kinds of statements (definitions, theorems, conjectures, hypotheses, examples, conditioned assertions); and understanding and handling the extent and limits of given mathematical concepts.
- *Mathematical argumentation skill*. This includes knowing what mathematical proofs are and how they differ from other kinds of mathematical reasoning, following and assessing chains of mathematical arguments of different types, possessing a feel for heuristics ("What can(not) happen, and why?"), and creating mathematical arguments.
- *Modelling skill.* This includes structuring the field or situation to be modeled; "mathematizing" (translating "reality" into mathematical structures); "de-mathematizing" (interpreting mathematical models in terms of "reality"); working with a mathematical model; validating the model; reflecting, analyzing and offering a critique of a model and its results; communicating about the model and its results (including the limitations of such results); and monitoring and controlling the modeling process.

- *Problem posing and solving skills.* This includes posing, formulating, and defining different kinds of mathematical problems ("pure," "applied," "open-ended," and "closed"); and solving different kinds of mathematical problems in a variety of ways.

- *Representation skill.* This includes decoding, interpreting, and distinguishing between different forms of representation of mathematical objects and situations and the interrelationships between the

various representations; choosing, and switching between different forms of representation, according to situation and purpose.

- *Symbolic, formal and technical skill.* This includes: decoding and interpreting symbolic and formal language and understanding its relationship to natural language, translating from natural language to symbolic/formal language, handling statements and expressions containing symbols and formulae, using variables, solving equations, and undertaking calculations.

- *Communication skill.* This includes expressing oneself, in a variety of ways, on matters with mathematical content, in oral as well as in written form, and understanding others' written or oral statements about such matters.
- *Aids and tools skill.* This includes knowing about and being able to make use of, various aids and tools (including information technology tools) that may assist mathematical activity, and knowing about the limitations of such aids and tools.

Among these mathematical competences, especially mathematical thinking skills, problem posing and solving skill, representation skill, symbolic, formal, and technical skills can be improved by classical ciphers in a very effective and spectacular way. In the following, we will corroborate this statement by demonstrating different encryption types on real historical ciphers.

Beyond the relationship between mathematical competences and historical cryptology, due to the interdisciplinary feature of cryptology, classical ciphers are appropriate to improve linguistic, historical, and IT skills as well.

Improving Mathematical Competences with Classical Ciphers

According to the definitions of Craig P. Bauer, cryptography is the science of creating cipher systems. Cryptanalysis is the science and art of breaking ciphers (deciphering without the key). Cryptology embraces both cryptography and cryptanalysis (Bauer, 2013, xix).

Somehow we have to draw a line between classical and modern cryptology. This line is usually drawn somewhere around World War II. Classical cryptography includes the systems and methods introduced before World War II. Many of these systems are still in use (mostly by amateurs), but for the most part, they have been replaced by methods that make use of computers (Bauer, 2013, xxi): this phase is called modern cryptology. According to the less formal definition, classical (or historical) cryptography contains encryption methods that can be decrypted with pencil and paper, i.e., codebreakers do not need a computer to solve them. In contrast, the puzzles of modern cryptology can typically be created and solved by a computer-aided process.

We know about attempts to introduce cryptology into public education. Still, these are typically higher educational instances, and most of these higher educational cases deal with modern cryptology, not the historical part of cryptography and cryptanalysis.

These historical ciphers are sometimes so easy to solve, that even primary school students can understand the encryption and decryption methodologies. However, sometimes even these easy types of historical ciphers remain unsolved, and besides the simpler types of ciphers, there are cipher types that are very challenging to crack. For instance, historians, linguistics, mathematicians, and IT professionals preoccupy with the encryption method of homophonic substitution ciphers even today. Thus a very wide age group (from elementary school to adults/professionals) can be affected and interested in this way of mathematical competence development.

In the following, three different cipher types of the early modern age will be presented with the short demonstration of decryption methods as well. We are moving from simpler cases to more complex ones, which simultaneously points from a simpler mathematical toolbar to a more complex one. With this series of historical examples, we would like to corroborate the statement that historical ciphers are pronouncedly suitable for introducing various mathematical methodologies and can entertain younger and elder audiences evenly.

Simple Substitution Cipher

A simple substitution cipher takes a letter of an alphabet and substitutes it with another letter (or number or any kind of symbol). The ciphertext is generated by this simple substitution process. A plaintext character will be replaced by the same ciphertext character during the entire ciphertext. Since only one code alphabet is used to encrypt the plaintext message, it is usually called a monoalphabetic cipher.

Let us see a historical example from the early modern age. This letter was written around 1664-1668 in connection with the Wesselényi conspiracy in an encrypted way[1].
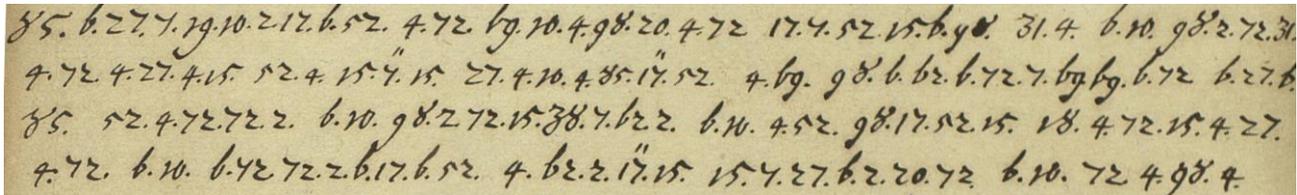

*Figure 1 - **Excerpt from the simple substitution cipher***

If we want to decrypt this message, the first thing we have to do is to count the different code characters. After this counting process, we will know how many different code characters does the message use and how long the encrypted text is. This 750 character-long simple substitution cipher uses 25 different code characters and contains the exclusively enciphered text. Since simple substitution is an easy way of encryption, we can even take a pencil and a piece of paper to count these parameters by hand/manually. We are curious about the frequencies of the individual code characters and the bigrams, trigrams, n-grams that appear in the text several times/repeatedly. Sometimes these recurring character lines can be the breaking point into the encrypted text.
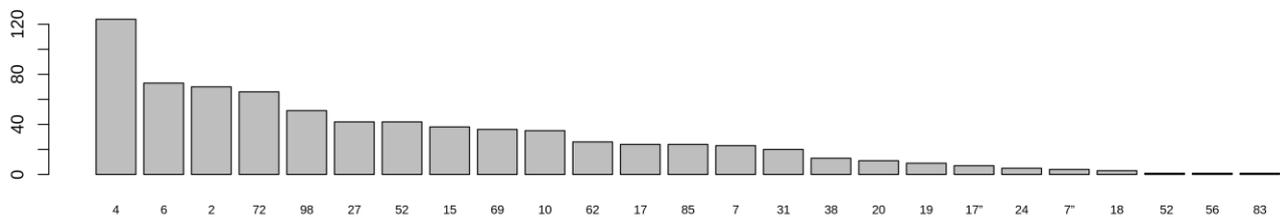
*Figure 2 - **Frequency analysis of the code characters***

Since this manuscript is presumably written in Hungarian, we will check the letter frequencies of the Hungarian language and compare it to the code character frequencies. In the Hungarian language, the most common letters are (in order): e, a, t, n, l, o. In the ciphertext, the most common code character is '4'. This character represents the letter 'e' in the plaintext with a very high probability. The second most frequent code character in the text is '6'. It probably stands for 'a' in the plaintext, and so on. In this cipher, '4' represents 'e' indeed, and '6' represents 'a.' The code character '2' stands for 'i', '72' for 'n', '98' form'. Based on these probabilities, we are already able to seek meaningful phrases, word parts. But if it proves insufficient - often because of the shortness of the ciphertext - we can analyze the n-grams in the ciphertext. This means that we prepare frequency analysis for bigrams, trigrams, and so on. This way, we will also find the longest character lines that appear several times in the ciphertext and can be with a high probability a breaking point into the ciphertext.

In the case of this monoalphabetic substitution letter, the n-gram statistics show that the character line [27 4 62 2 4 52 98 4 31] appears three-times in the text. If our letter frequency analysis is correct, the code character '4' presumably stands for 'e', '2' for 'i', '98' form'. If we substitute these letters into the character line, we will get: [27 e 62 I e 52 m e 31]. If someone is familiar with the early modern Hungarian written language and with certain courtesy habits of the ancestors, they can easily find the missing parts of this word.

---

1 ÖStA HHStA Ung. Akt. Spec. Verschwörerakten VII. Varia Fasc. 327. Konv. D. Chiffres 1664-1668. fol. 62. (Láng, 2015, p. 279)

The word is 'kegielmed', which nowadays would be written as 'kegyelmed'. This word means 'your grace' which was a courteous accost that time.

From this point success is at our fingertips. We know the plaintext equivalents of seven code characters, so based on the outlined wordpatterns and word fragments, we just have to find the plaintext equivalents of the code characters that form a meaningful text.

If, for some reason the aforementioned techniques do not bring the break-through, a vowel identification can also be performed. A very detailed description of this technique can be found in an American field manual (Basic Cryptanalysis, 1990, pp. 4-32).

Polyalphabetic Substitution Cipher

A polyalphabetic cipher is also based on substitution but uses multiple code alphabets (cipher alphabets). When encrypting a plaintext message, at each plaintext letter, we change the code alphabet according to some system. All the alphabets were usually written out in a large 26x26 table (since for the 26 letters, 26 different cipher alphabets were accessible).

Probably the most popular polyalphabetic substitution cipher is the one Blaise de Vigenère created in the 16th century. For a long time, it was called "le Chiffre indéchiffrable" since it was thought to be indecipherable. What we call Vigenère cipher nowadays is something easier than the original system of Vigenère.

In the wording of Kahn: the Vigenère cipher employs only standard alphabets and a short repeating keyword. Its table consists of 26 standard horizontal alphabets; each slid one space to the left of the one above. These are the cipher alphabets. A normal alphabet for the plaintext stands at the top. Another normal alphabet, which merely repeats the initial letters of the horizontal ciphertext alphabets, runs down the left side. This is the key alphabet. Both correspondents must know the keyword. The encipherer repeats this above the plaintext letters until each one has a key letter. He seeks the plaintext letter in the top alphabet and the key letter in the side. Then he traces down from the top and in from the side. The ciphertext letter stands at the intersection of the column and the row. The encipherer repeats this process with all the letters of the plaintext. To decipher, the clerk begins with the key letter, runs in along the ciphertext alphabet until he strikes the cipher letter, then follows the column of letters upward until he emerges at the plaintext letter at the top (Kahn, 1967, p. 148).

Cryptology has several unsolved enigmas. One of these puzzles is an encrypted message on a sculpture called Kryptos. Kryptos was unveiled in 1990, and it stands on the courtyard of the Central Intelligence Agency in Langley, Virginia, keeping its secret safe already for thirty years. This 12-foot-tall bent copper plate bears four encrypted messages (the fourth message is still unsolved) out of which two messages were encrypted with Vigenère cipher.

*Figure 3 - **The Kryptos sculpture***

The first message (marked with green) and the second message (marked with yellow) can be found on the left block of the whole kryptos text. On the right side of the copper plate, the Vigenère table can be found. This table contains the shifted alphabets of this polyalphabetic cipher. The alphabets are not just shifted letter by letter but are arranged for the word "kryptos". Now the sequence of the alphabets is known, but the keyword is still missing, which is the hardest phase in the decryption of a Vigenère cipher.

```
E M U F P H Z L R F A X Y U S D J K Z L D K R N S H G N F I V J    A B C D E F G H I J K L M N O P Q R S T U V W X Y Z A B C D
Y Q T Q U X Q B Q V Y U V L L T R E V J Y Q T M K Y R D M F D      A K R Y P T O S A B C D E F G H I J L M N Q U V W X Z K R Y P
V F P J U D E E H Z W E T Z Y V G W H K K Q E T G F Q J N C E      B R Y P T O S A B C D E F G H I J L M N Q U V W X Z K R Y P T
G G W H K K ? D Q M C P F Q Z D Q M M I A G P F X H Q R L G        C Y P T O S A B C D E F G H I J L M N Q U V W X Z K R Y P T O
T I M V M Z J A N Q L V K Q E D A G D V F R P J U N G E U N A      D P T O S A B C D E F G H I J L M N Q U V W X Z K R Y P T O S
Q Z G Z L E C G Y U X U E E N J T B J L B Q C R T B J D F H R R    E T O S A B C D E F G H I J L M N Q U V W X Z K R Y P T O S A
Y I Z E T K Z E M V D U F K S J H K F W H K U W Q L S Z F T I      F O S A B C D E F G H I J L M N Q U V W X Z K R Y P T O S A B
H H D D D U V H ? D W K B F U F P W N T D F I Y C U Q Z E R E      G S A B C D E F G H I J L M N Q U V W X Z K R Y P T O S A B C
E V L D K F E Z M O Q Q J L T T U G S Y Q P F E U N L A V I D X    H A B C D E F G H I J L M N Q U V W X Z K R Y P T O S A B C D
F L G G T E Z ? F K Z B S F D Q V G O G I P U F X H H D R K F      I B C D E F G H I J L M N Q U V W X Z K R Y P T O S A B C D E
F H Q N T G P U A E C N U V P D J M Q C L Q U M U N E D F Q        J C D E F G H I J L M N Q U V W X Z K R Y P T O S A B C D E F
E L Z Z V R R G K F F V O E E X B D M V P N F Q X E Z L G R E      K D E F G H I J L M N Q U V W X Z K R Y P T O S A B C D E F G
D N Q F M P N Z G L F L P M R J Q Y A L M G N U V P D X V K P      L E F G H I J L M N Q U V W X Z K R Y P T O S A B C D E F G H
D Q U M E B E D M H D A F M J G Z N U P L G E W J L L A E T G      M F G H I J L M N Q U V W X Z K R Y P T O S A B C D E F G H I

E N D Y A H R O H N L S R H E O C P T E O I B I D Y S H N A I A    N G H I J L M N Q U V W X Z K R Y P T O S A B C D E F G H I J L
C H T N R E Y U L D S L L S L L N O H S N O S M R W X M N E        O H I J L M N Q U V W X Z K R Y P T O S A B C D E F G H I J L
T P R N G A T I H N R A R P E S L N N E L E B L P I I A C A E      P I J L M N Q U V W X Z K R Y P T O S A B C D E F G H I J L M
W M T W N D I T E E N R A H C T E N E U D R E T N H A E O E        Q J L M N Q U V W X Z K R Y P T O S A B C D E F G H I J L M N
T F O L S E D T I W E N H A E I O Y T E Y Q H E E N C T A Y C R    R L M N Q U V W X Z K R Y P T O S A B C D E F G H I J L M N Q
E I F T B R S P A M H H E W E N A T A M A T E G Y E E R L B        S M N Q U V W X Z K R Y P T O S A B C D E F G H I J L M N Q U
T E E F O A S F I O T U E T U A E O T O A R M A E E R T N R T I    T N Q U V W X Z K R Y P T O S A B C D E F G H I J L M N Q U V
B S E D D N I A A H T T M S T E W P I E R O A G R I E W F E B      U Q U V W X Z K R Y P T O S A B C D E F G H I J L M N Q U V W
A E C T D D H I L C E I H S I T E G O E A O S D D R Y D L O R I T  V U V W X Z K R Y P T O S A B C D E F G H I J L M N Q U V W X
R K L M L E H A G T D H A R D P N E O H M G F M F E U H E          W V W X Z K R Y P T O S A B C D E F G H I J L M N Q U V W X Z
E C D M R I P F E I M E H N L S S T T R T V D O H W ? O B K R      X W X Z K R Y P T O S A B C D E F G H I J L M N Q U V W X Z K
U O X O G H U L B S O L I F B B W F L R V Q Q P R N G K S S O      Y X Z K R Y P T O S A B C D E F G H I J L M N Q U V W X Z K R
T W T Q S J Q S S E K Z Z W A T J K L U D I A W I N F B N Y P      Z Z K R Y P T O S A B C D E F G H I J L M N Q U V W X Z K R Y
V T T M Z F P K W G D K Z X T J C D I G K U H U A U E K C A R        A B C D E F G H I J K L M N O P Q R S T U V W X Y Z A B C D
```

*Figure 4 - **The two Vigenère ciphers in the whole Kryptos transcription**[2]*

The Vigenère cipher - as a type of encryption - remained unsolved for a long time. Charles Babbage - a mathematician, philosopher, inventor, and mechanical engineer - was the person who finally found the decryption method of "le chiffre indéchiffrable" around 1854. The basic idea of Babbage was that if our ciphertext was long enough, and the length of the keyword was somewhere between 2 and 26, we could probably find recurring sequences in the ciphertext. These recurrences were the clue for Babbage that led to the decipherment of the Vigenère cipher.

The first step is to look for recurring character lines. If we find some, we can suppose that these character lines recur because they were encrypted with the same code alphabet. We can prepare a table where these recurring sequences are listed with the spacing between the recurrences. We also have to look at the factors of all the spacings. The number which is indicated in all cases will be the most probable keyword length.

Now we probably know the length of the keyword but still do not know the word. So as a second step, we take our Vigenère cipher apart. Since each letter of the keyword is providing a different cipher alphabet for encryption, we can say we have as many monoalphabetic substitution ciphers in a Vigenère cipher as many characters the keyword consists of.

Thus the Vigenère cipher can be handled as a bunch of monoalphabetic substitution ciphers, which we already know how to cryptanalysis. Using a simple frequency analysis on each "monoalphabetic part" of the whole Vigenere cipher, we can compare the code character frequencies with the English letter frequencies. Based on these frequency values, we just have to find how many characters the cipher alphabet is shifted compared to the original alphabet. With the help of the diagrams' shape - peaks, valleys, plateaus - we can find where the two diagrams correspond to each other the best. If our comparison is correct, we can find the

---

2 You can find the editable Kryptos transcription on Elonka Dunin's homepage: https://elonka.com/kryptos/transcript.html

plaintext equivalents of the code characters, thus the letters of the keyword, if we repeat this process as many times as the length of the keyword requires.

As we finished the lingering letter identification process of the keyword, we simply have to do the substitution as the third and final step.[3]

The keywords for the first two encrypted messages of Kryptos are PALIMPSEST for the first part, ABSCISSA, for the second part. If we know these parameters, we just have to sort the alphabets by the keywords' letters and do the substitution. Thus the solution of the first cipher sounds like this: "Between subtle shading and the absence of light lies the nuance of illusion." and the second ciphers is: "It was invisible. How's that possible? They used the earth's magnetic field. x The information was gathered and transmitted underground to an unknown location. x Does Langley know about this? They should: it's buried out there somewhere. x Who knows the exact location? Only WW. This was his last message. x Thirty eight degrees fifty-seven minutes six point five seconds north, seventy-seven degrees eight minutes forty-four seconds west. x Layer two."[4]

Homophonic Substitution Cipher

In a homophonic substitution cipher single plaintext letters map to more than one code character (ciphertext symbol). In simpler cases, only the vowels and the most frequent letters were replaced with more than one code character. Still, in an advanced, complex cipher key, each of the plaintext letters maps to several code characters, so-called homophones in the ciphertext. In this case, the frequency distribution is flattened, making the task of the codebreakers much harder (s more difficult). Our example is a homophonic substitution cipher from 1664-1668. This letter's cipher key used homophones only for the vowels and used all in all 40 different code characters for 20 different plaintext letters. The frequency analysis of the code characters shows interesting results.
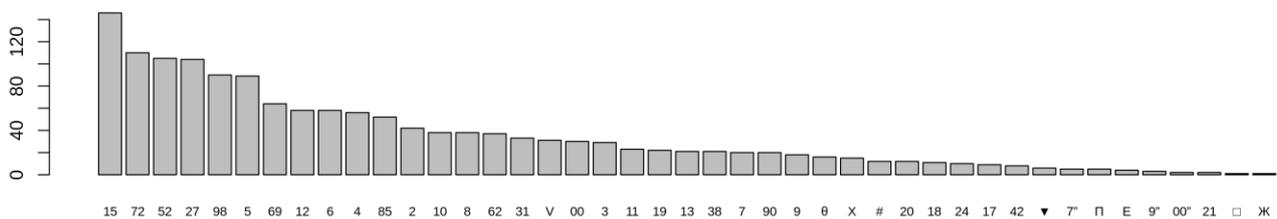

Figure 5 - ***Distribution of the code characters in the homophonic substitution cipher***

We were expecting a flattened distribution, but the results show a similar distribution that we experienced at the simple substitution cipher. A possible reason for this is the brevity of the text and the inaccurate use of the cipher key. In many cases, we face the phenomenon that the persons who encrypted these letters hundreds of years ago, used the cipher key in an improper or comfortable way: the key offered much stronger encryption than the encoder took advantage of. In this case, only the five vowels were replaced with several homophones (five homophones each). Still, these homophones were not used in an equal proportion during the encryption: some of them were prioritized, others were nearly ignored. That is why the shape of the diagram is very similar to the simple substitution distribution, but these code character frequencies do not follow the plaintext letter frequencies. The most frequent code characters stand for 't', 'n', 'l', 'k' and 'm'. The first vowel only appears in the 6th column. So instead of the uneven frequencies Figure 5 shows, these statistics will not help when we try to compare them with the plaintext letter frequencies.

Because of these circumstances, the methods that can help to decrypt a monoalphabetic substitution cipher are often too weak to find a breaking point into a homophonic substitution cipher. An additional decryption tool has to be involved. Among other possibilities, hierarchical clustering can bring some results in this case.

---

3 See the detailed description: Singh, 2000, pp. 83-96.
4 You can find the solution of the first three messages here for instance: https://en.wikipedia.org/wiki/Kryptos#Solutions

The first time when hierarchical clustering was successfully used to decrypt a homophonic substitution cipher was the decryption of the famous Copiale code[5].

Let us see how hierarchical clustering can support the decryption process. As Kumar formulates, cluster analysis groups data objects based only on information found in the data that describes the objects and their relationships. The goal is that the objects within a group be similar (or related) to one another and different from (or unrelated to) the objects in other groups. The greater the similarity (or homogeneity) within a group and the greater the difference between groups, the better or more distinct the clustering (Kumar et al., 2005, p. 490). Speaking of homophonic substitution ciphers, the context of the particular code characters was investigated.

To display hierarchical clustering graphically, the open-source Cran R[6] software was used, which visualizes the relationships as dendrograms. Each element on the bottom of the dendrogram represents a coded character. Looking at the dendrograms, we can separate different clusters. Each cluster consists of similar code characters. This similarity is based on the code characters' contexts: left and right neighborhoods. Height represents the level of the hierarchy, normalized from 0 to 1.

The vowel-consonant difference shows up high in the cluster map, smaller clusters low in the cluster map indicate very high similarity (e.g., homophone groups standing for one plaintext letter).
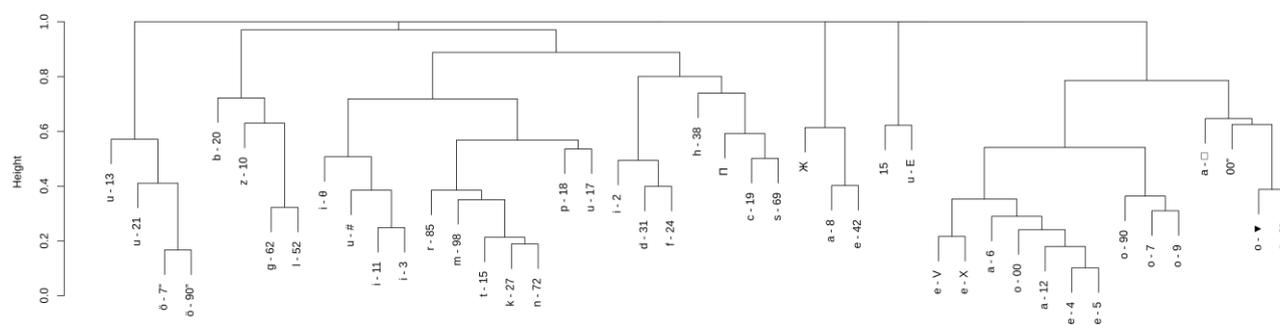

*Figure 6 - **Dendrogram of the homophonic substitution cipher***

In our case, the clustering process splits the code characters into two bigger and three smaller clusters. The three smaller clusters group the code characters that were difficult to classify. That is why these small clusters are not in the focus of our interest. However, the two big clusters represent the essence of this examination. The big cluster on the right contains exclusively vowels, the other big cluster on the left contains almost exclusively consonants (1 mistake[7] out of 22 elements which mean an efficiency over 95%). In some cases, even the homophone groups belonging to the particular plaintext letters are also identified correctly (see the smaller sub-clusters within the big clusters, e.g., the [7, 9, 90] homophone group that represents the letter 'o' in the plaintext).

Conclusion

After we learned the essence of simple, polyalphabetic, and homophonic substitution ciphers and also met the methods these ciphers can be cryptanalysis with, we can state that the discipline of cryptology is full of encryption and decryption methods that can demonstrate various mathematical issues. Since cryptology is a mysterious and interesting discipline by its nature, it can effectively and efficiently be used to be a basis for mathematical competence development. Since history has been handed down to us plenty of various encrypted manuscripts, we can even decide for which age group, or how difficult competence development we aim at.

---

5 The Copiale Cipher is a 105-pages long manuscript containing all in all around 75000 characters, using 90 different code characters. It was decrypted by Kevin Knight, Beáta Megyesi and Christiane Schaefer, presented on the 4th Workshop on Building and Using Comparable Corpora. Portland, Oregon, 2011.
6 R can be freely downloaded from the website https://cran.rapporter.net/
7 In the early modern Hungarian language 'u' usually stands for 'v' and letter 'i' represents 'j'. So the letters 'u' and 'i' are correctly grouped into this consonant cluster.

Acknowledgements

References

- *Basic Cryptanalysis (Field Manual No. 34-40-2).* Washington, DC: Headquartes Department of the Army, 1990.
- Bauer, Craig P. *Secret History: The Story of Cryptology.* Boca Raton, FL: CRC Press, 2013.
- Kahn, David. *The Codebreakers. The story of Secret Writing.* New York: Scribner, 1996.
- *Key Competences. A developing concept in general compulsory education.* Brussels, Belgium: Eurydice European Unit, 2002.
- Kumar, Vipin, Michael Steinbach, Pang-Ning Tan. *Introduction to Data Mining.* Boston: Pearson (Education Inc.), 2005.
- Láng, Benedek. *Titkosírás a Kora Újkori Magyarországon.* Budapest: Balassi Kiadó, 2015.
- *OECD: Measuring Student Knowledge and Skills – A new Framework for Assessment.* Paris, France: OECD, Programme for International Student Assessment (PISA), 1999.
- Singh, Simon. *The Code Book: The Science of Secrecy from Ancient Egypt to Quantum Cryptography.* New York: Anchor Books, 2000.
- *World Declaration on Education for All. Framework for Action to Meet Basic Learning Needs.* New York: UNESCO, 1990.

Appendix

Transcription of the simple substitution cipher

85 . 6 . 27 . 7 . 19 . 10 . 2 . 17 . 6 . 52 . 4 . 72 . 69 . 10 . 4 . 98 . 20 . 4 . 72 . 17 . 7 . 52 . 15 . 6 . 98 . 31 . 4 . 6 . 10 . 98 . 2 . 72 . 31 . 4 . 72 . 4 . 27 . 4 . 15 . 52 . 4 . 15 . 7" . 15 . 27 . 4 . 10 . 4 . 85 . 17" . 52 . 4 . 69 . 98 . 6 . 62 . 6 . 72 . 7 . 69 . 69 . 6 . 72 . 6 . 27 . 6 . 85 . 52 . 4 . 72 . 72 . 2 . 6 . 10 . 98 . 2 . 72 . 15 . 38 . 7 . 62 . 2 . 6 . 10 . 4 . 52 . 98 . 17 . 52 . 15 . 18 . 4 . 72 . 15 . 4 . 27 . 4 . 72 . 6 . 10 . 6 . 72 . 72 . 2 . 6 . 17 . 6 . 52 . 4 . 62 . 2 . 17" . 15 . 15 . 7 . 27 . 6 . 2 . 20 . 72 . 6 . 10 . 72 . 4 . 98 . 4 . 15 . 4 . 27 . 72 . 4 . 27 . 83 . 7 . 18 . 4 . 72 . 10 . 15 . 17 . 2 . 15 . 6 . 10 . 19 . 10 . 6 . 69 . 10 . 6 . 85 . 85 . 4 . 56 . 17 . 2 . 69 . 2 . 15 . 2 . 7 . 2 . 6 . 85 . 6 . 4 . 69 . 6 . 10 . 69 . 10 . 6 . 27 . 98 . 6 . 85 . 2 . 6 . 27 . 72 . 6 . 27 . 2 . 69 . 24 . 2 . 10 . 4 . 15 . 72 . 2 . 24 . 7 . 62 . 6 . 10 . 6 . 72 . 72 . 2 . 6 . 6 . 10 . 15 . 7" . 85 . 7" . 27 . 98 . 4 . 62 . 98 . 7 . 69 . 15 . 2 . 69 . 20 . 2 . 10 . 15 . 6 . 15 . 4 . 69 . 6 . 69 . 69 . 4 . 19 . 17 . 85 . 52 . 31 . 4 . 6 . 10 . 27 . 4 . 62 . 2 . 4 . 98 . 4 . 31 . 2 . 72 . 19 . 52 . 17 . 69 . 6 . 2 . 20 . 17 . 52 . 98 . 6 . 69 . 15 . 52 . 6 . 15 . 7 . 27 . 4 . 85 . 31 . 4 . 52 . 2 . 20 . 4 . 72 . 2 . 69 . 98 . 2 . 72 . 31 . 2 . 85 . 15 . 17 . 72 . 27 . 98 . 2 . 72 . 31 . 2 . 10 . 4 . 72 . 15 . 17" . 72 . 27 . 31 . 4 . 6 . 10 . 2 . 69 . 19 . 10 . 6 . 27 . 85 . 4 . 98 . 4 . 72 . 69 . 4 . 62 . 38 . 6 . 72 . 4 . 98 . 19 . 10 . 6 . 27 . 98 . 6 . 69 . 98 . 4 . 31 . 2 . 17 . 98 . 98 . 6 . 52 . 27 . 4 . 52 . 4 . 52 . 4 . 2 . 15 . 17 . 4 . 72 . 72 . 2 . 17 . 4 . 69 . 10 . 4 . 31 . 4 . 52 . 98 . 17" . 72 . 27 . 72 . 4 . 27 . 98 . 4 . 72 . 72 . 4 . 52 . 38 . 6 . 98 . 6 . 85 . 6 . 20 . 2 . 69 . 15 . 4 . 72 . 4 . 85 . 15 . 52 . 4 . 62 . 2 . 4 . 72 . 62 . 7 . 72 . 62 . 2 . 6 . 85 . 4 . 6 . 98 . 27 . 4 . 62 . 2 . 4 . 52 . 98 . 4 . 31 . 72 . 4 . 27 . 98 . 4 . 85 . 15 . 72 . 4 . 27 . 4 . 98 . 2 . 15 . 4 . 52 . 27 . 4 . 52 . 17 . 4 . 69 . 10 . 72 . 4 . 98 . 4 . 69 . 2 . 85 . 2 . 7 . 72 . 6 . 10 . 98 . 2 . 27 . 4 . 62 . 2 . 4 . 52 . 98 . 4 . 69 . 6 . 69 . 69 . 10 . 7 . 72 . 2 . 17 . 72 . 27 . 72 . 6 . 27 . 2 . 69 . 4 . 52 . 4 . 15 . 4 . 98 . 24 . 4 . 52 . 7" . 52 . 20 . 2 . 10 . 7 . 72 . 2 . 98 . 4 . 62 . 38 . 6 . 52 . 6 . 52 . 7 . 98 . 38 . 6 . 17 . 6 . 52 . 6 . 98 . 2 . 62 . 4 . 52 . 38 . 4 . 15 . 4 . 27 . 4 . 17 . 4 . 52 . 18 . 4 . 72 . 2 . 62 . 38 . 6 . 27 . 4 . 69 . 17" . 72 . 27 . 4 . 52 . 17 . 4 . 69 . 10 . 17" . 72 . 27 . 72 . 4 . 27 . 4 . 98 . 4 . 62 . 2 . 4 . 31 . 17" . 52 . 19 . 10 . 6 . 27 . 27 . 4 . 62 . 2 . 4 . 52 . 98 . 4 . 31 . 20 . 4 . 72 . 98 . 2 . 72 . 31 . 4 . 72 . 85 . 4 . 98 . 4 . 72 . 69 . 4 . 62 . 4 . 98 . 38 . 6 . 17 . 62 . 2 . 6 . 72 . 72 . 4 . 38 . 4 . 10 . 4 . 31 . 2 . 27 . 6 . 10 . 31 . 7 . 52 . 7 . 62 . 4 . 72 . 2 . 69 . 38 . 6 . 31 . 24 . 4 . 85 . 2 . 4 . 27 . 20 . 4 . 4 . 62 . 2 . 27 . 2 . 69 . 27 . 7 . 85 . 2 . 69 . 98 . 17 . 85 . 6 . 72 . 2 . 20 . 6 . 72 . 52 . 4 . 52 . 27 . 4 . 98 . 24 . 2 . 6 . 98 . 17 . 85 . 6 . 98 . 2 . 85 . 2 . 7 . 72 . 4 . 69 . 15 . 17 . 31 . 7 . 69 . 2 . 19 . 10 . 7 . 72 . 27 . 4 . 62 . 2 . 52 . 98 . 4 . 31 . 15 . 17 . 62 . 2 . 6 . 98 . 98 . 2 . 72 . 15 . 20 . 2 . 10 . 38 . 6 . 15 . 7 . 98 . 72 . 4 . 38 . 6 . 62 . 2 . 7 . 72 . 4 . 52 . 27 . 4 . 62 . 2 . 4 . 52 . 98 . 4 . 31 . 15 . 6 . 85 . 19 . 10 . 6 . 98 . 4 . 62 . 4 . 52 . 4 . 15 . 4 . 98 . 4 . 15 . 17 . 6 . 52 . 6 . 98 . 2 . 72 . 15 . 52 . 4 . 38 . 4 . 15

Key of the simple substitution cipher

2 – I	7" – Ö	17" – Ü	24 – F	52 – L	72 – N
4 – E	10 – Z	18 – P	27 – K	56 – Q	83 – J
6 – A	15 – T	19 – C	31 – D	62 – G	85 – R
7 – O	17 – U	20 – B	38 – H	69 – S	98 –

Transcription of the homophonic substitution cipher

20 . V . 72 . 52 . 5 . 17 . 4 . 72 . 72 . X . 98 . 98 . 00 . 72 . 31 . 9 . 15 . 15 . 6 . 98 . 27 . 62 . 27 . 12 . 10 . ▼ . 15 . 13 . 12 . 52 . 7 . 69 . 90 . 27 . 31 . 11 . 69 . 15 . 85 . 6 . 19 . 15 . θ . 7 . 72 . 6 . 27 . 15 . 21 . 52 . Π . 3 . 31 . 9 . 72 . 2 . 15 . 00 . 98 . 98 . 3 . 31 . ▼ . 72 . 69 . 13 . 20 . 69 . 19 . 85 . 18 . 15 . 3 . 7 . 2 . 12 . 6 . 52 . 12 . 15 . # . 12 . 52 . 90 . 19 . 9 . 19 . 69 . 27 . 90 . 69 . 52 . 5 . 17 . 4 . 52 . 5 . 15 . 98 . 8 . 52 . 19 . 9 . 72 . 24 . 4 . 85 . 8 . 52 . 72 . 12 . 98 . 6 . 72 . 72 . 12 . 27 . □ . 52 . 27 . 8 . 52 . 98 . 8 . 15 . 00 . 69 . 69 . 6 . 62 . 6 . 13 . 6 . 52 . 2 . V . 52 . X . 72 . 15 . 5 . 15 . 15 . 4 . 00 . 27 . X . 62 . 52 . 98 . X . 98 . 2 . 72 . V . 98 . 00 . 69 . 9 . 27 . 15 . 90 . 27 . 5 . 52 . 52 . 4 . 15 . 52 . 4 . 72 . 38 . 3 . 85 . 4 . 27 . V . 15 . 38 . 2 . 72 . 15 . 5 . 62 . 4 . 15 . 15 . 5 . 27 . X . 72 . 24 . 4 . 52 . 90 . 52 . 5 . 98 . 69 . ▼ . 15 . 69 . 10 . 12 . 52 . 12 . 69 . 12 . 85 . 9 . 52 . 19 . 7 . 72 . 24 . 3 . 31 . 4 . 72 . 15 . ▼ . 85 . θ . 85 . 13 . 12 . 72 . 00 . 27 . X . 62 . 98 . 42 . 72 . 5 . 98 . 4 . 52 . 52 . 2 . 5 . 27 . 4 . 15 . θ . 85 . 6 . 69 . 20 . 6 . 72 . 2 . 69 . 98 . V . 62 . 2 . 4 . 52 . 5 . 72 . 15 . 5 . 15 . 15 . 38 . 8 . 69 . ▼ . 98 . 52 . 90 . 27 . 12 . 15 . 85 . 5 . 24 . 4 . 85 . 6 . 52 . 15 . 98 . 8 . 62 . 12 . 2 . 69 . 27 . 62 . 52 . 31 . 98 . 3 . 27 . 5 . 15 . 2 . 85 . 90 . 19 . 69 . 27 . 12 . 52 . 15 . 12 . 27 . 72 . 5 . 98 . 4 . 52 . 52 . 2 . 4 . 27 . 5 . 72 . 4 . 52 . 52 . V . 5 . 98 . 98 . 5 . 52 . 15 . 9 . 69 . 6 . 62 . 90 . 69 . 72 . 12 . 27 . 6 . 10 . 38 . 8 . 85 . 00 . 98 . 24 . 4 . 52 . 00 . 00 . # . Π . 52 . 90 . 31 . 7 . 52 . 90 .

62 . V . 62 . 2 . 7 . 17 . 5 . 19 . 9 . 72 . 19 . 13 . 85 . 85 . 8 . 52 . 17 . 72 . 6 . 10 . V . 85 . 15 . θ . 85 . 15 . 12 . 98 .
4 . 85 . 10 . 5 . 27 . V . 72 . 72 . X . 52 . 72 . 12 . 27 . 98 . V . 85 . 15 . X . 85 . 5 . 15 . 72 . 4 . 27 . 72 . 5 . 27 . 69 .
00 . 15 . 72 . 12 . 27 . 11 . 69 . 6 . 72 . 72 . 3 . 00 . 20 . 52 . 2 . 62 . 6 . 15 . 9 . 85 . 11 . 6 . 2 . 12 . 85 . 8 . 69 . 7" .
15 . 19 . 90 . 85 . 18 . 7 . 85 . 8 . 52 . 5 . θ . # . 85 . 8 . 98 . 5 . 72 . 15 . # . 98 . 8 . 85 . 6 . 98 . 5 . 52 . 52 . 24 . 15
. 98 . 8 . 85 . 15 . 90" . 52 . 5 . 98 . # . 4 . 15 . 15 . 5 . 27 . 38 . 3 . 72 . 72 . 2 . 27 . 9" . 52 . 52 . 4 . 72 . 5 . П . 38 .
9 . 10 . 00 . 52 . 2 . 31 . 4 . 98 . 7 . 72 . 69 . 15 . 85 . 8 . 15 . 3 . 7 . 27 . 12 . 15 . 15 . 5 . 15 . 15 . 5 . 98 . 98 . 11 .
72 . 31 . 42 . 52 . 5 . 15 . 4 . 98 . 5 . 15 . V . 85 . 15 . 5 . 27 . 4 . 98 . 5 . 15 . 27 . 7 . 19 . 10 . 27 . 12 . 85 . 8 . # . 5
. 15 . 4 . 15 . 15 . 5 . 98 . X . 69 . 98 . 5 . 62 . 2 . 69 . 3 . 72 . 27 . 12 . 20 . 13 . 12 . 62 . 2 . 00 . 72 . 38 . 3 . 15 . 5
. 52 . 4 . 6 . 10 . X . 52 . 52 . V . 72 . 4 . 98 . 6 . 85 . 90 . 52 . 27 . 7 . 31 . 90 . 27 . 72 . 12 . 27 . 98 . 3 . 85 . 5 . 72
. 4 . 10 . 17 . 5 . 6 . 10 . 15 . θ . 85 . 15 . 12 . 98 . 72 . 12 . 27 . V . 72 . 27 . 4 . 69 . 10 . # . 6 . 62 . 2 . 00 . 27 . 6 .
10 . 31 . 00 . 52 . 62 . 9 . 27 . 20 . 13 . 52 . 27 . 3 . 6 . 52 . 52 . 12 . 72 . 2 . 6 . 10 . 15 . 3 . 15 . 27 . 7 . 27 . 12 .
15 . 98 . 5 . 52 . 52 . 2 . 5 . 27 . 4 . 15 . V . 31 . 31 . 3 . 62 . 15 . 13 . 15 . 15 . 6 . 98 . 98 . 42 . 62 . 15 . 6 . 85 . 15
. 6 . 72 . 9 . 98 . 72 . 4 . 98 . 98 . 3 . 72 . 15 . П . 10 . θ . 00 . V . 69 . 72 . 12 . 52 . 38 . 3 . 38 . V . 15 . 38 . 5 . 15 .
52 . 72 . 52 . 5 . 62 . 2 . 5 . 27 . V . 10 . 13 . 62 . 3 . 15 . 5 . 19 . 10 . 2 . 27 . 69 . 13 . 20 . 69 . 15 . 6 . 72 . 15 . 3 .
12 . 2 . 6 . 8 . 10 . 98 . 2 . 15 . 72 . 12 . 27 . θ . 85 . 15 . 12 . 98 . 27 . 62 . 52 . 31 . 98 . 8 . 62 . 8 . 20 . 7" . 52 . 19
. 69 . 11 . 15 . 3 . 52 . 5 . 15 . 2 . 85 . 4 . 38 . 8 . 62 . θ . 00 . 98 . V . 31 . X . 69 . 98 . 42 . 69 . 15 . 5 . 85 . 38 . 8 .
72 . 5 . 98 . 27 . 7" . 52 . 52 . 5 . 5 . 4 . 72 . 5 . 27 . 4 . 98 . 5 . 10 . 15 . 85 . 5 . 69 . 4 . 72 . 15 . 11 . 6 . 52 . 72 .
00 . 98 . 27 . 2 . 13 . 8 . 52 . 15 . 27 . 5 . 18 . 18 . 4 . 72 . 69 . 9 . 27 . # . 15 . 6 . 27 . 00 . 72 . 15 . 12 . 18 . 8 . 69
. 10 . 15 . 6 . 52 . 13 . 12 . 72 . 31 . 5 . 85 . 5 . 27 . 27 . 6 . 15 . 15 . 00 . 52 . 5 . 98 . 5 . 52 . 15 . 3 . 15 . 27 . ▼ .
52 . 15 . 12 . 27 . 5 . 69 . 6 . 10 . 7 . 27 . 12 . 15 . 98 . 8 . 69 . 9 . 27 . 15 . 17 . 52 . 4 . 69 . 98 . 8 . 69 . 38 . 00 .
72 . 72 . 6 . 72 . 15 . # . 31 . 15 . 12 . 98 . # . θ . 69 . 10 . 7 . 72 . 15 . 5 . 52 . 4 . 15 . 4 . 98 . E . 5 . 69 . 10 . 4 . 31
. 5 . 52 . 98 . 3 . 13 . V . 52 . 6 . 10 . 98 . 5 . 52 . 2 . 15 . θ . 15 . 27 . 90 . 27 . 12 . 15 . 11 . 4 . 52 . 5 . 72 . 15 . 5 .
15 . 15 . 5 . 98 . 15 . 11 . 15 . 00 . 27 . 72 . 12 . 27 . 72 . 4 . 98 . 15 . 12 . 85 . 15 . 7 . 15 . 15 . 12 . 27 . 6 . 10 .
00 . 85 . 5 . 72 . 31 . 11 . 69 . 10 . 98 . 3 . 72 . 4 . 27 . 9 . 27 . 12 . 5 . 85 . 15 . 27 . 62 . 52 . 31 . 69 . 4 . 98 . 5 .
52 . 18 . 85 . 7 . 69 . 4 . 98 . 18 . V . 85 . E . 5 . 62 . 2 . 5 . 27 . 2 . 21 . 3 . 69 . 10 . 8 . 11 . 6 . 15 . 38 . 8 . 38 . 13 .
15 . 7" . 27 . 72 . 5 . 27 . 5 . 52 . 4 . 62 . 5 . 15 . 6 . 27 . 8 . 85 . 72 . 8 . 27 . 15 . 5 . 72 . 72 . 2 . 6 . 62 . 6 . 52 . 52
. 2 . 12 . 72 . 6 . 27 . 13 . 62 . 2 . 6 . 10 . 98 . 11 . 72 . 15 . 6 . 72 . 27 . 6 . 27 . 85 . 5 . 72 . 31 . 3 . 38 . 90 . 52 . 9 .
15 . 18 . 5 . 31 . 2 . 62 . 52 . 5 . 72 . 72 . 2 . 72 . 19 . 69 . 38 . 3 . 15 . 4 . 52 . 5 . 98 . 72 . 12 . 52 . 00 . 27 . 27 . 2
. 6 . 20 . 20 . 17 . 52 . 52 . 12 . 19 . 10 . 11 . 27 . 15 . 7 . 52 . 9" . 98 . 15 . 11 . 15 . 27 . 7 . 52 . 13 . 12 . 19 . 69 .
4 . 52 . 5 . 27 . 5 . 69 . 10 . 72 . V . 27 . 69 . 9 . 27 . 00" . 31 . 9" . 15 . 7" . 52 . 24 . 90 . 62 . 13 . 12 . 98 . 11 . 72
. 31 . X . 72 . V . 27 . 4 . 15 . 42 . 72 . 38 . 8 . 10 . 8 . 98 . 69 . 10 . 9 . 52 . 62 . 6 . 52 . 6 . 15 . 15 . 8 . 72 . 8 . 27 .
98 . 8 . 69 . E . 15 . 15 . 3 . 12 . 15 . 11 . 69 . 15 . 12 . 52 . 6 . 52 . 00 . 98 . 69 . # . 62 . 2 . 12 . 72 . 6 . 10 . 7 . 27 .
15 . 13 . 52 . 27 . 2 . 27 . 72 . 5 . 27 . V . 98 . 38 . 3 . 69 . 10 . 72 . V . 27 . X . 52 . 72 . 42 . 98 . 69 . 10 . 6 . 27 .
12 . 31 . 00 . 27 . 38 . 8 . 27 . 62 . 31 . 72 . 4 . 27 . 15 . 5 . 19 . 10 . 11 . 27 . θ . 72 . 69 . 18 . 4 . 19 . 3 . V . X . 10
. 42 . 72 . 19 . θ . 24 . 85 . 8 . 27 . 6 . 15 . 27 . 13 . 52 . 31 . 38 . V . 15 . 11 . 72 . 12 . 62 . 2 . 24 . 5 . 85 . 4 . 72 .
19 . 72 . 5 . 27 . 98 . 11 . 31 . 00" . 72 . 20 . 6 . 72 . 72 . 12 . 27 . 4 . 72 . 6 . 10 . 90 . 72 . 19 . V . 31 . 13 . 52 . 12
. 15 . θ . 85 . 15 . 8 . 98 . 8 . 27 . 90 . 85 . 98 . 4 . 62 . 6 . 52 . 2 . 18 . 19 . 69 . V . θ . 31 . 00 . 52 . 90 . 62 . 20 . 6
. 72 . 69 . V . 98 . 98 . 11 . 15 . 69 . 5 . 98 . 15 . # . 31 . 15 . 6 . 98 . П . 10 . V . 85 . 15 . 69 . 42 . 98 . 98 . Ж . 31 .
11 . 69 . 62 . 11 . 69 . 15 . 13 . 69 . 15 . 72 . 5 . 98 . 98 . E . 15 . 12 . 15 . 15 . 12 . 98 . 72 . 5 . 98 . 11 . 69 . 98 .
17 . 15 . 12 . 15 . 00 . 27 . 98 . V . 52 . 52 . 2 . 4 . 15 . 27 . 27 . 18 . 85 . 00 . θ . 72 . 24 . 90 . 85 . 98 . 8 . 15 . 11 .
7 . 72 . X . 15 . 17 . 31 . 72 . 2 . 27 . 00 . 52

Key of the homophonic substitution cipher

A – 6 12 □ 8 П	F – 24	L – 52	R – 85
B – 20	G – 62	M – 98	S – 69
C – 19	H – 38	N – 72	T – 15
D – 31	I – 2 11 3 θ Ж	O – 7 90 9 00 ▼	U – 17 13 21 E #
E – 4 42 5 X V	K – 27	P – 18	Z –

Abderrahim MAMAD

The Role of Written Corrective Feedback in EFL Writing

Introduction

Although there is a great effort done by EFL teachers to develop students' writing skills, students still face many challenges in writing, and they cannot achieve their writing teachers' goals. According to Azim Javadi-Safa (2018, p.15), "most students, more or less proficient alike, see writing as a difficult task that they have to struggle with to pass their exams." Students' inability to write meaningful and grammatically correct sentences and well-written paragraphs and texts is due to many factors such as the emphasis on the product approach over the process approach to writing (Azim Javadi-Safa, 2018), lack of effective feedback' provision on students writing, teachers' unproductive method of teaching writing (Azim Javadi-Safa, 2018), and their perceptions of the provision of written corrective feedback (WCF). Writing in second (L2) and foreign language (FL) can also be challenging to many students at college or university level because of the different micro and macro aspects it involves, including organization, content, grammar, syntax, word choice, and composition of a communicative text. Essentially, teachers' most important goal is to enhance the writing of their students to become good writers. Therefore, WCF provision on students' written products is an effective element to achieve this goal.

Defining feedback

Researchers have defined feedback either broadly or narrowly by focusing on writing as an example. On the one hand, John Hattie and Helen Timperley (2007) states that "feedback is conceptualized as information provided by an agent (e.g., teacher, peer, book, parent, self, experience) regarding aspects of one's performance or understanding" (p. 81). On the other hand, Keh (1990) defines feedback as the teacher's input to a writer's composition in the form of information to be used for revision. Similarly, Mubarak (2013) considers it a "teacher's response to students' writing in the form of oral or written comments that aim to help them improve their writing performance" (p. 54). Thus, feedback may be either written or oral in form. Written feedback can be given either in the form of correction, including direct correction, indirect correction, and coding or in other forms in which teachers focus on metalinguistic explanation, marginal and content comments (Bitchener and Ferris, 2012). Unlike written feedback, oral feedback, which will not be the focus of this paper, includes many corrective strategies such as explicit correction, recasts, classification requests, metalinguistic feedback, elicitation, and repetition (Lyster and Ranta, 1997).

The importance of WCF

WCF is of great importance because of the following reasons:

- Students want to move to the next level of English FL studies or university studies and succeed in college, as many other students do. Writing is the key to all these things, and WCF can help improve students' writing.
- WCF aligns with the dominant philosophy of learning, which is active learning. WCF is a way for students to edit their work and become their own best editors
- Students want and expect WCF. Teachers might have a little revolution on their hands in their classes if they did not provide feedback. So, they are expected to provide it.
- And finally, there is an issue of accuracy in writing. The latter is often viewed differently from speaking. Teachers tend to tolerate a certain amount of errors in speaking, but they do not tolerate them in writing, and that is true even for native speakers of English. Teachers have the idea that writing should be error-free. Accuracy is a major factor in standardized writing exams. So, students are maybe doing well with ideas and with organizations, but if they lack accuracy, they may not pass the standardized writing exam. In their study on the effectiveness of focused

and unfocused written CF in developing high proficient L2 learners' accuracy in the use of the two English definite articles "a" and "the" Farrokhi and Sattarpour (2012) found that the focused WCF is more effective in improving the grammatical accuracy of high proficient L2 writers as far as the use of definite articles is concerned.

Typology of WCF

Written corrective feedback usually takes the forms of direct correction, indirect correction, and coding.

Direct correction (direct feedback) is when the teacher corrects students' errors in their scripts by writing the correct structural or lexical form (Lalande, 1982). Bitchener and Ferris (2012) argue that this type of correction draws students' attention to the error and provides a solution to it. The teacher shows students where their errors are and corrects these errors by providing the correct form (Sia and Cheung, 2017). This type of correction takes a variety of forms, such as Crossing-out, rewriting, and additions. If readers observe the following sentence "climate change still have (has) a big effect on all the human (s), "they will see that the teacher has responded to the errors by crossing them and has written the correct form right next to the spot where the error was. Thus, the teacher is providing the answer to the student. This method, as its name implies, is known as an explicit correction, where the teacher provides the correct answer to the student. Many researchers claim that students often like this kind of feedback as they are getting the answer to their errors. If the teacher asks students to rewrite, then what is needed to rewrite is right there; it is quite easy for students to do that. However, this method is quite a time consuming for the teacher to do; that is to cross and provide the right answer. Direct corrective feedback is generally preferred by the student but also can be quite a time consuming for teachers. Sia and Cheung (2017) support this by stating that "giving written corrective feedback is a time-consuming process for teachers as they have to go through students' writings in detail and provide feedback" (p.69).

Indirect correction (indirect feedback) is when the teacher indicates that there are errors in students' writing by underlining errors or circling them without providing corrections (Bitchener and knock, 2010). It is drawing students' attention to the locations of their errors without providing corrections (Bitchener and Ferris, 2012). Teachers, for example, can underline, circle, highlight, and use lines to indicate the location of errors. This kind of corrective feedback also has positive and negative sides. Back to the previous sentence with the same errors on it, "climate change still has a big effect on all the human (s), "the teacher has identified the error for the student, but he/she has not corrected it. This is what is called an indirect correction. The teacher is providing a clue as to the location of the error. This helps the student identifies which word or words may be a little problematic, but the teacher is not correcting. At its best, students often prefer this little bit less than they do for direct correction because it makes their work a little bit harder. The teacher still locates the error, and that is very important because it is clear that students have a hard time finding the locations of their errors. No surprise, because if they could locate their errors, they could probably correct them on their own. So, it is important for the teacher to indicate the error. Still, this method is different from the former as it asks the student to do the cognitive work that is required to correct the error. A question that is still under debate and which is based on individual differences is what type of students would benefit more from indirect feedback. According to Sia and Cheung (2017), students with high-level proficiency are more profitable of indirect feedback as their linguistic knowledge helps them to correct the types of errors. In contrast, low achieving students, as found in Lui's (2008) study, which was cited by Sia and Cheung (2017), make use of direct correction more than they do with the indirect one.

Coding, as another form of indirect corrective feedback, is when the teacher uses codes to indicate the location and type of error (Sia and Cheung, 2017) without correcting the error (e.g., S for spelling, T for tense, WW for word order). This method is also called coded feedback. Hendrickson (1984) considered an error correction code as an implicit type of correction. According to him, the use of codes involves symbols and abbreviations (e.g., Sing/Pl for singular and plural errors) through which

students know the locations and types of errors on their original texts. In the following sentence, "climate change still has (SVA) a big effect on all the (Art) human (Pl) " the teacher has provided codes that indicate the type of error with the insertion of the code. Going a little bit further, it is a kind of a scaffolding approach than the indirect method, but not quite a scaffolding as a direct method. It is a sort of in-between method of error correction. It locates the error and the code, then provides little support for students. The latter can identify through the code what type of error they made. The three types of correction are seen as different levels of scaffolding, with direct correction as being the most scaffolded and indirect correction as being the least scaffolded, and the coded correction as being somewhere in the middle. The challenge with doing coded correction is that students have to know and understand the code. If you are using the code like (SVA), typically that is used for Subject Verb Agreement, but students have to know that, recognize the code and understand it for them to respond properly to correct it. As a teacher, if you are asking students to rewrite, which typically most teachers do, then the code will help them do that. Students like this type of corrective feedback. It makes them somehow work harder, and the only challenge behind this method is that they have to know the code. Thus, teachers opting for this method are recommended to teach the code first.

Other forms of teacher written feedback are marginal comments, content comments, meta- linguistic explanation, verbal rule reminders, and minimal marking.

Limitations of WCF
- WCF is very time-consuming for teachers and students. Teachers sometimes forget how time-consuming it can be for students because they are so busy grading so many papers, but depending on the type of feedback they give students. Students also can spend a bit of time on revision, perhaps more time than teachers have given to correcting a paper.
- Student may not review teachers' WCF carefully.
- Students may not understand WCF. This depends on the type of WCF teachers are giving, or it may be students not understanding the issue.
- Some WCF may not be effective generally, or it may not be effective for the student. Wang and Jiang (2015) argued that the main objection to the practice of WCF revolves around the limited effectiveness of the explicit knowledge such as grammatical rules and linguistic forms of language on developing learners' writing performance. According to Wang and Jiang (2015), the current situation has given great emphasis on the importance of implicit knowledge in developing learners' communicative abilities rather than on the explicit knowledge that is gained from the instruction of linguistic forms and grammatical rules. Another criticism for the effectiveness of WCF has been acknowledged by Truscott (1996). He based his arguments on Pienemann's (1989) Learnability Hypothesis, claiming that learners will never be in a position to acquire a second/foreign language since WCF focuses on linguistic structures that are beyond learners' level of language acquisition. More importantly, WCF may lead to harmful side effects (Truscott, 1996) in the sense that it increases learners' anxiety and low self-esteem and therefore discouraging them from writing (Wang and Jiang, 2015). Besides, learners prefer to resort to writing in simple forms rather than complex ones because of their fear of making writing mistakes or constructing inaccurate structures. Another harmful side of WCF is that feedback provision has become the central focus of instruction (Truscott, 1996) at the expense of other more important classroom activities and practices. Also, teachers are not often at the level to provide adequate and consistent WCF because of their background as non-native speakers. Therefore, it is possible that this would affect negatively learners' writing accuracy.

Suggestions for providing WCF
- As a teacher, you may need to respond differently to the types of errors. If it is the rule-bound error, you may want just to locate the error providing an indirect correction. If it is an idiomatic error, you may want to provide some direct correction to support students as they may lack

     the proficiency level that helps them identify their errors and correct them (Bitchener and Ferris, 2012; Hendrickson, 1984)

- If your students are high level, you may want to provide them with indirect corrective feedback; whereas if they are low achieving students, you may need to support them with direct correction.
- With the help of technology, typically what you need to do is read the text, and when there is an error, you say that is a mistake, that is a subject-verb agreement error, and you need to address that, and then you will continue reading depending on the length of the text. You may need to have a sound file of 2 or 3 minutes.
- Another thing that you can do is you can number the error in the student's text as you go along and then categories them in a table. It is quite simple to make a table of your students' most common errors and so if the two first errors are to be article errors, you can list them in the article row in your table. All that provides a kind of profile to your students to see. They can see how many errors they are making and which type, and this allows to build awareness of their most common errors. That is one possibility, as shown in table 1.

Table 1: ***Error categorization***

Error category	Number		
Sentence Structure	7		
Verb Form/Tense	3	6	
Subject Verb Agreement			
Articles	1	2	5
Spelling	4		

- Another thing if you do not want to categorize them, you can still create a table (Table 2) for the student, number of the mistakes, and then ask the student to categorize them themselves. That is another challenge and another activity that you can do. Thus, all these are some of the interesting ways for teachers to reduce their working load related to providing WCF.

Table 2: Error categorization

Error Category	Number		
	7		
	6	3	
	1	2	5
	4		

Issues to Be Considered in Feedback Provision

Based on the literature (Brookhart, 2008; Bitchener and Ferris, 2012), there are almost eight essential practices that characterize the implementation of feedback or its provision. They are, in general related to (purpose, source, form, amount, timing, focus, mode, and audience).

Purpose of feedback: Many teachers have confusion over the purpose of feedback since the distinction between feedback that provides advice (formative) and feedback that offers evaluation (summative) are unclear (Black & William, 1998; Burke & Pieterick, 2010).

Wiggins (1997), who defined the types above, argued that the evaluative feedback purpose is to make sure the students clearly understand what the mark is for a task or assignment. In contrast, the advisory

feedback purpose is threefold; to provide learners with information about their performance in a task, to identify aspects which need improvement or support, and to aid the students' progress by telling what steps to take to move forward and to improve their writing in the future.

Source of feedback: The feedback can come from the teacher, from peers, and the learners themselves in self-assessment. About peer feedback, students can freely assist each other and provide advice during the process of writing rather than at the end of the writing session. Thus, peer feedback is advantageous in the sense that students play an active role in learning writing, use their peers' ideas to redraft their writing (Mendonca & Johnson, 1994), and can receive different points of view about their writing from different peer groups (Chaudrun, 1983). At its worst, it is considered time-consuming and lengthy, students may find it difficult to accept criticism from their peers and may respond defensively to their feedback, peer responses address surface issues rather than problems of meaning (Keh, 1990), and finally, some students may offer inadequate feedback as it is difficult for them to identify errors in their peers' writing (Horowitz, 1986).

Form of the feedback: Feedback can be guided (controlled) by the use of checklists, whereas it can be uncontrolled when spoken or written comments are given on the strengths and weaknesses of the piece of writing without the systematic coverage of a scale.

Feedback amount (Amount of feedback): It is related to how much feedback to give and on how many points to target (Brookhart, 2008; Bitchener and Ferris, 2012). Some teachers might prefer giving feedback on all aspects of writing, whereas, at the other extreme, others might focus on important aspects of students' writing. To put it simply, written feedback can be given on parts of a piece of writing, for example, when someone sits next to the writer and reads what they have just written after every two or three sentences are written; as well as on the whole of a piece of writing, or a portfolio of writing. Researchers like Lee (2013) and Bitchener and Ferris (2012) talked about how much written corrective feedback should be given in writing. They stated that teachers could choose between two types depending on their preferences: the first is selective WCF (marking a few specific error categories in a focused manner), whereas the second is comprehensive WCF (marking all errors in an unfocused manner). Brookhart (2008) explained that despite teachers seek to fix everything they see, and they have to take into account all the following three simultaneously dimensions: 1) the topic in general and teacher's learning target or targets in particular, 2) typical developmental learning progressions for those topics or targets and 3) individual students.

Timing of feedback: Feedback can be immediate or delayed (Brookhart, 2008). In other words, the feedback is either done promptly or done later. For example, a test can be received the next day, or it can be handed to students two weeks after it is completed. The important points, however, are to acknowledge the feedback that comes while students are still thinking of the topic, the assignment, or the performance in question; while they are still mindful of the learning goal as a learning goal. It especially needs to come while they still have some reason to work on the learning target.

Feedback focus (Focus of feedback): Teachers should be focused on giving feedback to their students (Brookhart, 2008). They are required to describe specific qualities of the work about the learning targets, make observations about students' learning processes and strategies that will help them figure out how to improve, foster student self-efficacy by drawing connections between students' work and their mindful, intentional efforts and lastly avoid personal comments. The focus of feedback can be achieved by teachers in different ways. Some teachers might choose between focusing on serious errors (those that cause communication breakdowns) or minor errors (do not obscure the comprehensiveness of the text); others may address frequent errors (errors that individual students make frequently) or infrequent errors. In contrast, others may focus on either local errors (relate to language form) versus global ones (related to the content and organization). Feedback can also focus on all aspects of the written product, or it can be narrowed down to focus on only one or two. Having a narrow focus can make peer evaluation more effective.

Feedback mode (Mode of feedback): Brookhart (2008) stated that feedback could be delivered in many modalities, including written feedback, oral feedback, a combination of written and spoken feedback,

demonstration, and conversation with students. He further emphasized that the feedback message should be communicated in the most appropriate way. For example, using oral feedback for students who do not read well or when there is more information to convey, and using written feedback for comments that students need to be able to save and look over. Demonstrations are also useful if the student needs to see how to do something or what something looks like. Another modality that teachers may prefer to use is called teacher-student conferencing. This is a discussion between teacher and individual students or a group of students about graded and corrected composition. It is has different conferencing styles (teacher-centered - student-centered - collaborative) and conferencing formats (one-to-one conference - group conference and online conference).

Feedback audience (Size of the audience): It deals with the kind of audience the teacher address. The feedback can be delivered to an individual student for reforming an individual problem, and it can be given to a group of students (Brookhart, 2008) if the whole class would benefit from it. In other words, a teacher can give feedback to the whole class, to small groups, and individuals.

Conclusion

This paper has just been an attempt to discuss some important issues related to WCF, which can provide illuminating guidelines for EFL language teachers and learners, educational settings, including language institutes, schools, and universities. The paper has cast light on the importance of teacher WCF in students' development of general writing accuracy and the types, limitations, and implementation of WCF. It has ended with suggesting several practical issues that should be taken into consideration when providing feedback. At its best, the paper can be a source of motivation for prospective researchers and teachers to do more investigations and reading on the issue of WCF, which is still considered an ongoing debate for the last three decades.

References

- Bitchener, J. & Ferris, D. (2012). *Written corrective feedback in second language acquisition and writing*. New York: Routledge.
- Bitchener, J., & Knoch, U. (2010a). Raising the linguistic accuracy level of advanced L2 writers with written corrective feedback. *Journal of Second Language Writing*, 19(4), 207-217
- Black, P. & Wiliam, D. (1998): Inside the black box: Raising standards through classroom assessment. Phi Delta Kappan 80. 2. 139–148.
- Brookhart, S. M. (2008). *How to give effective feedback to your students*. Alexandria, VA: Association for Supervision and Curriculum Development.
- Burke, D., and Pieterick, J. (2010). *Giving students effective written feedback*. McGraw-Hill International.
- Chaudron, C. (1983). *Evaluating writing: effects of feedback on revision*. Paper presented at the 12th TESOL annual convention, Toronto. (EDRS No. ED227 706).
- Farrokhi, F., & Sattarpour, S. (2012). The effects of written corrective feedback on improvement of grammatical accuracy of high-proficient L2 learners. *World Journal of Education*, 2 (2), 49-56.
- Javadi-Safa, A (2018). A Brief Overview of Key Issues in Second Language Writing Teaching and Research. *IJELS* 6(2):15-25. http://dx.doi.org/10.7575/aiac.ijels.v.6n.2p.15.
- Hattie, J. & Timperley, H. (2007). The power of feedback. *Review of Educational Research*, 77. 1. 81–112.
- Hendrickson, J. M. (1984). The treatment of error in writing work. In S. McKay (Ed.), *Composing in a second language* (145-159). Rowley MA: Newbury House.
- Horowitz, D. (1986). Process, not product: less than meets the eye. *TESOL Quarterly*, 20, 141-144.
- Keh, C. (1990). Feedback in the writing process: a model and methods for implementation. *ELT Journal*, 44, 94-304.

- Lalande, J. F. (1982). Reducing composition errors: an experiment. *Modern Language Journal*, 66, 140-149.
- Lee, I. (2013). Research into practice: Written corrective feedback. *Language Teaching*, 46(01), 108-119.
- Liu, Y. (2008). The effects of error feedback in second language writing. *Arizona Working Papers in SLA & Teaching*, 15, 65-79.
- Lyster, R. & Ranta, L. (1997). Corrective feedback and learner uptake: negotiation of form in communicative classrooms. *Studies in Second Language Acquisition*, 19(1), 37-66.
- Mendonca, C. O. & Johnson, K. E. (1994). Peer review negotiations: revision activities in ESL writing instruction. *TESOL Quarterly*, 28(4), 745-768.
- Mubarak, M. (2013). *Corrective feedback in L2 writing: A study of practices and effectiveness in the Bahrain context.* Ph.D, dissertation, University of Sheffield.
- Pienemann, M. (1989). Is language teachable? Psycholinguistic experiments and hypotheses. *Applied linguistics*, 10, 52-79. http://dx.doi.org/10.1093/applin/10.1.52.
- Sia, D., & Cheung, Y. L. (2017). Written corrective feedback in writing instruction: A qualitative synthesis of recent research. *Issues in Language Studies*, 6(1), 61-80.
- Truscott, J. (1996). Review article: the case against grammar correction in L2 writing classes. *Language Learning*, 46(2), 327-369.
- Wang, T. & Jiang, L. (2015). Studies on Written Corrective Feedback: Theoretical Perspectives, Empirical Evidence, and Future Directions. *English Language Teaching*, 8(1), 110-120.

Aye Aye Myint Lᴀʏ

An investigation into the relationship between teachers' job performance and job satisfaction in Myanmar

Introduction

In society, demanding the development of the youth, teachers' job performance both inside and outside the classroom is essential to fulfilling this demand. Teachers can influence the learning process to some significant extent. Teachers are expected to be role models for their students and, therefore, teachers' job performance is crucial for students' success. Teachers will normally be satisfied with their job if teachers have a good relationship with the principal(s) of their school, are offered the highest possible salaries, and are involved in the decision-making process at their school, they will normally be satisfied with their job. Job satisfaction is an important facet of people's lives and their productivity in the workplace. Job satisfaction can lead to a sense of responsibility and involvement toward achieving comprehensive career goals and contributing to the productivity of an organization (Harter, James, Schmidt, Hayes, & Theodore, 2002, cited in Ismail, 2012).

Robbins states, "job satisfaction refers to the individual's general attitude towards his or her job. He adds that "a person with a high level of job satisfaction holds positive attitudes about the job, while a person who is dissatisfied with his or her job holds negative attitudes about the job" (Robbins, 2003, cited in Younes, 2012). A principal's leadership style might affect teachers' job satisfaction. Teachers' job satisfaction could improve their performance in the classroom (Nadarasa & Thuraisingam, 2014). Teacher job satisfaction is a "...vital area of study since several studies have found that work satisfaction influences general life satisfaction. General life is an important influence on the daily psychological health of a teacher." This, in turn, has an impact on teachers' job performance (Andrew and Whitney, 1974, cited in Wangai, 2012).

Teacher job satisfaction is a source of motivation that sustains effort in performing tasks required of good teachers (Watson et al., 1991, cited in Wangai, 2012). Effort results in higher performance when employees clearly understand and are comfortable with their roles (Kreitner, 1986, cited in Gathungu & Wachira, 2013). If a teacher is incompetent, dissatisfied with his jobs, and not guided by proper values, the entire edifice of the education system will be shaky (Raza, 2010). Due to better performance shown by satisfied workers, it is the top priority of all organizations to achieve the desired goals by increasing their satisfaction (Chambers, 1999, cited in Iqbal & Akhtar, 2008). In this point of view, examining the relationship between teachers' job performance and satisfaction is crucially important for promoting a better job performance in the future.

Review of the Literature

Importance of Job Performance

Teachers play a basic and dynamic role in an educational system. Teacher performance is the most crucial input in the field of education. Teachers' performance is very crucial in the child's development. It is said that the good performance of students depends upon the effective teaching of their teachers. Teachers' performance is how a teacher behaves in the process of teaching. Teachers' performance is known to be related to teachers' effectiveness (Medly and Shannon, 1994, cited in Raza, 2010).

"Teachers' job performance could be described as the duties performed by teachers at a particular period in the school system in achieving organizational goals." In light of this, Adeyemi, (2010, cited in Roul, 2012) described teachers' job performance as the ability of the teachers to combine relevant inputs for the enhancement of the teaching and learning process. Teachers are the most valuable assets of any school. A successful high productive school can be achieved by engaging teachers in

improving teachers' job performance. All teachers are not equal in their performance. But if they are handled effectively, their moral can be increased, and they become more productive (Roul, 2012).

Factors Affecting the Performance of Teachers

The factors affecting the performance of teachers are of two types, the external factors, and the internal factors. There are many external factors affecting how a teacher makes decisions in the classroom. While it is difficult to attach any order of significance to these factors, because every teacher is different, they will include to some degree, the expectations of the community, the particular school system in which the teacher is employed, the school itself, the grade policies, the parents and the students. Many of the expectations from these external factors will appear conflicting, and it is the classroom teacher who welds these into a workable framework while integrating a range of internal factors (Hasan, 2004, cited in Akram, 2010).

Ferris et al., (1988, cited in Akram, 2010) identified teachers' job performance on seven performance dimensions. These were preparation and planning, effectiveness in presenting the subject matter, poise, relations with students, self-improvement, relations with other staff, and relations with parents and community. In this study, the factors affecting teachers' job performance developed by Kim and Richard (1991, cited in Akram, 2010) will be discussed in detail. They are (i) Teachers' Attitude, (ii) Subject Mastery of Teachers, (iii) Teaching Methodology, and (iv) Personal Characteristics.

Importance of Job Satisfaction

Job satisfaction is an important facet of people's lives and their productivity in the workplace. Job satisfaction can lead to a sense of responsibility and involvement toward achieving comprehensive career goals and contributing to the productivity of an organization (Harter, James, Schmidt, Hayes, & Theodore, 2002, cited in Ismail, 2012). Job satisfaction is vital not only for employees but employers as it increases productivity and decreases employee turnover. According to Syptak (1999, cited in Gathungu & Wachira, 2013), Job satisfaction is an important element in a work situation and has been associated with improved performance as well as increased commitment to the organization. Employee satisfaction has been an important issue for academicians and scholars. High levels of absenteeism and staff turnover have affected various organizations as recruitment and retaining take their role. Very few organizations have made job satisfaction a top priority, because of failure to understand the significant opportunity that lies in front of them. Organizations that create work environments that attract, motivate, and retain hard-working individuals will be better positioned to succeed in a competitive environment that demands quality and cost-efficiency.

According to Olulube (2008, cited in Ngimbudzi, 2009), teachers play a very significant role in the provision of secondary education, therefore studying the factors or facets that are associated with their job satisfaction is essential. Also, it is argued that the presence of such factors in the workplace influences employees' job performance and productivity (Witte, 2007, cited in Ngimbudzi, 2009). Teachers who are not satisfied in the workplace are more likely to leave the profession (Choy et al., 1993, cited in Ismail, 2012). If teachers can receive support from their principal and local parents if they are involved in the decision-making process, and if they work within a positive school climate and culture, they are more likely to succeed and remain in the profession (Lumsden, 1998, cited in Ismail, 2012). According to MOEC (1995, cited in Ngimbudzi, 2009), – job satisfaction and the ability of teachers to perform well professionally are key factors in the maintenance of the quality of education.

Facets of Job Satisfaction

The phenomenon of job satisfaction is associated with five main factors, namely: achievement, recognition, work itself, responsibility, and advancement. Herzberg, Mausner & Snyderman (1959, cited in Ngimbudzi, 2009) refer to these factors as the "basic satisfiers" or "motivators." Job satisfaction is a multidimensional phenomenon, and it is therefore argued that different scholars identify different job satisfaction factors or facets (Bolin, 2007, cited in Ngimbudzi, 2009).

Additionally, the teachers derive their satisfaction from such factors as salaries, fringe benefits, educational policies and administration, working conditions, advancement opportunities, responsibilities within the job recognition, and so on (Denga, 1996; Nwagwu & Salmi, 1999; Ossai,

2004; Ubom & Joshua, 2004; and Ubom, 2001, cited in Ngimbudzi, 2009). Ellis argues that teachers' motivation and job satisfaction are associated with intrinsic and extrinsic rewards. Intrinsic rewards include such issues as professional development, nature of work itself, and sense of achievement, while the extrinsic ones include pay and job security (Latham, 1998, cited in Ngimbudzi, 2009).

Intrinsic factors associated with increased levels of teacher job satisfaction included working with students, viewing the profession as rewarding, and feeling good about student progress. On the contrary, extrinsic factors leading to teacher job dissatisfaction included low wages, poor principal support, issues of student misconduct, minimal teaching resources, and a negative school atmosphere (Metlife Survey, 2001, cited in Biggerstaff, 2012). Because an employee's level of satisfaction varies with specific aspects of the job, it is proposed that numerous facets (variables) from the Job Satisfaction Survey (JSS) underlie this construct. The JSS (Spector, 1997, cited in Kaltenbaugh, 2008) assesses nine facets of job satisfaction. In other words, the survey instrument has to include nine job satisfaction facets or factors, and those facets include – pay, promotion, supervision, fringe benefits, contingent rewards, operating conditions, co-workers, nature of work, and communication.

Method

Overall Design of the Study

The specific aims of this study are:

- to find out the levels of job performance as indicated by teachers,
- to examine the levels of job satisfaction as indicated by teachers,
- to investigate the relationship between teachers' job performance and satisfaction.

In this study, the descriptive statistical design was utilized. Data were collected by using two questionnaires: a questionnaire for principals and questionnaires for teachers. To collect the general information of selected schools and demographic information of principals, questionnaires for principals developed by researchers were distributed to 6 principals from selected schools. Questionnaire for teachers was mainly used to examine the perceptions of teachers on their principal's transformational leadership style, their job performance. So, it composed of two parts. In the first part of the questionnaire, "Performance of Teachers," developed by Kim and Richard (1991, cited in Akram, 2010), was examined to investigate the teachers' job performance. In the second part of the questionnaire, "Job Satisfaction Survey (JSS)" developed by Spector (1994, cited in Rumph, 2012) was used to find out the teachers' job satisfaction. After collecting the related data, descriptive statistics, and the bivariate correlation of the variables were calculated using SPSS. Even though some of the questionnaires were not returned from teachers, there were six principals and 399 teachers from 6 selected Basic Education High Schools who participated in this study.

The Pilot Test

A sample of 3 Basic Education High Schools in Monywa Township was randomly selected to conduct the pilot study. The preliminary instruments were field-tested by 146 teachers (male=12, female=134) representing 3 Basic Education High Schools.

Reliability of Measuring Instruments

To measure the reliability of the instrument, the Pearson product-moment correlation method (Average Item Total Correlation) was used for internal consistency reliability. The questionnaire for teachers' job performance had the coefficient of correlation ranging from .832 to .865, and the average was .849. The instruments were found reliable for data collection, considering a minimum value of average item-total correlation 0.3 (Nurosis, 1994). The survey instrument used for knowing teachers' job satisfaction had the correlation coefficients ranging from .401 to .728, and the average correlation was .565. The instrument is reliable since the coefficient value was greater than 0.3.

Data Analysis

Using SPSS, descriptive statistics were calculated for teachers' job performance and job satisfaction. Pearson product-moment correlation coefficient was utilized to know the relationship between teachers' job performance and job satisfaction.

Findings

Teachers' Job Performance in Selected Basic Education High Schools

The teachers' job performance in selected Basic Education High Schools was assessed by "Performance of Teachers" developed by Kim and Richard (1991, cited in Akram, 2010). There are five factors affecting teachers' job performance. They are "Teachers' Attitude", "Subject Mastery of Teachers", "Teaching Methodology", and "Personal Characteristics". Table 4.1 shows mean scores for teachers' job performance in selected Basic Education High Schools.

Table 1: *Mean Scores for Teachers' Job Performance in Selected Basic Education High Schools*
(Teachers' Ratings)

Factors Affecting Job Performance	School						All Schools (n=387)
	A (n1=65)	B (n2=67)	C (n3=52)	D (n4=64)	E (n5=70)	F (n6=69)	
Teachers' Attitude	4.39 (0.39)	4.27 (0.09)	4.1 (0.48)	4.26 (0.47)	4.27 (0.51)	4.28 (0.49)	4.27 (0.43)
Subject Mastery of Teachers	4.17 (0.40)	4.29 (0.12)	3.96 (0.49)	4.14 (0.46)	4.13 (0.52)	4.17 (0.46)	4.15 (0.44)
Teaching Methodology	4.40 (0.41)	4.30 (0.1))	4.33 (0.44	4.32 (0.46)	4.28 (0.61)	4.32 (0.42)	4.32 (0.44)
Personal Characteristics	4.47 (0.40)	3.88 (0.09)	4.31 (0.53)	4.32 (0.44)	4.39 (0.51)	4.33 (0.43)	4.28 (0.46)
Teachers' Job Performance	4.36 (0.32)	4.19 (0.04)	4.17 (0.44)	4.26 (0.41)	4.27 (0.48)	4.28 (0.38)	4.26 (0.38)

1-2.33= Low Performance, 2.34-3.67= Moderate Performance, 3.68-5= High Performance
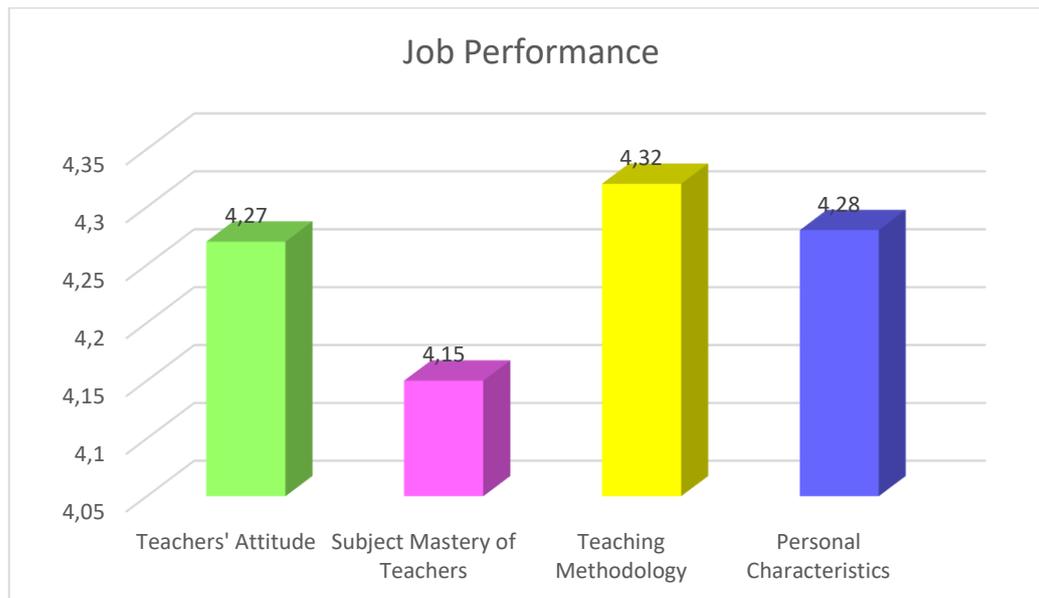
Figure 1: *Mean Scores for Teachers' Job Performance in Selected Basic Education High Schools*

Figure 1 shows the mean scores for teachers' job performance in selected schools rated by them. Concerning the performance of selected teachers from selected high schools, "Teaching Methodology" was found to be the most important performance perceived by teachers, followed in descending order, by "Personal Characteristics", "Teachers' Attitude", and "Subject Mastery of Teachers" as shown in Figure 4.2. In short, the overall job performance of teachers in selected high schools falls under the high-performance level.

Job Satisfaction Perceived by Teachers in Selected Basic Education High Schools
The job satisfaction of teachers in selected Basic Education High Schools was assessed by the Job Satisfaction Survey (JSS) developed by Spector (1994, cited in Rumph, 2012). In JSS, there were nine facets: "Pay", "Promotion", "Supervision", "Fringe Benefits", "Contingent Rewards", "Operating Conditions", "Co-workers", "Nature of Work", and "Communication". In this study, the teachers' job satisfaction is divided into three levels: Low Satisfaction Level (1 to 2.33), Moderate Satisfaction Level (2.34 to 3.67), and High Satisfaction Level (3.68 to 5). The mean scores of the data resulted from this survey are depicted in Table 2.

Table 2 *Mean Scores for Teachers' Job Satisfaction in Selected Basic Education High Schools*
(Teachers' Ratings)

Facets of Job Satisfaction	School						All schools
	A=(n1=65)	B=(n2=67)	C=(n3=52)	D=(n4=64)	E=(n5= 70)	F=(n6=69)	(n=387)
Pay	2.91 (0.86)	3.51 (0.06)	2.92 (0.48)	2.80 (0.64)	2.53 (0.90)	3.02 (0.61)	2.95 (0.72)
Promotion	3.23 (0.59)	3.73 (0.07)	3.20 (0.53)	3.43 (0.58)	3.22 (0.64)	3.41 (0.49)	3.38 (0.55)
Supervision	4.23 (0.44)	4.96 (0.15)	3.83 (0.45)	4.16 (0.47)	4.19 (0.47)	4.09 (0.49)	4.26 (0.55)
Fringe Benefits	2.80 (0.85)	2.74 (0.06)	2.70 (0.67)	3.09 (0.66)	2.62 (0.78)	3.10 (0.71)	2.85 (0.70)
Contingent Rewards	3.37 (0.40)	3.56 (0.06)	3.12 (0.39)	3.17 (0.39)	3.13 (0.42)	3.12 (0.40)	3.25 (0.38)
Operating Conditions	3.91 (0.63)	3.88 (0.07)	3.82 (0.43)	3.80 (0.48)	3.72 (0.56)	3.72 (0.41)	3.81 (0.56)
Co-workers	4.11 (0.41)	4.00 (0.03)	3.99 (0.45)	4.17 (0.50)	4.06 (0.41)	4.07 (0.40)	4.07 (0.40)
Nature of Work	4.19 (0.45)	4.00 (0.00)	3.87 (0.53)	3.90 (0.53)	3.85 (0.61)	4.07 (0.42)	3.99 (0.48)
Communication	4.20 (0.38)	4.24 (0.06)	3.97 (0.39)	4.11 (0.46)	4.09 (0.40)	4.08 (0.57)	4.12 (0.41)
Teachers' Job Satisfaction	3.66 (0.34)	3.85 (0.03)	3.49 (0.30)	3.62 (0.32)	3.49 (0.35)	3.63 (0.31)	3.63 (0.33)

1-2.33= Low Satisfaction, 2.34-3.67= Moderate Satisfaction, 3.68-5= High Satisfaction
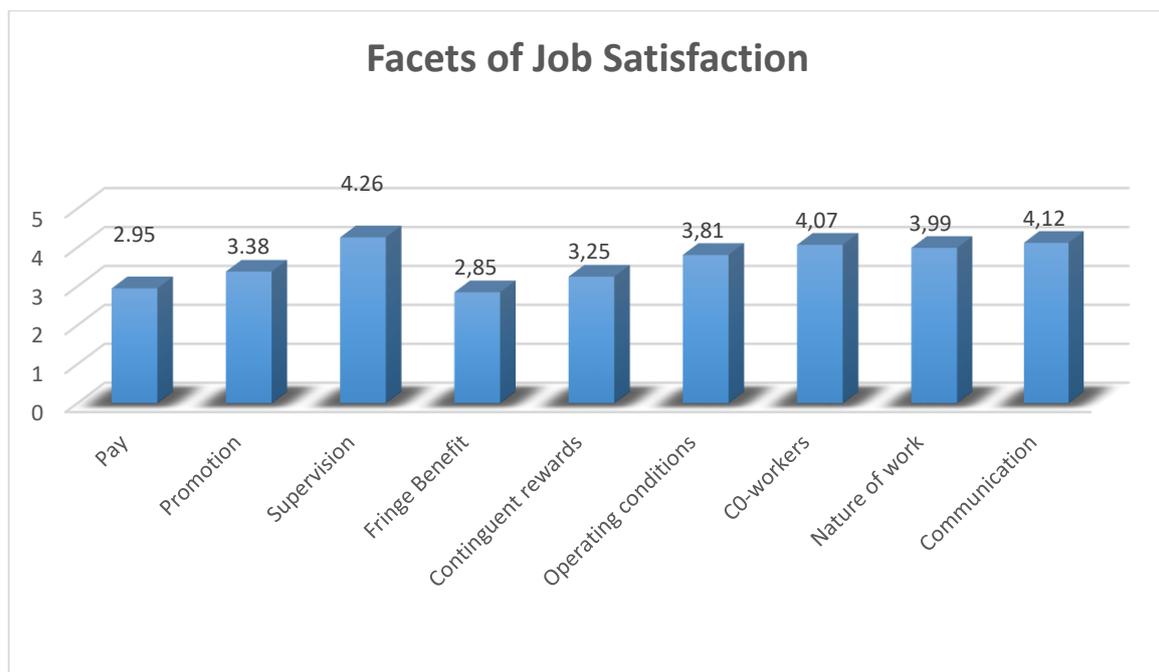

Figure 2: *Mean Scores for Teachers' Job Satisfaction in Selected Basic Education High Schools*

Figure 2 shows the mean scores for teachers' job satisfaction in selected Basic Education High Schools in Mandalay. According to Figure 2, "Supervision" was the highest satisfaction by the teachers in selected high schools and followed by "Communication", "Co-workers", "Nature of Work", "Operating Conditions", "Promotion", "Contingent Rewards", "Pay", and "Fringe Benefits" in descending order. In summary, the overall job satisfaction of teachers in selected schools falls under the moderate satisfaction level with the mean score of 3.63.

Relationship between Teachers' Job Performance and Job Satisfaction in Selected Basic Education High Schools

To explore the relationship between teachers' job performance (dependent variable), and teachers' job satisfaction (independent variable), the Pearson product-moment correlation coefficient was utilized. Table 3 shows the correlation between teachers' job performance and job satisfaction in selected Basic Education High Schools in Monywa Township.

Table 3: ***Correlation between Teachers' Job Performance and Job Satisfaction in Selected Basic Education High Schools***

Variables	1	2
1. Teachers' Job Performance	1	.404**
2. Teachers' Job Satisfaction	.404**	1

** Correlation is significant at the 0.01 level (2-tailed).

According to Table 3, teachers' job performance was significantly related to teachers' job satisfaction ($r=.404$, $p<0.01$). This indicated that a positive and moderate relationship existed between these two variables.

Conclusion

In conclusion, the teachers from all selected high schools have a positive attitude towards teaching, their pupils and their schools. Also, they possess knowledge and skills about their teaching subjects and related subjects to teach effectively and use many methods and techniques as possible in their teaching to understand their pupils. Moreover, they present a confident role image, speak, give precise directions, and act as role models. In doing so, their good performance can provide for their schools' success. A successful high productive school can be achieved by engaging teachers in improving teachers' job performance.

The results show that the teachers from selected Basic Education High Schools were highly satisfied with five facets of job satisfaction, namely, "Supervision", "Operating Conditions", "Co-workers", "Nature of Work" and "Communication", but they were moderately satisfied with four facets of job satisfaction including "Pay", "Promotion", "Fringe Benefits" and "Contingent Rewards". However, the level of job satisfaction in all selected high schools falls under the moderate satisfaction level with a mean score of 3.63. In short, the teachers from all selected high schools prefer the operating school conditions such as the workplace, work instruments, the work itself, school policy and school rules. They also assumed that their colleagues are sympathetic and understanding; sometimes they give helpful information, advice, and give practical assistance. Moreover, they have an effective interpersonal relationships among them and with their principals. They also like their profession and assumed that it provides them opportunities to learn and to use their skills and abilities. On the other hand, they assumed that financial compensations are not equitable according to their performance, and there is too little chance for promotion. Moreover, they do not satisfy their fringe benefits and contingent rewards. Therefore, the principals of selected high schools should pay attention to human aspects of subordinates' problems and behavioral aspects, such as motivating forces, processes in communication, goal setting, and control and performance characteristics. They should try to identify their teachers' needs and try to satisfy or meet them.

It was found a high positive relationship between teachers' job performance and satisfaction in selected high schools. If the level of job satisfaction of teachers is high, the level of job performance of teachers may be high. Satisfied teachers can contribute in improving students' academic performance and school effectiveness.

The results of this study are also in line with those of Indhumathi (2011) in that there was a positive relationship between job satisfaction and performance. Mbua (2003) also stated that if teachers in an educational organization are motivated, they will perform more efficiently and effectively. The infrastructure facilities pay scale, class size number of classes handled per day, and the attitude of students are all significantly favorable for the teachers. Thus these can improve teachers' satisfaction and their performance.

There are other factors that influence job performance and satisfaction, such as organizational culture, climate, and other external variables. For further research, researchers should explore the relationship between other variables and teachers' job performance and satisfaction.

References

- Akram, M. J. (2010). *Factors Affecting the Performance of teachers at Higher Secondary Level in Punjab*. Doctoral Dissertation, University Institute of Education and Research Pir Mehr Ali Shah Arid Agriculture University, Rawalpindi, Pakistan. Retrieved October 3, 2016, from http://prr.hec.gov.pk/Thesis/688S.pdf
- Biggerstaff, J. K. (2012). *The Relationship between Teacher Perceptions of Township Elementary School Principal Leadership Style and Teacher Job Satisfaction*. Doctoral Dissertation, Western Kentucky University, Bowling Green, Kentucky.
- Cristobal, E., Flavian, C., & Guinaliu, M. (2007). Perceived e-service quality (PeSQ) Measurement validation and effects on consumer satisfaction and web site loyalty. *Managing service quality: An international journal*, *17*(3), 317-340
- Gathungu, J., & Wachira, H. W. (2013). Job Satisfaction Factors that Influence the Performance of Secondary School Principals in their Administrative Functions in Mombasa District, Kenya. *International Journal of Education and Research*, 1 (2), School of Business University of Nairobi, Kenya. Retrieved November 28, 20146 from http://www.ijern.com/images/February-2013/08.pdf
- Indhumathi, S. (2011). Job Satisfaction, Occupational and Organizational Commitment and Performance of Teachers at the Secondary Level, M.Ed. Thesis, Tamilnadu Teachers Education University, Chennai.
- Iqbal, A., & Akhtar, S. (2008). Job Satisfaction of Secondary School Teachers. *Abasyn Journal of Social Sciences* 5 (1). Retrieved December 7, 2016, from http://64.17. 184.140/wp-content/uploads/2012/10/AJSS.Job-Satisfaction-Vol-51-paper-4.pdf
- Ismail, M. R. (2012). *Teachers' Perceptions of Principal Leadership Styles and How They Impact Teacher Job Satisfaction.* Doctoral Dissertation, Colorado State University, Fort Collins, Colorado.
- Kaltenbaugh, L. P. (2008). *A Study on Job Satisfaction among Campus Recreation Administrators at Four-Year Public and Private Institutions.* Doctoral Dissertation, University of Akron. Retrieved February 7, 2016, from https://etd.ohiolink.edu/!etd.send_file?accession=akron1216215872&disposition=inline
- Nadarasa, T., & Thuraisingam, R. (2014). The Influence of Principals' Leadership Styles on School Teachers' Job Satisfaction – Study Of Secondary School In Jaffna District. *International Journal of Scientific and Research Publications* 4 (1). Retrieved December 13, 2016, from http://www.ijsrp.org/research-paper-0114/ijsrp-p2502.pdf
- Ngimbudzi, F. W. (2009). *Job Satisfaction among Secondary School Teachers in Tanzania: The Case of Njombe District*. Master Thesis, University of Jyvaskyla. Retrieved November 8, 2014, from https://jyx.jyu.fi/dspace/bitstream/handle/123456789/25482/URN%3ANBN%3Afi%3Ajyu-201010152985.pdf?sequence=1

- Raza, S. A. (2010). *Relationship between Organizational Climate and Performance of Teachers in Public and Private Colleges of Punjab*. Doctoral Dissertation, University Institute of Education and Research Pir Mehr Ali Shah Arid Agriculture University, Rawalpindi, Pakistan. Retrieved December 2, 2016, from http://prr.hec.gov.pk/ Thesis/201S.pdf
- Roul, S. K. (2012). Practice and Problems of Principals' Leadership Style and Teachers' Job Performance in Secondary Schools of Ethiopia. *An International Multidisciplinary Peer Reviewed & Journal*, 1 (4), Bahir Dar University, Ethiopia.
- Rumph, A. B. (2012). *Tennessee Public High School Principals' Leadership Behaviors and Teachers' Job Satisfaction.* Doctoral Dissertation, University of Tennessee, Knoxville. Retrieved September 20, 2016, from http://trace.tennessee.edu/cgi/ viewcontent.cgi?article=2676&context=utk_graddiss
- Wangai, M. M. (2012). *Factors Affecting Job Satisfaction among Secondary School Teachers of Mwatate District, Kenya*. The Requirement of the Award of Certificate in Senior Management Course, Gti Embu, Kenya.
- Younes, M. R. (2012). *Job Satisfaction and Work Performance. A Case Study of the American University in Cairo*. Master Thesis, American University in Cairo.

Moses Njenga

Negative views towards TVET the role of colonial and post-colonial TVET policies in Kenya

Introduction

While vital for social and economic development, Vocational Education remains hampered by a negative parity of esteem. Individuals and households continue to view vocational education as a second option (Winch, 2013). However, colonial and post-colonial governments in Kenya have held a more positive view of vocational education and training (Sifuna & Shiundu, 1995). Each successive government has therefore attempted to provide vocational education and made policies to effect widespread provision. Despite these efforts, Technical and Vocational Education and Training (TVET) remains a second option for many in Kenya. This article reviews the history of these policies. It identifies the source of negative views towards vocational education on the one hand to discriminatory approaches by colonial governments and, on the other hand, to the burdening of education with the task of employment creation.

Pre-Colonial Kenya

Kenya, as a legal-political entity, was formed after the Berlin Conference in 1884, at which point it became a British protectorate. However this often obscures the fact that the country had always been inhabited by diverse peoples. As the cradle of humanity, the country is the home of all; Hominid habitation was dated back 2.5 million years ago; in the second millennium B.C.E the Stone Bowl Culture emerged in the Kenyan Highlands, and Bantu speakers started agriculture circa 500 B.C.E (Maxon & Ofcansky, 2014).

In modern history, Swahili speakers had formed towns and cities along the Indian Ocean coast as early as the ninth century. These towns and cities formed important trading points with Persians and Arabs as well as entry points to the interior. The Portuguese were among the first westerners to visit these towns in the 15th century (Maxon & Ofcansky, 2014).

Education in Pre-Colonial Africa

Assuming that there was no education in pre-colonial Africa would be incorrect. Like all other societies, African societies needed and therefore provided education to their members. The education provided was vocational with basic and advanced skills needed to live autonomous yet dependable lives being taught on a day to day basis and in on going manner (Mitei, 2015).

It would also be incorrect to make further dichotomies such as vocational versus general, practical versus liberal, and utilitarian versus egalitarian. The education was as vocational as it was general, practical as it was liberal and utilitarian as it was egalitarian. The intention was not to pigeon-hole people but to make them autonomous yet dependable members of society. With such an aim, it makes no sense to emphasize one characteristic of education over the other. This functional approach to education was disrupted when Europeans introduced Western approaches to the provision of education at the turn of the twentieth century (Akala, 2017).

This article gives a brief overview of the provision of vocational education in Kenya from the beginning of the twentieth century to the present, with a special focus on the development of vocational education policies.

Development of Vocational Education Policies in Kenya

Vocational education and training have a long history, especially as a tool for solving the challenges of school to work transition. In its long history, it has been strongly influenced by the historical context in which it has been provided. Consequently, its provision reflects the evolution of social, political, and economic conditions, as well as the influential philosophies that have shaped the rest of society. McGrath (2011) thus observes that the history of formal TVET in Africa is intertwined with Africa's colonial history and the ensuing racial, social, and conflicting notions of the authentic African identity.

Much of Kenya's education policy making has been through education commissions. These commissions are groups of experts appointed to review the state of education in the country and offer recommendations upon which policies can be made and implemented. All the commissions have addressed the issue of vocational education and made various recommendations, many of which were adopted. A common rationale in all the recommendations made has been the view that vocational education can enable socio-economic development through improved productivity.

Development of Educational Policies in Colonial Kenya

Construction of the Uganda Railway line began in 1896 and completed in 1901 when the railway reached Kisumu (Maxon & Ofcansky, 2014). The railway led to an influx of white settlers who needed cheap, reliable, and skilled labor. This demand for labor prompted the development of vocational education to suit their needs, adopting the vocational education practices that had been used on slaves and freed slaves in America (Berman, 1971; Mafela, 2015; Mitei, 2015).

Formal TVET provision and policies thus emerged in the early 1900s through to 1920s as colonialists sought to create a kind of docile but skilled slave labor to serve their interests (Maxon & Ofcansky, 2014). They drew heavily from the lessons of "negro" education in the USA (King, 1971 in McGrath, 2011), which lead to the establishment of industrial schools in Africa.

The Fraser Report, named after a commission headed by Nelson Fraser in 1909, recommended racially segregated education, arguing against liberal education for Africans. The fear was that Africans would become insolent; instead, the commission recommended basic manual skills such as carpentry and brick lying to replace the more expensive Indian labor. The commission also recommended the establishment of an Education Department to coordinate education in the colony. This allowed the colonial government to formalize its role in education, including providing financial aid to schools (Sifuna & Shiundu, 1995).

Similar views were held by the Education Commission of 1919. The Education commission argued against liberal and literal education for Africans and rejected their demand for access to higher education, arguing that such access would lead to rural-urban migration. Instead, the commission recommended technical education to enable Africans to engage in labor as opposed to clerkship and other similar occupations (Maxon & Ofcansky, 2014; Sifuna & Shiundu, 1995).

Later in 1925, the first Phelps Stokes commission recommended the learning of crafts rather than general education for Africans. The crafts, in this case, were gardening and simple, practical skills (Berman, 1971; Mafela, 2015; McGrath, 2011). It was not lost to Africans that the Phelps Stokes commission viewed Africans as inferior and only useful when laboring for the colonialists.

The policy of limited general education for Africans continued in the ensuing years. The Native Industrial Deport, meant to be a training and production school, was started in 1926. In line with the recommendations of the Phelps-Stokes commissions, the Jeans Schools was started in 1925 to train women in basic household practices (Sifuna & Shiundu, 1995).

Other commission reports such as the Beecher report of 1949 and Binns report of 1952 emphasized vocationalized education for Africans. Agriculture was recommended as the more important subject for the rural African, who was also to be provided with handcraft and carpentry skills. The Beecher report felt that education should develop rural attitudes for rural development, teaching rural sciences and handicrafts. One outcome of the report was the opening of 300 intermediate schools aimed at

training learners in carpentry and handicrafts and provided with land for agriculture and animal husbandry (Sifuna & Shiundu, 1995).

As expected, the reaction to these polices by Africans was more than negative. The sentiment of many, especially Africans, was against limiting what they could learn, viewing the vocational education as "servitude education". Africans thus started, against the wishes of the colonial government, African Independent schools. Believing that the independent schools encouraged anticolonial views, the colonialists never liked these schools, so much such that at the start of the emergency period in 1952, all the independent schools were closed (Maxon & Ofcansky, 2014; Sifuna & Shiundu, 1995).

While the value of vocational and practical training was accepted, many viewed general education as what mattered, and over time this argument won. The desire for more general education informed demands for independence with many post-independence governments implementing policy changes to effect the same (Berman, 1971; McGrath, 2011).

However, due to its relevance in meeting social and economic needs, vocational education continued to be offered, albeit with less support and resources. Curricular changes to improve the quality of education expanded the provision of vocational education to non-vocational schools. As educational debates moved from access to quality and relevance, vocational education was seen as a viable solution to the question of relevance. Vocational education was also necessary to bridge skill gaps after colonial officials left.

Development of Educational Policies in Post Colonial Kenya

In Post-Independence Kenya, the Ominde Commission of 1964 was tasked with reviewing and recommending education policies for the newly independent country. The commission was in favor of more academic learning. It advised against the Common Entrance Exam (CEE) at the end of the fourth grade. The CEE was seen as a tool to limit the progression of the majority of Africans in education. The Commission instead recommended a primary education cycle of seven years, followed by four years of secondary education, two years of advanced secondary education, and finally, three years of university education, so-called 7-4-2-3 system.

Later, the Gachathi report of 1976 questioned the removal of vocational education from the school curriculum. The expansion of access to primary education had led to a large number of youngsters who completed primary education while still young but lacking in employable skills. It was felt that vocational primary education could have provided these youngsters with skills to engage in self or paid employment after primary education.

In the ensuing years, the government announced in 1981 that country would adopt the 8-4-4 system, eight years of primary, four years of secondary, and four years of university education. This announcement followed the recommendation of the Mackey report, the outcome of the Presidential Working Party on the Establishment of a Second University. However, implementation started in 1984. This is the system that the country has used since then to present, although there have been major changes in the content and structure of the curriculum. The curriculum of the 8-4-4 system represented a desire to vocational education, in the hope that primary and secondary school leavers would be immediately employable, or could start their craft businesses.

Initially, primary and secondary education under the 8-4-4 system was heavily vocationalized. In addition to more academic subjects, vocational subjects such as agriculture, home science, arts and crafts, and music were included in the primary level. At the secondary level, applied education subjects such as agriculture, commerce and accounting, and home science were offered. In some secondary schools, industrial education, e.g., electricity and automotive mechanics, were offered. It was also hoped that the curriculum would be implemented using the education and work approach, where the learner would produce marketable products to supplement school resources (Sifuna & Shiundu, 1995).

A particular outcome of the move to the 8-4-4 system was the elevation of the existing fifteen secondary schools to technical training institutes to offer diploma courses in vocational subjects. This represented the need to provide post-secondary vocational education in the non-university sector. In

1966, the National Council of Churches of Kenya (NCCK) produced a report on the issue of teenage un-employment, after observing a large number of primary school dropouts and primary school leavers. The report was presented and discussed in 1972 at the Kericho Conference on Education and Employment and Rural Development.

The NCCK had thus started Youth polytechnics to provide employable skills to such youth. Other communities, including the government, copied this approach, leading to the proliferation of youth polytechnics throughout the country. Communities using fundraisings, called Harambees in Kenya, started the "Harambee Institutes of Technology", while the government started National Youth Service. These institutions offered artisan and craft courses by, owing to their voluntary foundations have always been bogged down by lack of sufficient funding, as well as low prestige, being attended by those who could not advance to secondary school.

In 1999, the Koech Commission carried out an assessment of the system and found it to be overloaded. The commission found that teachers were never properly prepared to teach so many diverse subjects; neither was the rationalization effective at such an early age. Thus, the commission recommends denationalizing primary education, trimming the content, and pushing some of the essential content to the secondary level. This recommendation was adopted.

In 1965, Foster argued that given the nature of formal labor in Africa, general education was better than vocational education, using the moniker 'Vocational education fallacy' to describe arguments for vocational education. Foster had identified that the incentive structure favored general education rather than vocational education. The vocational education at the time was also poorly resourced, simplistic, and of low quality, as it was based on the recommendations of Jones in the Phelp-Stokes Commission Reports (Berman, 1971). Thias & Carnoy, (1969) conducted the initial cost and benefited analysis of education in Kenya. The economic unattractiveness of vocational education at the time was supported by later academic research based on cost-benefit analysis: Pachoropoulos (1981), Heyneman(1985), Loxely (1985) and Lauglo and Lillis (1988), etc. Using these and similar studies that compared the returns of vocational education with returns from general primary, secondary, post-secondary, and university education, the World Bank argued and pushed for policy changes that supported general, known-vocationalized primary education as the most efficient way to reduce poverty (McGrath, 2011).

These views of vocational education are, however, changing. Donor countries and organizations that advocated against vocational education are challenged in the light of positive outcomes of vocational education in their own countries. Cost-benefit analysis suggests that vocational education is worthwhile (Hoeckel, 2008) while improving employability (Tripney & Hombrados, 2013). As a larger number of youth complete secondary education, governments are challenged to create pathways for the entry of youth to the world of work. Vocational education has thus regained priority, in contrast to the lull experienced in the first decade of the 21st century. For example, in 2009, UNESCO declared vocational education as one of its main thematic areas. But the dilemma of whether the content and practices align with the larger incentive structure remains unaddressed and unexplored.

In the 21st century, basic education is almost completely denationalized in Kenya. Never the less, debates on the relevance of vocational education at the basic level have not abated. Access, quality, and relevance of the vocational education offered at the post-basic level remain as issues of concern. Vocational education facing multiple challenges today, some occasioned by declining funding, is criticized as being costly and irrelevant in terms of the skills developed. It is also challenged as being slow in responding to modern industrial trends. Solutions suggested are new governance structures and autonomy to deal with the internal challenges of poor quality staff, out-dated curricula, and lack of engagement with the world of work (McGrath, 2011).

Analysis

An ability to do and create things necessary for the welfare of any society is essential, necessitating systems of vocational education. While pre-colonial African societies had established systems of education that were unified, colonization, as a forerunner to the globalization of Africa, was disruptive. Colonization forcefully introduced western concepts schooling and differentiated education-based one level on incomes from years of schooling, content, and race. Education was no longer about autonomy and dependability but status.

The economic benefits of academic education over vocational education offered only to Africans on racist grounds meant that Africans would never consider vocational education over academic education unless they had no choice.

Policy Swings

The review of the policies shows four stages in the vocational education policy of Kenya from the beginning of the 20th century. In the first stage, from 1900 to 1963, vocational education was for the African masses, to keep them docile and in servitude to the White race. In the second stage, 1963 to 1980, vocational education was not necessary for the basic education. In the third stage, 1981 to 2000, vocational education was an essential part of the education of Kenyans. In the final stage, 2000 to present, a repeat of the second stage, vocational education is not necessary for basic education. Instead, it ought to be offered at post-basic levels.

While these policy positions have never had universal acceptance, they represent the dominant positions at each stage. The racist undertones in the first stage lead to the second, an apparent overreaction. The third stage, a response to the problem of teenage unemployment, reflects the faith in education to address the problem of unemployment. However, education alone, especially if underfunded, cannot solve unemployment. The fourth stage represents the position of a more prosperous society that is willing to invest more in general education at the early stages, in the realization, it can afford to invest in vocational education at the post-secondary level.

Conclusion

However, the value of vocational education cannot be denied. As the swings in policy have shown, the Kenyan society attempted to ensure that vocational education was available to all. Unfortunately, the parity of esteem that took root in the early twentieth century has never been adequately addressed. Students and families still consider vocational education as a second alternative. Despite the confidence in the inherent current policy position, the lack of parity of esteem should be addressed. Otherwise, post-secondary education vocational education may never take root, as is hoped in the current policy position.

It is strange that improving vocational education and making it truly worthwhile has never been critically explored. The response to the issues that dog vocational education should depend on the root cause of the problem. If the curricula and its implementation are flawed, lower economic returns ensue. However, the labor market available for the vocational skills must also be considered. For example, how well one learns to repair vehicles is irrelevant if there are no vehicles to repair. On the other hand, if general education appears to lead to better outcomes, learners are dis-incentivized from pursuing the vocational track irrespective of its quality; and likely so will resource allocators. If vocational education is of low quality, that would only be an additional reason not to pursue it. It is, however, likely that both causes operate and feed into each other. The challenge then is to identify a set of polices to address both, not merely demanding better implementation of the extant curriculum. But either root cause is likely not in the domain of education policy makers to address, especially when both causes reinforce each other.

References

- Akala, W. J. (2017). The Challenge of Contextualization and Domestication of VET Reforms for Higher Education Staff Capacity in East Africa. In F. Eicker, G. Haseloff, & B. Lennartz (Eds.), *Vocational Education and Training in Sub-Saharan Africa: Current Situation and Development*. Bielefeld: W. Bertelsmann Verlag GmbH & Co. KG. Retrieved from https://www.oapen.org/download?type=document&docid=640951#page=213

- Berman, E. H. (1971). American Influence on African Education : The Role of the Phelps-Stokes Fund ' s Education Commissions. *Comparative Education Review*, 15(2), 132–145.

- Hoeckel, K. (2008). *Costs and Benefits in Vocational Education and Training*. OECD, 3, 17.

- King, K. (1971). Pan-Africanism and education: A study of race philanthropy and education in the southern states of America and East Africa. Oxford: *Clarendon Press*. Retrieved from https://scholar.google.com/scholar?cluster=8304458413225526250&hl=en&as_sdt=2005

- Mafela, L. (2015). Phelps-Stokes Commissions. Retrieved November 24, 2018,

- Maxon, R. M., & Ofcansky, T. P. (2014). *Historical Dictionary of Kenya*. Rowman & Littlefield Publishers.

- McGrath, S. (2011). Where to now for vocational education and training in Africa ? *International Journal of Training Research*, 9(1), 35–48. https://doi.org/10.5172/ijtr.9.1-2.35

- Mitei, J. K. (2015). *Teachers' Perception of Vocational Education in the Primary School Curriculum in Kenya: A case of Sotiti District*, Bomet County. Moi University.

- Sifuna, D. N., & Shiundu, J. O. (1995). Education with Production in Kenya. In W. Hoppers & D. Komba (Eds.), *Productive Work in Education and Training. A State-of-the-Art in Eastern Africa. The Hague: Center for the Study of Education in Developing Countries*. Retrieved from https://archive.org/stream/ERIC_ED384747/ERIC_ED384747_djvu.txt

- Thias, H. H., & Carnoy, M. (1969). *Cost-Benefit Analysis in Education: A Case Study of Kenya*.

- Tripney, J. S., & Hombrados, J. G. (2013). Technical and vocational education and training (TVET) for young people in low - and middle - income countries: a systematic review and meta-analysis. *Empirical Research in Vocational Education and Training*, 5(3), 1–14.

- Winch, C. (2013). The Attractiveness of TVET. In K. Ananiadou (Ed.), *Revisiting global trends in TVET: Reflections on theory and practice*. Bonn: UNESCO-UNEVOC International Centre for Technical and Vocational Education and Training.

Khin Khin Thant Sɪɴ

An innovative perspective of initial teacher training in myanmar: current school-university partnership practices

Introduction

The importance of school-university collaboration in teacher education started during the 1980s, where the criticism of initial teacher education emerged as a significant concern (Tsui et al., 2009). In the United Kingdom, David Hargreaves was the leading researcher. He initiated the idea of a school-university partnership by highlighting the lack of connection between knowledge production and application procedures.

There were reasons why the school-university partnership emerged in the 1980s. Among them, the most significant problem was the massive criticism on the quality of teacher preparation.

Theoretical Framework

Developing a school-university partnership is a difficult task to perform, and there is no perfect method to play for the successful one (Tushnet et al., 1993). According to the author, some principles have been established for the implementation of school-university partnerships for different purposes, even though there is no perfect method for it. Among them, the school and university collaboration for teacher training in Australia has demonstrated some fundamental principles to follow in the professional development of prospective teachers.

The interpretative framework, which is developed from an actual collaboration between schools and universities, provides a focus for establishing and thinking of successful partnerships for promoting teacher quality through considering the different strengths and weaknesses of schools and universities (Jones et al., 2016). According to this framework, there are four components that are essential for obtaining successful school-university partnerships. The four pillars include growing school-university partnerships (GUSP), enabling Innovative Practices, Representing partnership practices (RPP), and enabling growth. These components are core parts of a holistic partnership model in which these components help to support to run partnerships, to investigate how the connection has embedded in the practice, to consider the methods that result from the fruitful collaboration and finally the growth in professional teacher education because of the successful partnership (Jones et al., 2016).

In the four components of the framework, the "growth" component is concerned with the professional development of partners when they are collaborating with their partners. This "growth" component of the framework showed that identity, confidence, praxis, and relationship of partners (student teachers, mentor teachers, and university teachers) could be improved and promoted through effective collaboration between schools and universities (School-based partnerships in teacher education, 2018).

School-university partnership not only enables the professional development of its partners but also serves many other purposes. Nowadays, scholars see "school-university partnership" as an innovative solution to bridge the connection between the knowledge produced and its application sector. This kind of consideration can be taken from the "knowledge triangle" concept.

According to Sjoer (2011), the idea of the knowledge triangle means the conceptual tool in which research, education, and innovation are linked together with their respective processes on its three sides and "orchestration tools" in the heart which balances these three (research, education, and

innovation)components. According to him, the knowledge triangle renovates the flow of information among actors. In the traditional "one way" method, the data only goes from research to education and from educators to students. In contrast to this conventional way, the knowledge triangle considers the "mutual flow of information" between three partners; research, education, and innovation.

In the context of a school-university partnership, the examination has been taken in higher education institutions (universities). "Innovation" sector of knowledge triangle can be seen as schools where the innovation is embedded in the daily practices of teachers in a school (Halasz, 2016). From this concept, school-university collaboration is one of the suitable ways to innovate education and to close the gap between research and its application.

Methodology

Participants
Qualitative method is applied in the study. Five student teachers have participated in the study. All of them are from the University of Education. Two final year male student teachers and three female fourth-year student teachers were interviewed by the researcher.

Interview
Five student teachers were interviewed by the researchers through focus groups and individual interviews. Three female student teachers were interviewed through focus group interviews, and two male student teachers were interviewed individually. All of them are from the University of Education. Interview questions are developed by the researcher focusing on the student teachers' experiences in their practical teaching, aiming to investigate the professional development through school-university partnership.

Observation
To have more information about the school-university partnership practices, the researcher did the observation. The demonstration, which is done by the college teachers from the Methodology Department, has been observed by the researcher. The presentation took place in the college of education, where teacher educators taught "a sample teaching to elementary children" in a simulated classroom setting. The aim of the demonstration is to show "student teachers" about the real classroom situation and to show them the different teaching methods.

Data Analysis
Data have been analyzed through the forming of sub-categories, categories, and themes through the interviews. The observation was analyzed according to formed categories.

Findings

Both the results of interviews and observation will be presented in this section.

Interview results
According to student teachers' interview results, they became more confident after their practical teaching. Because of the real experiences of the classroom, the student teachers got an enormous amount of teaching experiences, classroom management, and planning lessons. However, the professional development that they improved came from their practices and interaction with pupils in their classroom. They agreed that they rarely got information and rarely learned from school mentor teachers or university teachers since there was less communication between them.

"I got so many experiences from my practical teaching. I have to manage classrooms, organize lessons, and everything relies on me. And this is great. I learned a lot from teaching experiences. Now, at least, I know how to manage the classroom and how to communicate with students." (Student teacher 1)

"Normally we organize our lessons by ourselves. We communicate rarely with mentor teachers. We never discuss with mentor teachers for planning lessons and teaching methods". (Student teacher 2)

According to the interviews with student teachers, the university teachers and mentors teachers are not usually keep in touch. According to their opinion, the university teachers and the school teachers are in a separate world.

"When university teachers came to visit us when we are practicing teaching, I only see that she talked to the school principal. I never see the school mentors and the university teachers talk to each other". (Student teacher 3)

"Once, the university teachers came to visit us. She gave us a suggestion about how to teach our subjects. It is very helpful. But I don't see her talking to school mentors". (student-teacher 4)

Concerned with the practical teaching period, the student teachers are not fully satisfied with the short period. They think that two-week practical teaching is so short for them. "Two weeks is not enough for us. That is one of the reasons that we have less communication with mentor teachers because we are so rush in teaching and learning in classrooms, no time to communicate with school teachers". (Student teacher 5)

Observation
Observation of teacher educators' demonstration aimed at investigating how the schools and universities collaborate to promote student teachers' learning. Demonstration in this article means that the teacher educators teach the elementary school children in a simulated classroom where the student teachers can observe.

In demonstration lessons, taught by teacher educators, school teachers, and the college teacher, educators had no communication between them. And teacher educators rarely observed what lessons are teaching at the schools in the current time. School teachers showed no interest in what kind of experiences will be taught by teacher educators. Therefore, teacher educators only chose the lesson to teach elementary children based on their academic expertise and preferences. It is observed that school teachers were talking to phone when teacher educators were teaching the children. Observation results showed that schools and universities should be more collaborated to promote student teachers' learning.

Conclusion

Schools and universities individually have been a small place to learn and find out new things at this age for providing professional development training (Stoll & Louis, 2008). Living and learning in a separate world are not enough at this age, especially for the learning society today. One of the best ways to promote teacher education and to provide professional development of prospective teachers can be gained through schools-universities collaboration. School-university partnerships can provide opportunities for teachers to engage in the professional learning communities and to interact with their colleges to innovate education (Sandholtz, 2002).

References

- Halasz, G. (2016). School-University Partnership for effective teacher learning: Issues Paper for the seminar co-hosted by ELTE Doctoral School of Education and Miskolc-Hejőkeresztúr KIP Regional Methodological Centre

- Jones, M., Hobbs, L., Kenny, J., Campbell, C., Chittleborough, G., Gilbert, A., Herbert, S., & Redman, C. (2016). Successful university-school partnerships: An interpretive framework to inform partnership practice. Teaching and Teacher Education, 60, 108–120. https://doi.org/10.1016/j.tate.2016.08.006

- Sandholtz, J. H. (2002). Inservice training or professional development: Contrasting opportunities in a school/university partnership. Teaching and Teacher Education, 18(7), 815–830. https://doi.org/10.1016/S0742-051X(02)00045-8

- School-based partnerships in teacher education. (2018). Springer Berlin Heidelberg.

- Sjoer, E., Nørgaard, B., & Goossens, M. (2011). Implementing Tailor-Made CEE in theory and in practice: The Knowledge Triangle as a Conceptual Tool. In Proceedings of the 1st World Engineering Education Flash Week, SEFI annual conference, Lisbon 2011: Global Engineering Recognition, Sustainability, Mobility SEFI: European Association for Engineering Education.

- Stoll, L., & Louis, K. S. (2008). Professional learning communities: Divergence, depth and dilemmas. McGraw-Hill/Open University Press.

- Tsui, A., Edwards, G., Lopez-Real, F. J., & Kwan, T. (2009). Learning in school-university partnership: Sociocultural perspectives. Routledge. https://books.google.hu/books?hl=hu&lr=&id=hB2RAgAAQBAJ&oi=fnd&pg=PP1&dq=Learning+in+school-university+partnership:+Sociocultural+perspectives&ots=0dFQGrJiIX&sig=dQHQzo4aG616st8O0zqgC1fVDWo&redir_esc=y#v=onepage&q=Learning%20in%20school-university%20partnership%3A%20Sociocultural%20perspectives&f=false

- Tushnet, N. C., Educational Partnerships Program (U.S.), & Southwest Regional Laboratory for Educational Research and Development. (1993). Guide to developing educational partnerships. The Program: For sale by the U.S. G.P.O., Supt. of Docs.

Sounantha Phavadee

Teaching that takes account of different learning styles: A literature reviews

Introduction

In the education circle means the teacher and the learner should be together, to build the quality in education one most important thing is the focusing of the individual learning style, needs and preference are not enough. Yet, it should be together with focusing on the way of teaching of the teacher in terms of his or her teaching styles, the use of the method, technique, and strategy dealing with the learner. It can be called the chain-reaction which is one effect another, if the learner's learning style is not matched with teacher teaching style as well as the teaching method which teacher provide in teaching-learning activities, the consequence of getting at the end may show in the disappointing way (Chen, 2009).

The individual students have their different styles, aptitude, and preference. At the same time, one likes more in concreting information as well as dealing with the fact in true the experimental or by the real experience, and another one may prefer working on abstract as such enjoy searching for theories, models,s and concepts. In the other hand, the way of teaching from a teacher also depends upon their preference and styles, if there is the mismatching between teaching and learning style have found in teaching-learning process, what is going to happen with the effect of the education at the end, as Felder & Spurlin (2005) illustrated "When the learning styles of most students in a class and teaching style of the professor are seriously mismatched, the students are likely to become uncomfortable, bored and inattentive in class, do poorly on tests, get discouraged about the courses, the curriculum and themselves, and in some cases change to other curricula or drop out of school"(Felder & Spurlin, 2005, p. 103). Those issues will cause the effectiveness of the teaching-learning system negatively, and more than that, its effects on the education system to be of low quality.

There are many educators from the decades who developed the variety of learning style models, such as David Kolb, Carl Jung, Neil D. Fleming, Dunn & Dunn, Felder & Silverman, Grasha & Reichmann, Honey & Mumford and many other more. In this article, work will be adopted in many models from the previous work of many scholars, which it is working on teaching and learning styles that is to find out the issues and effectiveness between both include how educator's teaching style effects for students' learning styles and vice versa. When understanding the students learning styles can help teachers in the adaptation of their learning styles, and teachers confidently use the proper teaching styles in each differential of their students (Sripongplerd, 2017). Because of developing teaching-learning activity is an effective and comfortable way.

Methods

In this work, an author has conducted on the literature review of finding the work of other authors in terms of the teacher teaches in different styles, the various strategies and methods to use in response to different students' learning styles. There are about ten articles have been selected to this work which it was specifically focusing on the work of teaching styles, learning styles, the matching of teaching and learning styles toward students' academic performance and what is the problems in teaching and learning styles regarding of the previous work in various countries and institution which the authors conducted on their article research. All the articles were mostly from the current few years ago until back to 5-10 years. The author selected these articles by the connecting of keywords and their specific work, which it's useful for review from the techniques and their finding result.

Teaching style

The focussing on an individual difference apart from a student's learning style, teaching style can affect on changing behavior toward teaching (Pimwapee & Sudrung, 2019). This study has found the changing behavior in science teachers regarding clinical supervision, self-directed development, and administrative monitoring.

The teacher's teaching styles are also important, which are many teachers can be able to adjust their teaching style in terms of the needs of students. (Gill, 2018; Pachina, 2019) have introduced about five strategies that teachers mostly use in the classroom with each strategy. Has pros and cons depending upon the use of teacher's teaching style toward the different learning styles of students.

- Authority (Lecturer) style: It is teacher-centered in which the teacher takes big among of time to speak during the class, students just listen to absorb the knowledge and take notes what the teacher has explained. This style ordinally appropriate in higher education where there is a large number of the students in a big hall or big classroom, and it's suitable for some course which relates that to memorize the critical fact like location, date, or historical events.
- Demonstrator (Coaching) style: the teacher as a demonstrator is likely to a lecturer, but he/she has more teaching aids to support like multimedia toward the presentation and various activities during class; this style is appropriate for students in a small group.
- Facilitator (Activity) style: The teacher-facilitator is to advocate students together with stimulating in the process of learning. This style is very good at promoting self-learning. It can develop students' critical thinking skills's which can lead to being self-actualization that students can realize on their potentiality and talent.
- Delegator (Group) style: This style can help students in collaborative skills by group work and group activities, teacher as the observer, and provide advice to any question from students. It can be suitable for the laboratory, the group debate activity, or the team project. This style promotes students' freedom of choosing and thinking.
- Hybrid (Blended) style: the teacher as a conductor. This is the line on an integrated approach which it blends the type of teacher's personality into students' needs and interests by linking with the curriculum approach method. This can help a teacher can adopt to the students learning styles and with proper course matter.

All the strategies above have the advantage and disadvantages in vice versa, that depends on the educational level, the number of people in the classroom, the curriculum approach, and the subject matter. Additionally, teachers know their style and what kind of strategy do suits them, including an understanding of individual students' needs. Teachers will be able to know their strengths and weakness that can raise them to develop their teaching performance.

Learning styles

Learning style is the process of learning in each people toward learning, the individual behavior that influence in reaction and response to the environment (Sripongplerd, 2017). According to Kolb, in 1985 has developed four learning styles:
- Divergent learning style is the way of user experience, the feeling, and understanding of those experience individuals have got. In here, the learners can be able to understand and create their imaginations and can see the overall of the frame through that imaginations. They can learn well in a situation that has various thinking, and they are interested in people and cultures.

- Assimilation learning style is an emphasis on contemplation that is trying to understand the experiences; they are good at critical thinking, and using the reason, these learners prefer to summarize the principles and study on theories. Interested in abstract principle more than action practicing, and they are not too much interested in bringing the theories into practice.
- Convergent learning style focuses on the reason, thinking, and experiment. The learners who can apply abstract thinking to be in practice, they can conclude and find a better strategy or technique to solve the problems. They preferer to work with objects than people; they tend to the interest of any specific thing.
- Accommodation learning style can be able to use their thinking to be in the experiment. Learners like to search for new experiences; they love to experiment and practice. The learners learn well with the adjustment situation, can solve what they are thinking, and wish to learn from their mistakes, prefer to work with people.

According to Grasha and Riechman have grouped the students depend upon their characteristics into six learning styles (Rollins, 2015):

- Avoidant: These group of students can't stand on some of the course that teacher always uses same strategy and method, together with the enthusiastic teachers who are very active in their teaching, they are in another side of collaborative learners, lack of engaging in study or sometimes conversely, they show over interesting in the class. These learners don't like to do any kind of activities and assignment, not prefer teacher-learner reactive, and prefer the teacher to give a good mark without any testing.
- Collaborative: They learn well by group work, group activities, and discussion, prefer to share the ideas and collaborate with the teacher and peer in every activity, the classroom for them is reactive of social and learning. They like the lecture that includes activities like debate and small group discussion, from them the classroom should be the students determine the content and teachers provide the knowledge what students want to know
- Competitive: These students like to learn the content by their expectation of getting a higher score in the classroom than their peers, prefer competitive to get a reward, and always feel excited about the competitive activities in the classroom situation with the expectation of winning. These students likely to be the leader during the group discussion, always keep asking the questions in the classroom, and they appreciated the complementation. They like the teacher-centered approach classroom.
- Dependent: They seem to be a passive learner who lacks in enthusiastic and prefers to learn only what their teacher provided in the classroom, always look at teacher and peers as the knowledge source and provide assistant without self-help, so they always seek for someone good at the class to offer them explanation and guidance. They appreciate when teacher notes the points on the board together with explaining, always ask for the deadline determination from the teacher for any task teachers gave and prefer teacher-centered classroom.
- Independent: learn well by their thinking and study alone, they have their clear aims to learn only what they like to learn which they think that is the important one, high of self-reliance in their ability to learn. Prefer self-study and the content which provides for the learner using their idea, like the project that designs by learner and student-centered.
- Participate: These learners are very enthusiastic to learn and collect new knowledge from their teacher, they have a high responsibility in both classroom and outside tasks to get their work quality, excellent collaboration with peers when getting any assign for doing group tasks. Prefer

discussion lecturers and students like to get the assignment from teachers to work at home and prefer teachers who are good at analyze and synthesis.

The matching of the teacher's teaching style and learners' learning styles and academic performance

Many of research works have given the reason for matching teaching style with learning style related to the effect of academic achievement (Felder R., 2002; Khalid, Akhter, & Hash, 2017; Chetty, et al., 2019). In these studies, some of them indicated in the student's preference for their learning styles enhances effective in their academic performance. Some studies point out the individual attitude In the work of Chetty, and her colleagues (2019) has shown about there is a significant impact from teaching style toward students' learning styles and their academic achievement (Chetty, et al., 2019). According to the work of Ruslin Amira and Zalizan Mohd Jelasa (2010), by using Grasha-Riechman (1994) Teaching and Learning Style Inventories among 120 lecturers and 545 students at Universiti Kebangsaan Malaysia (UKM) to find out whether teaching and learning styles are matched in the higher education institution or not. And regarding the result has shown that the lecturers are outstanding among teacher teaching style together with the collaborative and competitive are notable toward students' learning styles and this work can find out the outcome for the institution and raising the teaching-learning process among both students and teachers (Amira & Jelasa, 2010). As showing in the result, which is some positive parts are not outstanding, independent, and participant that can be shown about an inactive in the classroom. That cannot reach the effective in the strategies of learning among students. From Grasha Riechman by observing during teaching-learning interactive between students to teachers and students to students which both articles mentioned above are using this model.

The work of Ruslin Amira and Zalizan Mohd Jelasa (2010), the authors have recommended of providing assessment toward individual and increasing the task to work with the group, that can enhance the participant and encourage the independent among students (Amira & Jelasa, 2010). While the work of Chetty and her colleagues (2019) recommended for the lecturers before taking the class should prepare more activities and teaching aids for the same title what he or she will teach in the classroom, that is for impact to the variety of individual learning styles which can help the lecturer deliver the activities and knowledge to everyone in classroom thoroughly (Chetty, et al., 2019). If the institutions aware on the diversity of learning styles in students and organize an appropriate of the variety of classroom method, techniques, and curriculum, and assessment on teacher teaching styles together, the individual students will comfortable follow their learning styles and develop their knowledge accordingly which it's the impact of the students' academic performance in the good result.

Toxic in teaching and learning styles

This study had been conducted in China among some Chinese teachers and students toward the English language class. The author emphasized on few toxic factors which they are harmful to the relationships, enthusiasm, and adjustment during the day today education time (Jian-xiang, 2007), there are authoritarian styles by following the classic concept from the Confucian teaching model, it can say that the teacher-centered approach which means everything in classroom controlled by the teacher. The rigid style, even the world, is changing day after day, but the way of teaching method is out-of-date and still traditions. Additionally, the careless of individual needs and interest had rejected according to the author, which it mentioned that all of the students have been put in the same place, contents, homework and follow the same syllabus without focusing on their intelligence and backgrounds. And the last is Chinese-based style by most of the teacher believes that to translate from another language into their language is the heart of their work. Apart from the weakness points above the author has pointed out, the strengths have mentioned as the healthy style of teaching and learning as such cooperative style between teacher and learner can increase efficiency in teaching and learning

activity; the flexible modern style improves the adjustment; an English thinking style which focuses on what have learned should enter to the heart of the course concerned; and the last should focus on individual styles (Jian-xiang, 2007). According to this article, the author has learned about understanding and aiming into teaching, and learning styles are the key to success in teaching-learning activity.

Discussion

There is several research in teaching and learning styles; regularly, the researchers use Grasha and Riechman to investigate teaching and learning styles (Felder R., 2002; Chetty, et al., 2019; Khalid, Akhter, & Hash, 2017; Amira & Jelasa, 2010). From their research works have found that the teacher's teaching styles have a significant impact on students' learning styles and their academic performance. There are the dominant gaps have been pointed out from research works; one significant point is the students were not practicing learning style for being independent and not the active learner. They are only being observers and passive learning, which it necessary for teachers and educators should look back about issues by using suitable strategies, methods, and teaching styles that recognize the diversity of student learning styles. Through the teaching styles, even though the authority style can be used with higher education. However, the educators and teachers need to consider controlling of the classroom as teacher-centered can bring the students facing difficulties and can't develop their collaborative and communication skills; the students who are not the visual and audio learning styles will get bored and unimprovement. In the author's view, if the teachers know the individual differences and can adopt their style of teaching, strategy and method for all differences can bring the students interests and improve their knowledge skills, their understanding. They can absorb knowledge and get more experience.

Conclusion

Based on the results of many articles show that teaching styles have a huge influencing impact on learning styles and the result of academic performance. The important factors in supporting this teaching-learning process are understanding the nature of individual difference and use the right strategies and method together with adopting teaching style of teachers, that is to get the smooth interaction in the classroom. It's good for both teachers and learners in the teaching-learning process; it helps learners to develop their critical thinking, problem-solving and applying for their real life.

References

- Khalid, M., Akhter, M., & Hash, A. (2017). Teaching Styles of Secondary School English Teachers and Learning Styles of their Students and Relationship of Teaching Learning Style Match with Students' Achievement. *Bulletin of Education and Research*, pp. 203-220.

- Sripongplerd, P. (2017). Learning styles and teaching styles. *Thaksin University Library Journal*, 64-86.

- Amira, R., & Jelasa, Z. M. (2010). Teaching and Learning Styles in Higher Education Institutions: Do They Match? Procedia Social and Behavioral Sciences; International Conference on Learner Diversity, *Science Direct*, 680-684.

- Chen, M.-L. (2009). Influence of grade level on perceptual learning style preferences and language learning strategies of Taiwanese English as a foreign language learners. *Learning and Individual Differences Journal*, 19(2), 304-308.

- Chetty, N. S., Handayani, L., Sahabudin, N. A., Ali, Z., Hamzah, N., Rahman, N. A., & Kasim, S. (2019). Learning styles and teaching styles determine students' academic performances. *International Journal of Evaluation and Research in Education* (IJERE) , 610-615.

- Felder, R. (2002). The effects of personality type on engineering student performance and attitudes*. *Journal of Engineering Education*, 2.

- Felder, R. M., & Spurlin, J. (2005). *Applications, relibility and validity of the index of learning styles*. TEMPUS publications, 103.

- Gill, E. (2018, 08 21). *What is Your Teaching Style? 5 Effective Teaching Methods for Your Classroom*. Retrieved from https://resilienteducator.com/: https://resilienteducator.com/classroom-resources/5-types-of-classroom-teaching-styles/

- Jian-xiang, G. (2007). Removal of toxic English teaching & learning styles in China. *US-China Education Review.*

- Pachina, E. (2019, 5 9). *The 5 Main Types of Teaching Styles*. Retrieved from https://www.teflcourse.net/: https://www.teflcourse.net/blog/main-types-of-teaching-styles/

- Pimwapee, K., & Sudrung, J. (2019). Instructional Supervision Models Affecting the Change of Teaching Behaviors of Science Teachers. *Journal of Education Studies*, 22-40.

- Rollins, M. (2015, 1 7). *Learning Style Diagnostics: The Grasha-Riechmann Student Learning Styles Scale*. Retrieved from https://elearningindustry.com/: https://elearningindustry.com/learning-style-diagnostics-grasha-riechmann-student-learning-styles-scale

- Tabinas, C. A. (2019). Teaching styles and instructional flows in chemistry course: A pattern for a 5-step, 5-cycle teaching model. *African Educational Research Journal*, 48-65.

Gabriella MIKE

150-year Vocational Teacher Training at Budapest University of Technology and Economics

The Collection of Scientific Essays of a Conference

The vocational teacher training whose history is related to the initiation (1870) of József Eötvös has already been in progress at Budapest University of Technology and Economics for 150 years. One of the departments of this University, the Technological Pedagogy Department, is one of the most significant vocational teacher training institutions in the field of engineering and economic teacher training.

On this occasion, there has been launched a conference series organized every year. It aims to create a forum that provides an opportunity, in the procedure of the constant renewal of professional training and education, for common thoughts and further corporation involving new partners. The target group is primarily researchers, developers, and decision-makers participating in vocational teacher training. The highlighted mission of the forum is for Carpathian institutions' teachers and researchers to teach in the Hungarian language to be able to introduce their latest research results and exchange their thoughts and experience with their colleagues from Hungary. Besides, it can ensure a possibility for doctoral candidates to present their research work, which promotes their scientific development.

The first event of the conference series, titled **1st International Conference on VET and Education: Today and Tomorrow**, was taken place on 20-21 November 2019. The conference was held in Hungarian and English and was organized in the buildings of the University of Technology and Economics. The conference was opened by the Chancellor of Budapest University of Technology and Economics, *Attila Kotán* who greeted the participants then *Gáborné Pölöskei,* Deputy Secretary of State responsible for Vocational Training and Adult Learning, made a speech about the strategy of vocational training 4.0 and the actions/ measures of the development of the vocational education system.

There will be released an online collection of scientific essays from the presentation of the conference sent in by the performers who are high authorities and practiced in teacher training and participated in the conference. Altogether 70 studies which are classified in 6 thematic units have arrived in:

1. Development of History of Vocational Training
2. Pedagogy of Higher Education
3. Teacher Training
4. Pedagogy of Subjects
5. Methodological Innovation
6. Research & Innovation. Studies in English

The first section of the online collection of scientific essays was titled as **Development of History of Vocational Training,** in which seven lecturers' studies were classified. The volume of essays and studies and the first section were started by the study of *András Benedek.* In his introduction, he referred to the objectives of the conference series and the mission of the segment led by him. In this part, the authors targeted the introduction of the development of the history of vocational training as the title marked. Professor Benedek took a fling at determining the main period of development of the history of professional practice during the last one and a half-century, and he divided it into four periods. The author reckons that there would be needed more research for analyzing the theme thoroughly. The work of *Zoltán Sturcz* traced back into 1848 when József Eötvös during his ministerial years made a short study about the formation of teacher training construction and the professional system. Historical events did not make it possible for his thoughts to be materialized. During József Eötvös's second ministerial period in 1869, the organizational work which led to the opening of such an institute starting vocational teacher training could be launched involving of Budapest University of Technology.

The second section of the volume of essays and studies was titled as **Pedagogy of Higher Education**. This part involves thirteen lecturers' researches. *Péter Tóth* as the guest lecturer of János Selye University and his co-author *Kinga Horváth* also from János Selye University describe the results of university students' inductive reflectiveness test. The topicality of their research is that the early school leaving is significant, referring to mainly science subjects in Higher Education in the East-Central Europe region. In the background, there is abstract thinking of the students with different development levels. The most important target of the research was to identify competencies that can be related to early school leaving and to prognosticate them, which are significant in the working life.

The study of *Magdolna Daruka* and *Olga Csillik* introduced the marking learning process training, curriculum development, and the innovative education processes at Budapest Corvinus University. In the project EFOP-3.4.3-16, twelve training modernization processes took place at the university. In their studies, they presented how these development processes carried out then and nowadays, and they examined how the attitude towards the teaching-learning process of the teachers participating had changed due to the curriculum development and the education innovative processes.

The third section is **Teacher Training**, which contains seventeen studies. As the title shows, it involves publications about mainly learning-teaching methods. *Katarína Szarka* and *György Juhász* examined the role and the practice of a developing and formative assessment in their publication. Schleicher (2018) said the students could not become lifelong learners if they did not see their teachers as lifelong learners. The authors think that it is true in the case of new teacher generations as they do not possess innovative and proactive teacher attitudes referred to the profession if they do not see the same on the part of their teachers during their studies. They applied focus-group interviews in their research, where they examined how the teacher trainees were practiced and open-minded towards using innovative assessment methods.

Rita Pletl is looking for the answer in her work, *Linking points between secondary education and teacher training,* what kind of situation is in the Hungarian secondary education in Romania, and is trying to map what kind of opportunities are available in the field of teacher training. The target of the research is to plan improvements needed in teacher training taking into consideration the needs of secondary education.

The fourth section is **Subject Pedagogy**, in which there can be found eleven publications. In this part, studies related to didactics can be read. *Barnabás Vajda's* work primarily analyzed and described the current status of history didactics academically. First, he described the conception of history didactic then he wrote about its international and scientific institutions. After it, he described what the

difference was between history didactics and history methodology. Finally, he outlined existing and potential research orientations of history didactics.

Improving different abilities is very grateful but also a challenging task at the same time. Professor *Péter Tóth* is writing in his work about the improvement of perceptibility on draft lessons. According to the author, there is not such a thing that we need to improve only one ability. The solution for each task requires a complex activity. The pedagogue has to possess such attitudes and knowledge by which he or she can recognize which tasks, what abilities the student has to have. The aware and technical skill development is the highlighted task for draft teachers. The author traversed the method of the improvement of perceptibility in his study.

The fifth section is **Methodological Innovations**, in which there can be found thirteen publications. In this part, the studies about modernistic and innovative methods were included. It can be heard more that students are not motivated in the acquirement of the curriculum as it is required. It means a big challenge for pedagogues to find such modernistic methods on their lessons by which students can be encouraged for the acquirement of the curriculum to help their improvement there through.

At the end of 2018, *Benedek Forrai, Bence Sipos, Brigitta Szilágyi*, started to develop such an innovative and optional subject by which they can motivate junior mechatronics and energetic engineering students in their mathematics studies. They looked for the answer in their research on what expectations can emerge about this subject. In their work, we can get an answer to the point of their advanced method. *Katalin Harangus*'s study, The Available Info-Communication Equipment in Education, has an actuality because people who possess the knowledge of ICT devices application predominate on the labor market. Without computers, mobile phones, and digital technologies skills, we do not have a chance on the labor market. The author referred to the requirement of the European Parliament that using ICT devices should be involved better in education. The author described two types of research in her study. In her first survey, she examined the situation and problems of native-language vocational training in the teaching-learning process in secondary schools. In the second survey, she examined the situation and problems of native-language vocational training regarding the conditions and people in education in vocational schools.

As the conference held both in Hungarian and English, English publications were involved in the volume of essays and studies. The publications (nine pieces) titled Research & Innovation, Studies in English, which were performed and written in English at the conference, were put into the last, sixth section. *Előd Gőgh* and *Attila Kővári* in their publication examined self-regulating learning in some technical secondary schools in Budapest. The target of their research was to estimate how the students are aware of self-regulating learning, how they know learning methods, and which one they prefer during their learning. The research is some kind of orientation because the young have to be coached for lifelong learning, and self-regulating learning is an essential criterion of it. In the volume of essays, there was a lot written about digital teaching, the importance of improving the use of ICT devices in education. In the study of *György Molnár*, the topic is approached from a new perspective. The author described the specific components and characteristics of the digital learning environment and the role of digital competence these days. After this, he presented his short research whose aim was to reveal which modern digital devices based on web 2.0 are used by students.

I tried to choose from 70 publications of the volume of essays that the readers have a comprehensive overview of this edition concerning the content, and they feel like reading it. The online collection of scientific essays will be found from May on the website of the Technological Pedagogy Department http://www.mpt.bme.hu/. The next conference will be sometime in autumn, depending on the crisis.